RELATIONSHIP BETWEEN ACHIEVEMENT AND INTEREST OF SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS AND THEIR LEARNING STYLES IN BENUE STATE, NIGERIA

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CERTIFICATION

We certify that this thesis titled: "Relationship between Achievement and Interest of Senior Secondary School Biology students and their Learning Styles in Benue State, Nigeria" has been presented **by Benjamin Ayodele Fakolade (BSU/CUT/PhD/14/4005)** of the Department of Curriculum and Teaching, Faculty of Education, Benue State University, Makurdi and has been approved by the examiners.

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DEDICATION

This thesis is dedicated to Almighty God for miraculously sparing my life in that terrible armed robbery attack of June, 2014 and for his love, mercy and kindness over me and the entire members of my family.

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ABSTRACT

In this study, the relationship between Achievement and Interest of Senior Secondary School Biology students and their learning styles in Benue State was investigated. A correlational survey research design was employed in the study, one research question was answered and 13 hypotheses were tested at 0.05 level of significance. The sample comprised of 36 purposively selected secondary school students and 1,570 (859 male and 711 female) Senior Secondary Two (SS II) biology students. The Barsch Learning Style Inventory (BLSI) was used to identify Students' Learning Styles. A Biology Achievement Test (BAT) and Biology Interest Questionnaire (BIQ) were used to collect data on their achievement scores and interest rating respectively. The result of data analysis revealed that the predominant learning style among biology students in the state was Auditory with a significant relationship between its mean interest rating and mean achievement scores ($r = 0.44$, $N = 474$, $p(0.000) < 0.05$). Kinesthetic and Visual–Kinesthetic Learning styles were the least preferred learning styles among the students and there was no significant relationship between mean interest rating and mean achievement scores of biology students with Kinesthetic learning style. ($r = 0.004$, $N = 110$, $p(0.963) > 0.05$). It was further revealed that the relationship between mean interest rating and mean achievement scores of both male and female biology students with multimodal learning styles is significant, the same for male and female biology students with unimodal learning styles. Based on the findings, it was recommended, among others, that biology teachers need to take into cognizance the students' diverse learning styles and design teaching strategies that take care of these diversities. Teachers should concretize the teaching of abstract biological concepts and make them more real for the students.

CHAPTER ONE

INTRODUCTION

1.1   Background to the Study

Teaching and learning of science is an integral part of science education, from the primary to the tertiary levels of education. A teacher, according to Imonivwerba, Obiunu and Pupu (2014) is a prime factor of consideration in the curriculum implementation process. A teacher carries out the presentation, co-ordination and evaluation of learning activities. In order to achieve the primary purpose of teaching, the teacher employs various teaching methods and strategies, which include discussion, lecture, project, demonstration, inquiry, concept mapping, cooperative and many others.

Bello (2007) posited that teaching is a parasitic concept because it cannot stand on its own as it depends on learning to derive its full meaning. Teaching is a process of attending to people's needs, experiences and feelings, and making specific intervention to help them learn particular thing. Furthermore, Bello (2007) saw teaching as an activity of some sort that is intentional and aimed at achieving some specific goals. The author explained that teaching facilitates learning, hence, teachers are facilitators of learning. Fatemeh and Nasrin (2017) stressed that teaching is much more than mere verbal communication of knowledge by the teacher. Teachers therefore, need relevant skills as well as development of self-confidence, self-respect and self-control in order to perform their duties effectively.

According to Sequeira (2017), the role of teachers is categorized into two: traditional role (teacher-centered) and modern role (students-centered). The author

reiterated that there has been a change from the traditional role to the modern role of learning if the set educational aims and objectives as well as students' optimum learning are to be realized. Learning increases when the teacher builds on the previous experiences of the students.

However, individual's way of learning differs and each individual learns at his or her own pace. Thus, the identification of the learners' styles and individual attention of the teacher may be required. Hirst (2006) sees teaching as a series of activities and tasks which are characterized by intention or purposes to bring about learning. The tasks of teaching must be related to the present state of the learner in such a way that it is possible for the learner to learn particular subject content.

In addition, teaching is to cause the pupil to learn and acquire the desired knowledge, skills, and desirable ways of living in the society. Teaching is a tri-polar process involving the teacher, the pupil and the subject matter. It is an interactive process having multiple phases and levels, a planned activity, intentional, communication between two or more persons, coding and causes motivation to learners. Teaching is a professional activity and an art as well as science (Ranvirt, 2012). According to Oyetunde (2004), teaching is conceptualised as an active, constructive process in which the teacher assumes the role of a strategic planner, making decisions about the content and appropriate instructional strategies. An effective teaching is a deliberate and planned activity, it is purposeful, coherent, meaningful and functional. All these imply that effective teaching consists of assisting students to acquire and use knowledge and learn to think and solve problems (Sequeira, 2017).

Learning on the other hand, is a key process in human behaviour, which can be defined as any relatively permanent change in behaviour that occurs as a result of practice and experience (Aman, 2017). The individual is constantly interacting with and influenced by the environment. This experience makes him/her to change or modify behaviour in order to deal effectively with the environment. Therefore, learning is a change in behaviour, skills, knowledge, habits, attitude, interests and other personality characteristics are all the result of learning. Learning is a relatively lasting shift between what students used to exhibit and their present state of mind and expression as a result of exposure to learning experiences and practice.

Bello (2007) opined that learning is a continuous process for a lifetime without separation from work related activities. The author reiterated further that learning is no longer an internal, individualistic activity but all encompassing, interactive, co-operative and learners-centered activity, it provides an insight and skills to the learners on how to flourish and progress.

Science according to Akpan (2015) is both an organised body of knowledge that represents current understanding of natural systems and the process whereby that body of knowledge has been established and is being continually extended, refined and revised. Both elements are essential as one cannot make progress in science without an understanding of both.

According to Osuolale (2014), science subjects that are being taught in Nigeria senior secondary schools are biology, chemistry and physics. Some of the most distinct and similar characteristics of these science subjects are experimentation, observation and discovery. These provide the development of scientific skills, like

asking of questions and making investigation in students. Teaching and learning is an integral part of science education. Science education is regarded as a veritable test for economic and technological development in the areas of self-reliance and self-sufficiency because it is the platform and the process that leads to the production of citizens who are creative, critical, analytical and rational (Enuma & Onah, 2017).

Biology is the natural science that studies life and living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanisms, development and evolution. Biology according to Bagley (2017), is the science of life which derives its meaning from two Greek words 'Bio', (life) and 'logos' (study). There are at least nine (9) umbrella fields of biology which are: Biochemistry, Botany, Cellular biology, Ecology, Evolutionary biology, Genetic molecular biology, Physiology and Zoology (ScienceDaily, 2018).

Nevertheless, effective biology teaching occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge (Omoifo, 2012). During effective learning, students learn how to learn, students develop conceptual understanding and thinking skills, thus helping students change their intuitive, everyday ways of explaining the world around them to incorporate scientific concepts and ways of thinking. Therefore, students' ability to solve problems and perhaps enhance learning occurs during interaction with biology by using concrete teaching aids and materials as well as appropriate and result oriented teaching methods by the teacher in a biology class.

In addition to this, according to Stein (2016), active learning is experiential, mindful and engaging. Through this, a learner can explore a set of learning

experiences that can be more interesting and can take more responsibility for better understanding of concepts to be learnt. Looking at teaching aids such as pictures, graphs and maps help students to interpret information and understand without difficulties. Shanika (2016) opined that keeping students engaged and motivated can be a challenge, even for the best teachers. It is easy to teach the same lessons year after year simply because they have worked in the past, without giving much thought to students' current interest level. The author reiterates further that the regular curriculum still needs some variety once in a while to make learning fun. Likewise it is important for students to be aware of learning strategies that are both effective and fun for them. There are five strategies that can assist teachers and students with this process to make learning interesting: offering students choices, teachers tailoring lessons to students' needs, teachers making learning practical, teachers being aware of how students learn and teachers paying attention to students' interest. These strategies as suggested by Shanika (2016) can assist biology teachers in making the class interesting for the students, arrest their attention and arouse their interest in biology.

Janelle (2018) suggested some teacher-tested ways to keep the class interesting so that students will stay engaged at all times. These ways are: incorporating some mystery into the lessons, creating classroom games, giving students learning choices, utilizing technology, making lessons interactive and relating materials to students' lives. Ayodele (2006) identified the use of inappropriate, non-effective teaching method as a major factor hindering students' interest and achievement in biology. This means that there is need for full involvement of learners or students in biology teaching and learning at all levels. Onose, Okogun and Richard (2009) posited that

many inexperienced teachers teach biology in abstraction, thereby making biology lessons boring and the students finding it difficult to understand some biological concepts, skills and principles. These authors observed further that most teachers emphasize theory rather than practical aspects of biology and most of them do not have adequate knowledge of the subject matter and the competence to deliver. Although, the Federal Republic of Nigeria (FRN, 2014) through the National Policy on Education emphasized activity-based and child-centered learning, a lot still needs to be done in this regard in most schools in Nigeria. There are few classrooms with demonstration method and when in use it is often teachers demonstration not students', which makes students passive listeners. Biology students and teachers are expected to be meaningfully involved in the teaching-learning processes in order to make the set educational objectives of the National Policy on Education in biology realizable and achievable (Omoifo, 2012).

There is therefore the need for teaching and learning of biology to be student-friendly and student-directed. As a result of this fact, the way students refer to learn or how they want to be taught should be considered and brought into focus. The processes of finding ways out of students' poor achievement in biology in Senior Secondary Schools are ways of finding out how individual learners or students wish to be taught. Learning styles can also be regarded as learners' individual way of processing, absorbing and recalling information. Based on this premise, this research is focused on students' learning styles, how these can be identified, and how they can best be explored to enhance students' academic achievement and interest. There is a strong intuitive appeal by professionals and experts in the field of education that

teachers should pay closer attention to students' learning needs, by diagnosing them, encouraging learners to reflect on them and designing teaching and learning interventions around them (Mutua, 2015).

Meanwhile, learning-related concepts which will provide valuable insight into learning in both academic and other educational settings like learning styles could be one of possible solutions to students' achievement and interest in biology. Learning style has been defined as a consistent way of functioning that reflects the underlying causes of learning behaviour (Mutua, 2015). Learning style is both a characteristic which indicates how a student learns and likes or prefers to learn, as well as instructional strategy informing the cognition, context and content of learning. Previous studies have reported that students' academic achievement and interest could be improved if proper learning style dimensions could be taken into consideration when developing any learning or instructional process (Graf, Liu & Kinshuk, 2010). Utilizing awareness of learning style within the educational background should promote more effective learning and hence improve academic achievement of students. According to Gokalp (2013), a country never stops to explore and develop its own methods of learning in order to respond to the demands particular of its environment. It is pertinent that the relationship between achievement and interest of secondary school biology students with different learning styles be examined. Learning styles in biology have been cited as effective means of helping teachers to recognize the incredibly diverse needs biology students bring into the classroom, as well as helping the learners discover how they learn biology concepts best for optimum academic achievement. Through developing a variety of teaching strategies to benefit all

learners, the students learn how to learn and consequently achieve better academic result as well as develop positive attitude and interest.

There is a great need for students to be motivated to develop positive attitude which is crucial to achievement in any subject most importantly biology. According to Awodun, Adekunle and Femi – Adeoye (2016), interest is a feeling of curiosity or concern about something that makes attention turn towards it. Lack of interest culminated to poor and negative attitude, and it is very evident that biology students in Benue State have learning difficulties which was as a result of lack of interest which translated to poor and negative attitude of students towards biology (Ityokah & Adejoh, 2014).

Furthermore, lack of interest and poor attitude in biology in secondary schools in Benue has been unabated over the years and is a re-occurring decimal every year. Despite all the efforts that have been put in place by stakeholders in education, the low interest and poor attitude remain the same. This is evident in the poor achievement of senior secondary school biology students each year for the past ten or more years. Therefore, a deep look into interest in biology in secondary school students should be considered a worthy research, because the achievement of students in any subjects depends on the level of interest and attitude of the student in the subjects.

Academic achievement in biology has for the past one and half decades been the focus of interest in biology education and in most educational research. Achievements of students in Biology in Senior Secondary Schools in Nigeria are poor and this has been a recurrent problem for many years (Obomanu & Akporehwe, 2011). The attestation to this poor achievement by stakeholders in the education sector

including school administrators, parents and relevant national and international examination bodies like the National Examination Council (NECO) and West African Examination Council (WAEC) make this a worrisome, embarrassing and problematic plague (see Appendix A for students' achievement in biology (2006 – 2016). The problem of poor academic achievement is eating deep into our educational system and is derailing the realization of the set educational aims, goals and objectives of biology education in Nigeria.

Meanwhile, many reasons have been put forward as being responsible for the poor or below average performance of students in Biology in secondary schools in Nigeria. Some of the reasons given include: poor teacher quality (Adedayo & Owolabi, 2012); lack of instructional materials (Omebe, 2015), lack of infrastructure such as laboratories (Obomanu & Akporehwe, 2011), poor funding of science programmes in schools (Ogbonnaya & Okunamiri, 2008); parent factors (Doryan, 2000); teachers' inappropriate teaching style (Bruce & Neville, 2008); and students' factors (Matthew, 2014). Despite all the aforementioned reasons given for being responsible for poor achievement of students in biology, the trend of poor academic achievement continues unabated in secondary schools in Nigeria.

One of the most topical issues all over the world is gender differences and equality in biology learning and academic achievement among teachers and students in schools. Sex and gender are words that are seemingly synonymous and many at times used together, but not exactly the same. Tatarintseva (2002) explained that, a common use of the term "sex" is to restrict it in referring to biological distinctions between males and females while the term "gender" refers to the psychological

features or attributes associated with these categories. Over the years there has been a growing awareness of the role of the female gender at home, in schools and community in general. However, worries have equally been expressed about the role of women in the political, social, cultural, psychological, economic, scientific and technological development of the nations. A major area of concern has been the gender influence in biology learning and the differences in the learning styles of male and female secondary school students and the relationships that exist between interest and achievement.

In addition, Ibrahim (2012) confirmed that women constitute about 50% of Nigeria population and their potentiality in contributing to the national development cannot be ignored. Jekayinoluwa (2005) lamented that schools and the nation at large are making profound contributions to the creation of positive learning environment that could motivate learning achievement more in boys than girls. Jegede and Inyang (1990) worked on gender differences in academic achievement and interest in integrated science in Junior Secondary Schools. The duo reported that males performed better than females; and demonstrated significantly more positive attitudes towards science than female. Owuamanam and Babatunde (2007) noted that, the females exhibit more positive attitude towards Biology and males towards physics. The authors also noted that the girls tend to go for career that do not require much energy and brain tasking such as home management while boys go for careers in management, engineering, banking and other brain – tasking professions.

Childhood training and experience, gender differences in attitudes, parental and teacher expectations and behaviours, selective career taking and biological differences

between the sexes may all be instrumental to the gender differences in achievement (Feingold, 2017). The rather high gender disparity in various spheres of public life and the patriarchal social structure in Nigeria may also lead to disparity and discrimination against the female gender in Nigeria. Onwuameze (2013), further reiterated that despite significant progress in the expansion of education in most developing nations, females still lag behind in enrolment and achievement at all levels of schooling. At the lowest level of basic schooling (primary), participation rates are high for both males and females and appear to have promising gender-leveling prospect, but the situation reverses remarkably at later transitions i.e the secondary and tertiary levels of education where the discrimination and segregation against the girl child education is obvious and the handwriting is well written on the wall (Stromquist, 2015).

According to Olagbaju (2014) the two sexes (male and female) have differences in their strengths and weaknesses. Each student has a peculiar way of learning and interpreting whatever information is being presented to him or her. This peculiarity in learners is known as learning styles. Learning style and gender have a commensalism – like relationship because one seems to influence the other.

Dundas (2004) agreed with the peculiarities of learning and interpreting information of male and female gender and posited that groups of learners differ in composition, brain make-up and sociological status but recent studies by Jayanama (2013), Onwameze (2013), Masume, Mohammed and Afsanegh (2016) have found that men and women fall into different group of learners namely: visual, auditory and kinesthetic learners. How these differences in preferred styles may affect learning outcome and the extent to which they are relevant is still not completely understood.

Similarly, the complete understanding of the learning styles of students in biology is not yet understood. Also, whether any aspects of these styles differ by gender is still an issue. A better understanding of how biology students of both genders learn will contribute to better academic outcomes of students.

There is therefore a strong need to find out if gender differences in learning style exist among Biology students, knowing fully well that the students learning style will aid the development of the most effective teaching approaches. Having the information about the similarities and differences of male and female learning styles may assist in the development and implementation of gender- specific teaching approaches that maximize students' interests, motivation and learning while tailoring instruction to students' needs found to influence learning. This work is premised on the conviction that given appropriate teaching methods and strategies that take cognizance of students' learning needs, most students' learning difficulties can be solved. Dunn (2001) in Mpholo and Shanah (2014) reported that students who learn under conditions matching their preferred learning styles performed significantly better and developed more positive attitudes and interest than their peers who were not in their preferred learning styles conditions.

Consequently, being aware therefore of the learning difficulties that students have especially in biology and taking cognizance of the dwindling lack of interest of students and poor achievement in biology, this work attempts to investigate the

relationship between the achievement and interest of secondary school biology students with different learning styles and the interplay with gender in Benue State.

Therefore, a critical look into the poor interest with the resultant poor achievement and likely solutions to this menace in senior secondary school biology in Benue State will be a worthwhile study for the benefit of all stakeholders in Education in the state and in Nigeria in general.

1.2   Statement of the Problem

A lot has been researched and written about teaching and teaching methods but not much has been said and researched about students' learning or ways students wish to be taught or learn, otherwise known as students' learning styles (Weimer, 2014). Most teachers do not pay attention to individual students' learning needs and their differences. The ways students wish to learn or how they wish to be taught seem not to be put into consideration by the teacher during the teaching- learning processes. This neglect has led to poor attitude and interest in biology and has been the situation in most Nigerian schools.

Over the years ,the low achievement of biology students in senior secondary schools in both internal and external examinations has been a major concern to all stakeholders and has been a re- occurring decimal in the educational sector. With the current trend of unabated and worrisome poor results in biology according to Chief Examiner's Report, West African Examination Council (WAEC, 2016), it has become evident that students are having learning difficulties in understanding most of the concepts and topics being taught in the classrooms. This has consequently led to

frustration of biology teachers who complain incessantly that their painstaking instructional efforts are not yielding the expected learning results. They are therefore confronted by poor grades, unresponsive or hostile learners, poor attendance to classes and high rate of drop out of students from offering the subject. All these therefore translate into very poor academic interest and achievement in biology. One area that has not been fully studied is students' learning styles. Consequently, there is a need to find out what effect learning styles may be having on students' achievement and interest in biology. Perhaps this can provide us a clue on how to help the students overcome their difficulties in learning biology. This study therefore explored and investigated the relationship between achievement and interest of senior secondary school biology students using different learning styles in Benue State, Nigeria.

1.3   Purpose of the Study

The purpose of this study is to investigate the relationship between achievement and interest of Senior Secondary School Biology students with different learning styles in Benue State, Nigeria.

Specifically, the study sought to:

1.   Identify the learning styles among biology students in secondary schools.

2.   Ascertain the relationship between mean interest rating and mean achievement scores of biology students with Visual learning styles.

3.   Find out the relationship between mean interest rating and mean achievement scores of biology students with Auditory learning styles.

4.   Find out the relationship between mean interest rating and mean achievement scores of biology students with kinesthetic learning styles.

5.   Find out the relationship between mean interest rating and mean achievement scores of male biology students with visual learning styles.

6.   Find the relationship between mean interest rating and mean achievement scores of female biology students with visual learning styles.

7.   Find the relationship between mean interest rating and mean achievement scores of male biology students with auditory learning styles.

8.   Ascertain the relationship between mean interest rating and mean achievement scores of female biology students with auditory learning styles.

9.   Ascertain the relationship between mean interest rating and mean achievement scores of male biology students with kinesthetic learning styles.

10.   Find out the relationship between mean interest rating and mean achievement scores of female biology students with kinesthetic learning styles.

11.   Determine relationship between male students with multimodal learning styles' mean interest rating and mean achievement scores in biology.

12.   Determine relationship between female students with multimodal learning styles' mean interest ratings and mean achievement scores in biology.

13.   Determine relationship between male students with unimodal learning styles' mean interest ratings and mean achievement scores in biology.

14.   Determine the relationship between female students with unimodal learning styles' mean interest ratings and mean academic scores in biology.

1.4   Research Question:

The one research question guiding the study is as follows:

-        What are the learning styles among biology students' in secondary schools in Benue State?

1.5   Hypotheses:

Thirteen null hypotheses were formulated and tested at 0.05 level of significance:

1.   There is no significant relationship between mean interest rating and mean achievement scores of biology students with Visual learning styles.

2.   There is no significant relationship between mean interest rating and mean achievement scores of biology students with Auditory learning styles.

3.   There is no significant relationship between mean interest rating and mean achievement scores of biology students with Kinesthetic learning styles.

4.   There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Visual learning styles.

5.   There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Visual learning styles.

6.   There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Auditory learning styles.

7.   There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Auditory learning styles.

8. There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Kinesthetic learning styles.

9. There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Kinesthetic learning styles.

10. There is no significant relationship between male students with multimodal learning styles and their mean interest rating and mean achievement scores in biology.

11. There is no significant relationship between female students with multimodal learning styles and their mean interest rating and mean achievement scores in biology.

12. There is no significant relationship between male students with unimodal learning styles and their mean interest rating and mean achievement scores in biology.

13. There is no significant relationship between female students with unimodal learning styles and their mean interest rating and mean achievement scores in biology.

1.6 Significance of the Study

The findings of this study may be of benefit to biology teachers, biology students, curriculum planners, parents and school administrators and managers. This study is aimed at assisting biology teachers understand the various learning styles favoured by the learners, it may also help them recognize the important relationships between learning style preferences, academic achievement and interest of biology

students. The biology teacher from the findings of this study may be made aware of different learning styles of individual students and therefore know how to adopt teaching strategies that match the learning styles and needs of individual biology students in order to achieve the expected learning outcomes.

Biology students may benefit from the knowledge about their own learning style and needs, and can take control or direct their own learning through modifying their habits and materials for optimum learning by discovering the learning styles that suit them the most by adjusting and adopting appropriate modes of study and learning for better learning outcomes. When learners learn in a way that suits them, there will be dramatic improvements in the effectiveness of the learning process. This automatically leads to the accomplishments of their goals and desires in academic achievements and to realize their long term dreams and aspirations in life.

This study may assist the curriculum planners to have a better circumspect and understand the needs and yearnings of different categories of students when designing and planning the curriculum. Diverse needs of students should be put into consideration with appropriate learning experiences that will assist the development of teaching strategies that match students' needs and maximize their achievements and interest in Biology.

Also, parents and guardians may have a lot of benefits to derive from the findings of this study in making them have a better understanding of the learning needs of their children and also to identify their learning styles to be able to know them better. As a result of this, parents and guardians will be of great assistance to their children in helping them adjust quickly to their learning styles when not in

school with their teachers through encouragement, and provision of logistics and other resources. This could catalyse the learning process and make learning more enjoyable, fruitful and productive for their wards.

This study may also be of assistance to the school administrators and managers in the learning of diversities that exist among biology students and therefore make adequate plans and preparations to utilize the learners' needs and learning styles to maximize students' achievement and interest. By this awareness, the school management should take individual students' learning unique style into consideration when managing them in other to bring out the best in them.

1.7 Scope of the Study

The geographical scope of the study is Benue State, Nigeria, which comprises of all the three education zones in the state namely: zones A, B and C. The choice of this area of study is based on the fact that Benue State is one of the educationally advantaged state in the North central region of the country, with the highest number of educated people which can conveniently represent the zone (My Guide Nigeria, 2016). Its unique and strategic location as well as its proximity from the Federal Capital Territory of the country where there are in and out influx of people of different ethnic affiliations makes it more suitable for the area of this study.

This study is limited to Senior Secondary School (SS II) Biology classes. This is the class in which the students have firm grip of all the subjects taught and most students are matured emotionally and mentally stable so they should be able to decide, think and take positions on things concerning their wellbeing. Furthermore, many

fundamental topics including ecology are taught in this class. Ecology is a topic in biology which deals with the study of living things in relation to the environment. It also deals with the interaction of different elements and components (including man) of ecosystem with each other, climatic factors, ecological factors, ecological instruments and population studies in ecology. It is an easy and self-explained topic which is very easy for students to comprehend and can easily be applied to their lives and day to day activities. So, ecology is considered the most suitable topic for the students to learn and for the teacher to teach for the purpose of this research work.

1.8   Operational Definition of Terms:

The operational definition of terminologies used in this research work are as follows:

Learning Style: Learning style as used in this study is the unique way individual biology students prefer to learn and to be taught by the teacher - visual, auditory and kinesthetic learning styles.

Achievement: This is the score students obtain in a 25-item multiple choice objective test tagged 'Biology Achievement Test' (BAT) on ecology in the SS II biology curriculum.

Interest: Expression of like or dislike and positive or negative attitude towards biology by SS II students through a Biology Interest Questionnaire (BIQ).

Unimodal Learning Style: As used in this study, is the preference of students to learn and to be taught biology through one particular learning style. It could either be Visual (V), Auditory (A) or Kinesthetic (K) learning style.

Multimodal Learning Style: In this study, multimodal learning style refers to the preference of students to learn biology and to be taught biology through more than one learning styles.

Visual Learning Styles: The preference of students to learn biology through what they see like charts, video, power – point presentation, puzzle, maps, diagrams.

Auditory Learning Style: The preference of students to learn biology through what they hear or listen to like audio tapes, radio, lecture, storytelling, discussion.

Kinesthetic Learning Style: The preference of students to learn biology through moving, doing and touching, demonstration, experiments, practicalization and interacting with the environment.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1   Introduction

This chapter covers related literature under four areas of theoretical framework, conceptual framework, empirical studies and summary.

2.2   Theoretical Framework

Several theories have been developed over time by scholars in the field of learning style. The followings are relevant to this study: Fleming's VAK Learning Style Theory, The Kolb's Experiential Learning Theory, Honey and Mumford's Learning Style Theory and Dunn and Dunns' Learning Style Theory. This study is firmly rooted in Fleming's VAK Learning Style Theory propounded by Neil Fleming (1987).

a.   Fleming's VAK Learning Style Theory (1987)

One of the most widely accepted theories of learning style is that of Fleming's VAK Theory which categorizes students' learning styles into three groups: "Visual Learners (V), Auditory Learners (A) and Kinesthetic or Tactile (K). Neil Fleming, a teacher in Lincoln University, New Zealand, authored VAK (Visual, Auditory, Kinesthetic) books and the proponent of VAK learning theory in 1987. The theory states that "human learning is based on sensory modalities and are categorized into visual learning, auditory learning and kinesthetic learning.

Fleming explained that visual learners have a preference for learning through the eyes – seeing (Visual aids that represent ideas using methods other than words such as graphs, charts, diagrams, and symbols. Auditory learners learn best through listening to lectures, discussions and tapes and kinesthetic or tactile learners prefer to learn via experience (moving, touching and doing, active exploration of the world, science projects and experiments). According to Fleming, students can use the model to identify their preferred learning style and maximize their learning by focusing on the mode that benefits them the most. This model acknowledges that students have different approaches to how they process information, referred to as preferred learning modes.

Fleming (2011) outlined the main idea of VAK (Visual, Auditory and Kinesthetic) as:

(a) Students' learning style have significant influence on their behaviour and learning.

(b) Students' learning style should be matched with appropriate teaching strategies.

(c) Information that is accessed through students' use of their learning style shows an increase in their level of comprehension, motivation and metacognition.

Fleming further explained that students have different learning styles in which unsuitable lessons can affect the quality of students' learning and behaviour in the classroom. Students have distinctive learning styles. So using the teaching and learning process that is tailored towards the learning needs of students positively influence their behaviour and learning. It is believed that learning and the resultant change in behaviour of students are maximized when students identify and understand

their learning styles and their learning needs are put into consideration during teaching and learning process.

Furthermore, when appropriate teaching strategies used by the teacher match students' learning style, high academic turnover can be achieved by the teacher and the students themselves. There are diverse teaching strategies and methods of teaching, each of these strategies and methods are best applied and are result oriented during teaching process provided it matches the learning styles and students learning needs. The table of students learning styles, their characteristics as well as their appropriate teaching methods as outlined by Fleming (1987) is shown in appendix Q.

Fleming (1987) is also of the idea that after students had identified and understood their learning style which is usually done with the help of a diligent and resourceful teacher, students' rate of learning will be increased and their level of comprehension and motivation will experience a sharp increase. In addition to this, the teachers' lesson and information presentation to the students that is in tandem with students' learning styles leads to a better academic achievement by the students.

These ideas of VAK as outlined above are worthy of research to study the correlation that exists between students preferred learning style and their achievement as well as their interest in biology. Its use in instruction allows teachers to prepare classes that address each of these areas, especially in biology. Students can also use the model to identify their preferred learning style and maximize their learning by focusing on the mode that benefits them the most. (Fleming, 2011). It is on this theory of learning style that this study is anchored on.

The study is premised and built on VAK [(Visual, (V), Auditory (A) or Kinesthetic, (K)] theory originally developed by Neil Fleming (1987). Based on this theory, several scholars have developed learning style inventories which can be applied in research and classroom set-up, for example, Barsch (1982), Eicher (1987), (Fielder and Silvermann (1988) categorize learners based on their sensory perceptions. One of the family of learning style models that has gained popularity recently and is commonly used has been those which emphasized sensory modalities as a means of providing stimuli to the learner, known as VAK. The way learners receive information based on the VAK theory has been divided into three categories, sometimes referred to as modalities: Visual – sights, pictures, diagrams, symbols, Auditory – sound, words, Kinesthetic – taste, touch and smell. (Fleming,1987). Although there are some learners who tend to use a combination of both visual and auditory.

Visual learners remember best what they see: picture, diagrams, flow charts, timelines, films, and demonstrations. They prefer to learn by reading books, seeing words or looking at some teaching tools. Therefore, they like the teacher to write more than talk in the classroom. Power-point presentation is suitable for these learners. Auditory learners remember more of what they hear and say. They engage in a lot of discussion, prefer verbal explanation to visual demonstration and learn effectively by explaining things to others.

Auditory learners also referred to as verbal learners; prefer to learn by listening. For them, they may enjoy to have interaction with others by talking. So, in formal instruction setting, they would rather listen more than see. A few teaching approaches may suit them, such as the oral approach, the audio – lingual approach and

communicative approach. Tactile learners and kinesthetic learners are similar, the former prefer to learn by feeling or touching something with their hands while the latter like movement. (Fleming,1987). Learners of these two kinds will feel comfortable when teachers see the total physical response approach like demonstration or practical activities. According to Fleming (2012), learning will be more effective if it is tailored around the learning approaches by the learners. This learning style theory forms the basis of this study where secondary school biology students' learning styles based on Visual (V), Auditory (A) and Kinesthetic (K) and any other possible combinations of these three styles was critically studied. Through this study, the predominant learning style among biology students was identified and the inter-play of students' gender between the different learning styles and achievement as well as interest was explored.

b.   Kolb's Theory of Experiential Learning Style (1984):

David Kolb, a professor of Organizational Development at Case Western Reserve University Cleveland, Ohio published his learning style model in 1984, in his book titled Experiential Learning: Experience as the source of learning and development. The theory states that "an ideal learning process is based on human experience, which is the source of learning and developmental approaches towards grasping and transforming the experiences". (Kolb, 1984).The model gave rise to related terms such as Kolb's Experiential Learning Theory (ELT) and Kolb's Learning Style Inventory (LSI) (Kolb, 1984).

Kolb proposed a four-stage hypothetical learning cycles, where teachers are classified into four categories based on their preferences in taking and incorporating

information: these he called accommodator, diverger, assimilator and converger. Similarly, the four stages of this theory can be described as Concrete Experience (CE; experiencing) which favours experiential learning; Abstract Conceptualization (AC; thinking) where there is a preference for conceptual and analytical thinking in order to achieve understanding; Active Experimentation (AE; doing) involving active trial-and-error learning; and Reflective Observation (RO; reflecting) where extensive consideration is given to the task and potential solutions before there is any attempt at action. The four learning orientations form two orthogonal bipolar dimensions of learning as shown in figure 1.
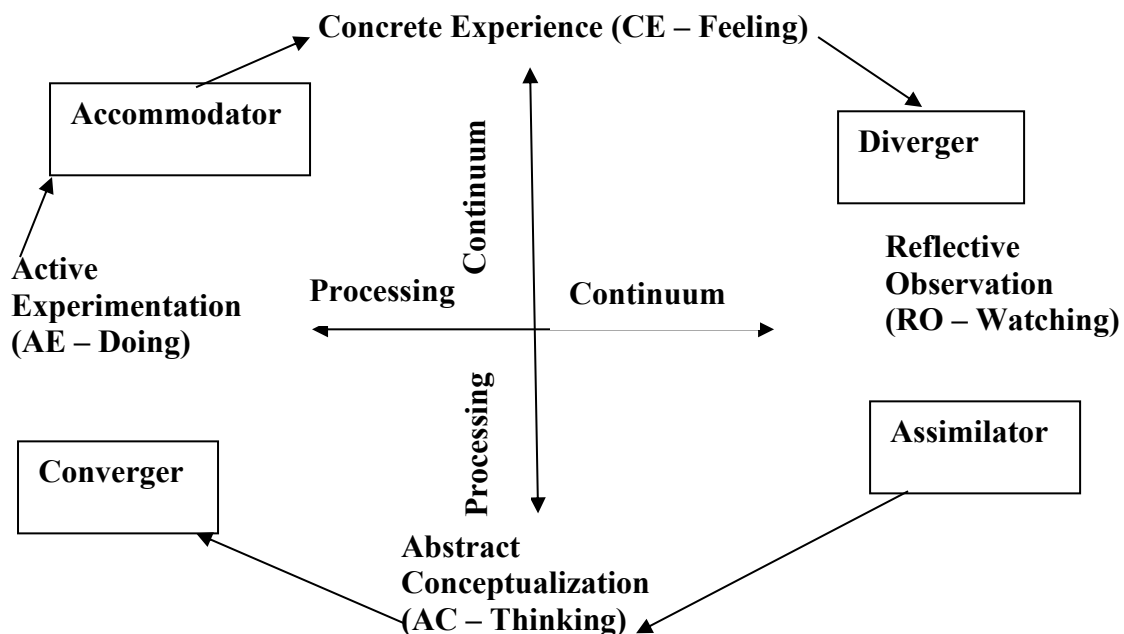
Fig.1: Diagram of Kolb's Experiential Learning Style
Source: http://www.nwlink.com.hnt.styles.kolb

Accommodator refers to a learner who prefers to receive information from feeling and process it by doing. Diverger on the other hand refers to a student who

prefers to perceive information from feeling and learn about the processing of information by watching. The assimilator; prefers to learn by thinking and watching, in a formal learning situations, students with this style prefer reading, exploring analytical models; they are strong in inductive reasoning and creation of theories. The convergers are students who prefer to receive information by thinking and doing, students prefer to experiment with new ideas, simulations, laboratory assignments, practical applications, and application of theories through hands on practical activities.

These four different learning styles in Kolb's theory: Accommodator, Diverger, Assimilator and Converger are related and similar in many ways to the learning styles being discussed in this research work. Visual learners have preference for learning through the eyes, they think in pictures, and need to create vivid mental images to retain information similar to the assimilators, in Kolb's experiential theory of learning, visual learners enjoy looking at maps, charts, pictures, videos and movies. They also have visual skills which are demonstrated in puzzle building, sketching, painting and manipulating images. The auditory learner which is similar to Kolb's Diverger learning styles, learn through listening, they have highly developed auditory skills and think in words rather than in pictures. They also demonstrate their skills in storytelling and speaking. The kinesthetic learners, like convergers and accommodators in Kolb's experiential theory of learning learn through moving and touching. They remember and process information through interacting with space around them, have skills demonstrated in physical coordination, hands on experimentation, using their hands and body movements. (Kolb, 1984).This implicates Kolb's theory of experiential learning style in the current study.

c.   Honey and Mumford's Learning Style Theory (1986)

Peter Honey and Alan Mumford of University of Leicester in 1986 identified four distinct styles that people use while learning. The proponents built on Kolb's work to propose their theory of learning which states that "learning is synonymous with managerial experiences in having an experience, reviewing, concluding the experience and planning". The four learning styles propounded by Honey and Mumford are: activist (Kolb's experimentation); reflector (Kolb's reflective observation); theorist (Kolb's abstract conceptualization; and pragmatist (Kolb's concrete experience). In other words, there is arguably a strong similarity between the Honey and Mumford styles or stages and the corresponding Kolb learning styles: Activist ≡ Accommodating; Reflector ≡ Diverging; Theorist ≡ Assimilating; and Pragmatist ≡ Converging. Honey and Mumford first renamed the stages in the learning cycle to accord with managerial experiences: having an experience, reviewing the experience, concluding the experience and planning the next steps. The researchers aligned these stages with their four learning styles: activist, reflector, theorist and pragmatist.

In addition to this, Honey and Mumford (1986) explained the categories of learners as follows:

a. Having an Experience '(stage 1) and Activist (style 1): 'here and now', gregarious, seek challenge and immediate experience, open-minded, bored with implementation.

Activists involve themselves fully and without bias in new experiences. They are happy to be dominated by immediate experiences. They are open-minded,

not skeptical and this tends to make them enthusiastic about anything new. Their philosophy is: "I will try anything once". They tend to act first and consider the consequence afterwards. Their days are filled with activity and they tackle problems by brainstorming, as soon as the excitement from one activity has died down they are busy looking for the next. They tend to thrive on the challenge of new experiences but are bored with implementation and longer term consolidation. They are gregarious people, constantly involving themselves with others but, in doing so they seek to center all activities on themselves.

b. Reviewing the Experience (stage 2) and Reflectors (style 2): 'stand back', gather data, ponder and analyze, delay reaching conclusion, listen before speaking, thoughtful.

Reflectors like to stand back to ponder experiences and observe them from many different perspectives, they collect data, both first hand and from others, and prefer to think about it thoroughly before coming to a conclusion. The thorough collection and analysis of data about experiences and events is what counts so they tend to postpone reaching definitive conclusion for as long as possible. Their philosophy is to be cautions; they are thoughtful people who like to consider all possible angles and implications before making a move. They prefer to take a back seat in meetings and discussions, they enjoy observing other people in action, and they listen to others and get the drift of the discussion before making their own points. The reflectors tend to adopt a low profile and have a slightly distant, tolerant unruffled air about them. When they act it is part of a wide picture which includes the past and the present.

c. Concluding from the Experience (stage 3) and Theorists (style 3): think things through in logical steps, assimilate disparate facts into coherent theories, rationally objective, rejects subjectivity and flippancy. (Honey & Mumford, 1986).

   Theorists adapt and integrate observations into complex but logically sound theories, they think problems through in a vertical, step-by-step logical way and they assimilate facts into coherent theories. Theorists tend to be perfectionist who won't rest easy until things are tidy and fit into a rational scheme. They like to analyze and synthesize and are keen on basic assumptions, principles, theories/models and systems thinking. Their philosophy praises rationality and logic. "If it's logical it's good". Questions they frequently ask are: Does it make sense? "How does this fit with that?" "They tend to be detached, analytical and dedicated to rational objectivity rather than anything subjective or ambiguous. Their approach to problem is consistently logical, this formed their mental set and they rigidly reject anything that doesn't fit with it. They prefer to maximize certainty and feel uncomfortable with subjective judgments, lateral thinking and anything flippant.

d. Planning the next steps (stage 4) and pragmatists (style 4): seek and try out new ideas, practical, down-to-earth, enjoy problem solving and decision-making quickly, bored with long discussions. Pragmatists are keen on trying out ideas, theories and techniques to see if they work in practice. They positively search out new ideas and take the first opportunity to experiment with applications. They are the sort of people who return from courses brimming with new ideas that they want to try out in practice. They like to get on with things and act quickly and

confidently in ideas that attract them. Pragmatist tends to be impatient with ruminating and open-ended discussions. They are essentially practically down to earth people who like making practical decisions and solving problems. They respond to problems and opportunities as a challenge and their philosophy is "there is always a better way" and if it works, it's good. (Honey & Mumford, 1986).

Based on this model, Honey and Mumford developed a Learning Style Questionnaire (LSQ) which has been effectively used to identify students learning styles in the field of education. Although, developed for use with management trainees, the LSQ has been used in a range of settings including education. Like Kolb's theory of experiential learning, Honey and Mumford's learning style theory is also viewed from the physiological angle, though their learning styles and cycles accord with managerial experience. The Visual (V), Auditory (A) and Kinesthetic (K) learning preferences of the Fleming's VAK learning style theory is synonymous with the Activist, Reflectors, Theorists and Pragmatist learning preferences of Honey and Mumford's learning style theory. The activists are similar to the students' preference of Kinesthetic learning style in which students love new challenges and immediate experiences, activity filled exercises and hands-on activities.

The reflectors are good listeners and observants, they love group discussion from where data are gathered for further consumption. The reflectors are the same as students that are auditory (A) in their learning style. The theorists are visually inclined in whatever they do, they are visual learners, while the pragmatists like the activists love hand-on activities, experimentation, touching things; moving around exactly like

the kinesthetic learners in this study. These four learning styles of Mumford's theory are acquired styles that are adaptable, either at will or through changed circumstances rather than being fixed personality characteristics. (Honey & Mumford, 1986).

Students' gender might determine the preferred learning styles, some students are unimodal in their learning style while others might be multimodal. (Mutual, 2015). Those who learn to adapt study skills to incorporate all three learning styles might learn faster and remember longer than those of a single learning style. The identification of students' learning styles might correlate with their levels of achievement and interest. Therefore, the relevance of this theory to the present study is in the striking similarities that exist between the learning styles of the two theories. More so, in the adaptabilities and flexibilities through changed circumstances of the learning styles targeted in this study. i.e Visual (V), Auditory (A) and Kinesthetic (K) and all other possible combinations especially when students discover their weaknesses and strength and work on it.

d. **Dunn and Dunn's Learning Style Theory (1976)**

The Dunn's couple (1976) are Rita and Kenneth Dunn. Rita Dunn was a professor at St. John's University together with her husband Kenneth, also a professor at Queen's College, United States of America. Both authored a book on learning styles in 1976. The Dunn and Dunn learning style theory states that "learning is a complex process where individuals learn differently under the influence of the environment, emotion, sociological, physiological and psychological factors". Through their work, the proponents observed distinct differences in the ways students

responded to instructional materials. Some students like to learn alone while others preferred learning in groups or from a teacher. Out of this preliminary work, they identified five key dimensions on which students' learning style differed: (a) environmental, (b) emotional support, (c) sociological composition, (d) physiological and (e) psychological elements.

In terms of the environment, the Dunns noted that students differed in terms of their definition of an ideal place to learn. Some wanted a warm, brightly lit place with desks, many people and much verbal interaction while others preferred cooler, more subdued lighting with a quieter, more informal environment. Though many teachers believe that they have little control over elements, Dunn and Dunn describe how the standard square box of a classroom can be partitioned into separate areas with different environmental climates.

The emotional dimension centres on the extent to which students are self-directed learners. At one end of the continuum are self-starters who can be given a long-term project and who monitor and pace themselves until finishing the job. At the other end are students who need considerable support and have to have their assignment in small chunks with periodic due dates. Semester-long projects without periodic checks would be disastrous with such students. Understanding your students' learning experiences therefore, helps students succeed and learn more effectively.

Students also differ in how they react to peer interaction, some dislike group projects, preferring instead to learn by themselves. Others thrive on the companionship and support provided by group work. Still others prefer the more traditional approach of learning from adults. A teacher can capitalize on these

preferences by varying his/her teaching techniques based on different learning configurations. Another important dimension identified by the Dunns relates to individual differences in terms of physiological preferences, the most important element here is learning modality: some are visual, others prefer auditory, mobility or the ability to move around periodically is another element here. Another important element is time; some students are morning people, while others don not function fully until later in the day. (Dunn & Dunn, 1976). Teachers should accommodate this dimension when they set up learning centres that allow students' movement. This dimension may be one of the difficult situations for teachers to accommodate.

The fifth and final learning style dimension according to Dunn (2000) is psychological. This dimension refers to the general strategies students use when faced with learning problem. Some attack them globally, looking at the big picture, while others prefer to address individual elements of a problem separately. In a similar way, some students jump into problems, figuring things out as they go along, while others are more reflective, planning before beginning.

The Dunn and Dunn's learning style theory and Fleming VAK learning style theory share a common ground and dimension on which students' learning styles differ i.e physiological dimensions. The physiological dimension of Dunn and Dunn's learning style is similar to Visual (V) Auditory (A) and Kinesthetic (K) of Neil Fleming's learning style. On this, the two theories shared a common ground and are related.

2.3   Conceptual Framework

In this section, the following concepts are discussed. The concepts of learning styles, factors influencing learning styles, implications of learning styles in learning and teaching, concepts of achievement and interest.

a.   The Concept of Learning Styles

Learning styles have a range of competing theories that aim at accounting for differences in individuals' learning. It is an individual's preferential way in which he or she absorbs, processes, comprehends and retains information (Obiefuna & Oruwari 2015; Wichuda, Charsiri, Manoch, Athavudh & Juntina 2015). Learning style theories propose that all people can be classified according to their preferred style of learning. Although the various theories present different views on how the styles should be defined and categorized, a common agreement is that individuals differ in how they learn.

Esen (2007); Ibe (2015); Adeniji (2015), defined learning style as the manner and the condition under which learners most efficiently and effectively perceive, process, store and recall what they are attempting to learn. An Individual's learning style depends on cognitive, emotional and environmental factors, as well as prior experience. According to Mutua (2015) and Lorna (2013), learning style is the characteristics of cognitive, affective, social and physiological behaviours that serve as relatively stable indication of how learners perceive, interact with and respond to the learning environment. Learning styles, cognitive styles and learning strategy are frequently used imprecisely in theoretical and empirical account of the topic. The term

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learning style and cognitive style are, on some occasions used interchangeably, whilst at other times they afforded separate and distinct definitions. Cognitive style is described as an individual's typical or habitual mode of problem solving, thinking, perceiving and remembering, while the term learning style is adapted to reflect a concern with the application of cognitive style in learning situations. (Geof, 2015; Clikeman, 2015).

Apart from the three sensory modalities of learning styles that had been defined earlier in learners (Visual, Auditory and Kinesthetic), some have preferences for and learn through two or more of the modalities. (Fleming & Mitts, 1992). Multimodal learners are thus, sub-classified as bi, or trimodal learners who prefer to use two or three learning styles respectively. Learning style preference dimensions might in general be unimodal i.e preferring single learning style dimensions like visual (V), auditory (A) or kinesthetic (K), bimodal learning dimensions like visual/auditory (VA), visual/kinesthetic (VK), auditory/kinesthetic (AK) and trimodal learners that prefer visual/auditory/kinesthetic (VAK) dimensions.

Adeniji (2015), Nasir, Gbarekhai and Ghasempour (2016) perceived learning style as a habitual and unique behaviour to acquire knowledge, skills and feedback through study or experience. Learning style is the way that learners prefer over other ways in their content learning process, and it is the most efficient and effective learning method for every learner. Thus, every student has a personal style for receiving, processing, saving and remembering new information. Therefore, it makes sense to say that the learner's efficiency will be enhanced if their learning process is matched with their learning style. Conversely, incompatibility between the teaching

method and the person's learning style may result in demotivation and failure in learning.

Furthermore, Malik and Hukam (2010) explained the concept of learning in the light of the opinions of behaviourists, connectivists and humanist. The authors further reiterated that, according to the behaviourist, learning is not an active but passive process of memorizing information that requires external reward. According to humanists, learning is a personal act of an individual to fully utilize his potential. It is essential that instructional activities should be based on the learner's basic need for the success of the learning process. It is an unending curiosity that includes: identifying, discovering, drawing in from the outside world and making that which is drawn in a real part. Malik and Hukam (2010) explained that the connectivists believe that learning is a way of being, it is an ongoing pattern of attitudes and actions by individuals and groups which they employ to deal with the surprising novel, messy, obstructive events and situations.

Broadly speaking, the idea behind learning styles is that students have a preferred learning style and students learn best if they are allowed to learn in their preferred learning style. Petty (2004) made the following claim: "there is strong research evidence that multiple representations help learners whatever the subject they are learning". Five years later, in 2009, in his book: "Evidence based teaching" Petty went further to state that: It is tempting to believe that people have different styles of learning and thinking, and many learning style and cognitive style theories have been proposed to try and capture these.

The learning style theories such as the Flemings VAK theory (1987), Kolb's learning style (1984), Honey and Mumford, (1986) and Dunn and Dunn theory (1976). Cognitive style theories such as multiple intelligence theory by Howard Gardner (1999), Mental Self Government by Robert Sternberg (1994), learning modalities by Neil Flemings (1987) and concrete and Abstract theory by Anthony Gregorc (1984) shared a common ground and are related by explaining the different way individual students process, interpret and applied information at different times and situations.

Petty (2009) summarizes his teaching strategies into 10 stages, which are as follows: clear lesson goals, sharing information and knowledge and modeling how to do it, questioning to check understanding, summarizes new learning in a visual graphical way, encourage students to practice and engage in practical activities, provide students with feed back, flexible about how long it takes the students to learn, make student work together, teach strategies not content and nurture meta-cognition. Meta-cognition involves thinking about one's options, choices and results. Petty (2014) in the approach likened learning styles to active learning. This entails involving students practicing important skills and in applying new knowledge, using their audio, visual and kinesthetic endowments for getting involved actively in the teaching and learning activities.

The concept of learning style generally is used to describe individual differences in the way people learn. Each person has a unique way for absorbing and processing experiences and information. According to Erdogan (2008) students' learning style is mainly defined in large part by the answers to five questions which an effective teacher should ask him or herself as follows:

(a)   What type of information does the student preferentially perceive? - sensory (external) sights, sounds, physical sensations or intuitive (internal) possibilities, insights, hunches?

(b)   Through which sensory channel is external information most effectively perceived? - visual (pictures, diagrams, graphs, demonstration or auditory (words, sounds)?, or Tactile (touch, feel)? or Kinesthetic (movement, demonstration)?

(c)   With which organization or information is the student most comfortable? - Inductive, facts and observations are given, underlying principles are inferred or deductive, principles are given, consequences and applications are deduced?

(d)   How does the students prefer to process information? - Actively, through engagement in physical activity or discussion, or reflectively, through introspection?

(e)   How does the students' progress toward understanding? - Sequentially, in continual steps, or globally, in large jumps, holistically?

Another important term closely related to learning style is learning strategies. Learning strategies is defined as the strategies students adopt when studying (Hartley, 2008). Hartley (2008) asserts that, different strategies can be selected by learners to deal with different tasks. More of learning strategies according to Berkley (2015) is a way of initiating learners into effective ways to help them engage in activities based on ideas about how people learn. Furthermore, learning strategies can also said to be any action which students take to solve a problem in learning. This is to make most of

the learning process speed up and optimize the cognitive, affective or social behaviour (Mariani, 2002).

Learning styles might be more automatic than learning strategies which are optional. Chianson, Aligba and Jimin (2015) described learning styles as the preferences, tendencies and strategies that individuals exhibit while learning. It can also be defined as the characteristics, strengths and preferences in a way and how people receive and process information.

b.   Factors Influencing Learning Styles:

Many factors can influence students' learning styles. These factors include: gender, age, academic achievement, brain processing, culture and creative thinking (Obiefuna & Oruwari, 2015). Learning is composed of individual traits people use to interact with situations and objects, and the intersections of these traits indicate individual learning styles. Vermont and Vermetten (2004) observed that cultural differences in pedagogical and educational practices may give rise to differences in learning pattern structures. In the same vein, Park (2000) states that research has identified cultural differences in the learning styles of various ethnic groups and group differences between high achievers and low achievers students. In supporting that culture has influence on learning style preference, Woodraw and Sham (2001) found that the British - Chinese learners preferred working on their own and in quiet classrooms than to be in a group. The researcher further discovered that the British got nervous and embarrassed when they had to work in group. British – Chinese learners were not compatible with asking questions or being asked questions.

However, culturally different regions of the world were compared. Joy and Kolb (2009) carried out a study in the sub-saharan Africa region that consisted of Namibia, Nigeria, South Africa, Zambia and Zimbabwe. This cluster may have suggested a near homogenous group, it was pointed out that the culture in this sub-group are very different. Furthermore, Mpholo and Shanah (2014) conducted a study on how cultural values influence learning style preferences in Leribe province, Lesotho. Results show that the learners in the highlands and lowlands largely preferred visual learning style. This could be attributed to the socialization of the learners in which respect for authority (teachers and elderly) is seen as paramount. Naserich and Sarah (2013) similarly concluded in their findings that learning style is a function of individual preference and that it might even be context dependent.

In addition, the cultural socialization of the Basotho learners, (in Boswana) could be thought to have influenced the visual learning style. According to Holtbrugge and Mohr (2009) some cultural values can affect learning style preferences of students while other cultural values do not seem to have an impact. It is therefore important for teachers to identify those cultural values that have impact on learners' learning styles in order to move closer to the desirability of the convergence of educational system. This is due to the fact that educational systems are drawn from cultural values and address National goals and aspiration. (Holtbrugge & Mohr, 2009).

Tatarintseva (2002) posited that male and females learn differently from each other. Males tend to be more kinesthetic, tactile and visual and need more mobility in a more informal environment than females. The researcher stressed further that males also are more non-conforming and peer motivated than their female classmates. Boys,

according to Kray and Thompson (2004), learn to compete in hierarchical groups while girls learn to co-operate in small groups in which mutual liking is important.

To further buttress how gender influenced learning styles, Wilfred and Allan (2010) asserted that males feel comfortable in a lecturing role which is a demonstration of expertise and status, while females feel comfortable in a listening role which shows a desire to co-operate, bond and be liked, by-products of a world of connection not status. It was further opined that females are more likely to have a reflective and visual learning style in comparison to males. (Prajapati, Dunne, Bartlet & Cubbidge, 2011).

Students' learning styles is also influenced by age, or it can also be interpreted that students' learning styles changes with age and maturity. According to Seiler (2011) learning style changes between elementary and middle school and between middle school and high school. The learning style continue to change in college and during adulthood and the style of older adults in the 65 – 85 years old range differ in many ways from those of younger people.

Nevertheless, individual change in unique ways. Some people hardly change their learning style but others experience rapid and multiple changes. (Wilfred & Allan, 2000).

O'Donnell and Tobkell (2007) affirmed that age is considered an important factor in learning styles and outcome. It is also influenced by modern technologies and social system. Students who were born in the millennium (year 2000) are socialized in modern technologies than those born before this time. The millenials are quick to

learn through audio – visuals platforms and Computer Aided Instruction (CAI) based learning systems (Barnes, Marateo & Ferris, 2007).

Corbin (2017) affirmed that dependent learning style is common to all age ranges of students from childhood to adulthood as well as old age, all students of different age group desire dependent learning especially ages 41 – 55 years. On the other hand, the millenials preferred independent and competitive learning styles such as the visual, auditory and kinesthetic styles.

Furthermore, individual students differ in their learning styles based on the way their brain process information. Individual differ in how information are absorbed and processed new and difficult information. Investigation of the variables of global and analytic and left or right – preferenced processing revealed that relationships exist among these cognitive dimensions and many students' environmental, emotional, sociological and physiological learning style traits. (Tatarintseva, 2002).

Pappas (2016) likened a brain to be processor, a complex machine that takes raw data and turns it into thoughts, memories and cognitions. The inner regions of the brain control the most primitive aspects of human nature such as fears and emotions while the cortex, the outermost region takes care of complex thinking abilities like memory language and personality traits. (Pappas, 2016).

According to Ivec (2018), brain is biologically primed to acquire language right from the very start of life. There is an inverse relationship between age and the effectiveness of learning. In general, the younger the age of exposure, the more successful the learning. Clikeman (2015) posited that the brain begins to mature at birth and continues to mature throughout life. Though, the brain does not mature at the

same rate in an individual. It is important for teachers and parents to understand that maturation of the brain influences readiness in learning and the learning styles that will be adopted or preferred by the students. This is also important when designing lessons and selecting which strategies to use.

Wellington (2004), also opined that the individual students' learning styles could also be determined by the following: social differences, students' shyness and confidence, ability to listen and ability to work in groups. Other factors which could influence the learning styles of students are students' physical differences, visual and hearing impairment, past experiences, classification and course level, environmental factors and educational setting.

Esen (2007) noted that, when dealing with learning styles, physiological, cognitive and affective aspects should be taken into consideration. It was further analyzed that cognitive aspect involves the process of encoding, processing, storing and retrieving information. Physiological aspect involves sensory perceptions, environmental characteristics, time of day for learning and need for food during study. Affective aspect include emotional and personality characteristics, such as motivation, attention, locus of control, interest, persistence, responsibility and sociability. Ibe (2015) stated that, one's preferred learning style include characteristics such as quiet or background noise, bright or low light, formal or casual sitting arrangement, uninterrupted study or intermittent breaks. According to Adeniji (2015), the prevalent learning style in a particular country or place is largely guided by the culture and tradition of educational system in that place.

The educational system in Nigeria is the true reflection of the country's cultural values and norms. Therefore, the learning experiences, strategies and methods to be used by the teacher in the classroom should not be disconnected from all these attributes. The students preferred learning styles should also be guided, fine-tuned and moderated by the teacher so as to achieve better learning outcome.

c.   Implications of Learning Styles on Learning and Teaching

To achieve a desired learning outcome, it seems logical to suggest that one should provide teaching interventions that are compatible with the students' learning styles. Thus, 'learning style' is a concept that is important not only in shaping teaching practices, but also in highlighting issues that help school administration think more deeply about their roles in facilitating students' learning (Bruce & Neville, 2008). When teaching takes place, it is intended to result in learning, especially when teachers understand and apply certain principles of learning when designing and implementing their teaching activities. Neglect or misapplication of principles of learning could easily result in teaching that fails to achieve result. Therefore, it is important that teachers become familiar with the underlying principles in learning. Previous studies have reported that students' learning performance could be improved if proper learning style dimensions are taken into consideration when developing any learning or instructional process (Graf, Liu & Kinshuk, 2010, Athmet, Susan, Levent & Osman, 2007; Albert, 2016; Esen, 2007; Ibe, 2015; Mutua, 2015).

According to Mutua (2015), learning may not take place if the teaching is not structured to facilitate learning even when the teaching mode is appropriate. The basic unit of learning in any educational setting is the learner while the teaching approaches

are at the classroom level (macro), learning takes place at the individual student level (micro), influenced by the individual learning style preferences, the challenge to the teachers is the attempt to bridge this gap (Lorna, 2013).

Proponents of learning style assessment contend that optional instruction requires diagnosing individual learning style and tailoring instruction accordingly. Assessments of learning style typically asks students to evaluate what sort of information presentation mode they prefer (e.g words, pictures, speech) and what kind of mental activity they find most engaging (e.g analysis, listening), although assessment instruments are extremely diverse. According to Harley (2015), optimal method of teaching is the method that closely matches students' learning styles.

Coffield, Moseley, Hall and Ecclestones (2004) comprehensively reviewed students' learning styles and concluded that a teacher wishing to utilize a learning style approach must decide which of the many different learning style theories or approaches is to be adopted. The knowledge of the overall learning style profile of students allow teachers to make adjustments to teaching strategies. Any good teacher strives and passionately stays committed to his/her profession and is anxious to convey or impart knowledge to their students. If teachers are not inclined to much self-reflection and appraisal about their teaching methods and practices, they are likely to continue teaching their students the way they want to teach and not considering the students, assuming that this way will work for all the students. But given the increasing and higher expectations for teaching performance among school administrators, it is necessary that teachers should urgently rethink their effort to consider students' learning styles. Teachers may be able to reap equal satisfaction

from reinvigorating their teaching practices, hence, high academic achievement (Lorna, 2013). The objective of this study is to critically study the relationship that might exist between interest and achievement of senior secondary school biology students with different learning styles in Benue State.

d.   The Concept of Achievement

Achievement, according to Kundu and Tutoo (2004), means to succeed in reaching a particular goal, status or standard, especially by making an effort for a long time. It may also mean the realization and attainment of specific aims, goals, and objectives generally determined by working hard. Achievement is the actualization of pre-determined goals of an establishment or a course of study (Landu, 2003).

Akande, Landu and Kolo (2008) defined achievement as the fact of achieving, realizing and attaining specific aims, goals, and objectives generally determined by working hard. It is the actualization of a determined goal with resources available and hard work. Operationally, achievement is defined as the accomplishment of one's purpose of carrying out a task.

Academic achievement can also be defined as successful completion through efforts of the acquisition of academic content and skills. Achievement is defined as measurable behaviour in a standardized series of tests (Simpson & Weiner, 2010). The tests are usually constructed and standardized to measure proficiency in school subjects. The most highly valued method of determining whether a successful completion has taken place for a learner is quantitative in nature. In other words, numbers are used to indicate whether a student has been successful or unsuccessful in mastering academic content and skills.

According to Bruce and Neville (2008), accomplishment is sometimes used in place of achievement. According to these authors, educational achievement is measured by standardized achievement test developed for school subjects. This means that academic achievement is measured in relation to what is attained at the end of a course, since it is the accomplishment of medium or long term objectives of education. What is important is that the test should be standardized. For a test to be standardized; it must be valid over a period of time. Areepattamannil and Freeman (2008) reiterated that academic achievement means that all students in a school take the same subject content, engage in it the same way, through methods of teaching, reading of textbooks, practical activities and so on. The bottom line in academic achievement is based on scores and grades. Students may not be permitted to graduate from school, if they are unable to maintain a specific percentage score or specific grade point average. (Steve, 2000).

According to Steve (2000), achievement is distinguished from performance in that achievement is long term, while performance is measurable at any point in time. He further classified activities that occur in performance as academic performance index. The writer further explained that satisfactory academic achievement award is given to recipient who maintains satisfactory academic performance and progress towards the attainment of certificate. This is to suggest that academic achievement is cumulative and progressive. Achievement cannot be attained within a short period, this indicates that performance culminates into and influences achievement. Although, the distinction between achievement and performance is contentious and controversial among scholars and experts in the education industry. (Jost, 2018). Dirk, (2018)

however, opined that achievement implies ownership and self-directed activity while performance expresses how well one has done work undertaken or assigned and whether one's output or activities has met expectations.

Performance is defined as the observable or measurable behaviour of a person in a particular situation (Simpson & Weiner, 2010). This means that performance measures the aspect of behaviour that can be observed at a specific period. To determine performance, a performance test is conducted. Steve (2000) defined performance test as the type of mental test in which a student is asked to do something, performance test is the type of test which throws light on the ability of students to deal with academic exercises. In relation to educational research, academic performance of a student can be regarded as the observable and measurable behaviour of a student in a particular situation. Therefore, we can equate academic performance with the observed behaviour or expectation of achieving a specific statement of or statement of educational intention in a research. Academic performance of students consists of scores obtained from teacher – made test, termly examinations, projects, presentations, skills assessment test, checklist, observation, log book, verbal questioning and anecdotal test. (Landu, 2008). .

Academic achievement has always been influenced by the student's previous performances. (Staffolami & Bratti, 2016); student's social and emotional status and well being (Erdogan, 2008); the school environment (Davies, 2009); attitude (Erdogan, 2008) among other factors. Achievement for the purpose of this study will be based on SSII biology curriculum focusing on ecology, using multiple choice questions format where students will be expected to tick the right options and the whole responses

computed over 100 percent. The biology achievement mean scores of students will be computed and converted to be at the same level with the mean interest ratings for easy statistical analysis. The students' mean achievement scores will be correlated with the mean interest ratings of different learning styles to reveal any existing relationship.

e.   The Concept of Interest

Interest according to Kundu and Tutoo (2004), is the term used to designate a concept pertaining to factors within an individual, which attract him to or repel him from various objects, persons and activities within the environment. Andrew (2003), in Oxford Dictionary of psychology defines interest as attentiveness, undivided attention, absorption, engrossment, heed, regard, notice, scrutiny, curiosity, inquisitiveness, enjoyment and delight in an activity or a subject. Interest may be looked upon as an emotional attitude, which arranges our activities in a subjective scale of value. Disha (2016) defines interest as the conditioned stimuli related to goal objects and expressed as likes or dislikes of activities, objects, characteristics or people in the environment. Interest basically refers to the motivating force of an individual which compels him to attend to an object or an activity (Shivangi, 2015). An interest is a subjective attitude motivating a person to perform a certain task, it affords pleasure and satisfaction.

In addition, Kundu and Tutoo (2004) explained that psychologists and philosophers have attempted to define as to evolve a definite inventory of criteria regarding the basic meaning of interest. One of the criteria of measuring interest among individuals was the amount of attention shown by them in a given operation.

There is a close relationship between attention and interest. (Prakash, 2011). It was assured by a group of investigators among who are Anwar (2014); Guhan (2017) and Koran, Koran and Foster (2002) that if attention was demonstrated, interest was present. But other concomitant factors which also operate simultaneously on the individual during the aroused state of interest are also contributive in the generation of this state of interest.

Davies (2009) reiterated that interest has subjective and objective aspects. The subject sphere entails the feeling components and this is observed through those that are highly interested. On the other hand, the objective sphere emphasizes the motor behaviour of individual which is noticeable through an approach to choice of alternatives, which are equally available to the individual in so far as environmental barriers do not influence choice. Uhumuavbi and Umoru (2005), divided interest into two parts namely: extrinsic interest and intrinsic interest. Extrinsic interest is the interest in a particular thing that comes from other factors outside the individual.(Shivangi, 2015). For example; interrelationship in the environment. Intrinsic interest is the interest that comes from within the individual such as attitude, aptitude. (Prakash, 2011).

Davies (2009) in his findings about college students' interest in biology, emphasized that with the gradual shift of emphasis in education from the mastery of subject as an end in itself to the careful reconsideration of the needs of students, a paramount problem for educators becomes that of determining students learning needs. Not until there are adequate understanding of these learning needs will teaching become really effective. (Geof, 2015). Although the sources of materials relative to

needs are many, each is an important aid in obtaining a full picture; students' interest is one of these aids. Ukoh (2010), revealed that there is a significant relationship between students' interest and students' performance. Ukoh therefore, recommended that there is need for teachers to make their lessons captivating to the students by relating science to the environment of the learners and using the appropriate teaching strategy to arouse and maintain students' interest in the subject. Kundu and Tutoo (2004), suggest that the teacher in his teaching process is primarily concerned with motivating his pupils and stimulating them to hard work. The use of audio – visual aids in teaching sciences which arouses interest in students, was therefore advocated as this helps in capturing the attention and interest of students.

Consequently, when students' interest and learning needs are identified, properly understood and adhered to by the teacher, students' achievement takes a positive turn – around and better academic and educational objectives will be achieved. (Anwar, 2014). Individual students have a particular learning style where learning is at its best and when the teaching strategies and learning experiences match the students' learning style, better academic output ought to be achieved. So, this study takes a look at the relationship that exists between interest and achievement of students with different learning styles in senior secondary school biology in Benue State.

2.4   Empirical Studies

Some empirical studies that are related to the study are reviewed. These studies give the researcher the knowledge and idea of how various studies related to learning styles, interest and achievement around the world were carried out. These review also show the direction and pitfalls in the conduct of the studies and also show likely expected outcome as well as the missing gaps that are existing in the studies under review.

An empirical study conducted by Obiefuna and Oruwari (2015), using a quasi-experimental research design assessed the effect of learning styles on students' performance in English Language in senior secondary schools in Imo State, Nigeria. A purposive sampling technique was used to select 300 students in the area of study. Two research questions were answered using frequency, mean and percentages while two research hypotheses were tested using ANCOVA at 0.05 level of significance. The result of the analysis showed that the learning style preference for English language is converging i.e (Kinesthetic learning style). The result also revealed that when teaching methods match the students learning styles, they perform better. Gender had no significant impact on students' learning styles and performance. Though this empirical study was carried out in the secondary schools, using gender as a moderating variable, it will be a novel idea when gender is the moderating variables in the interplay between learning styles and academic achievement as well as interest in Senior Secondary School biology students in a different geographical location with different people in Benue State. The study under review used a quasi- experimental research design while the current study used survey research design. The studies are however related because learning styles was the independent variable.

Chianson, Aligba and Jimin (2015), conducted a study in Benue State, Nigeria titled: The prevalent learning styles among secondary school mathematics students and its influence on gender and age. A sample of 191 students from five randomly selected secondary schools in Makurdi metropolis were used. A total of 78 males and 113 females responded to the Mathematics Learning Style Questionnaire (MLSQ). A descriptive survey design was employed in the study. Three research questions and three hypotheses were formulated to guide the study. Statistical tools of mean, standard deviation and two-way ANOVA were used to analyse responses from the respondents. The findings of the study revealed that there was no significant difference in the mean scores prevalent rate of the auditory, visual and tactile learning styles among mathematics students. There was no significant difference in the mean scores, prevalent rate of the auditory, visual and tactile learning styles among male and female mathematics students. Age had no significant influence on the mean score prevalence of auditory, visual and tactile learning styles among secondary school mathematics students. It was concluded that students have the ability to use the three learning styles depending on the learning environment or the teacher's strategy. It was therefore, recommended that teachers should be able to accommodate all three students learning styles in the teaching of mathematical concept. A lot still need to be desired in the imperativeness of the relationship between achievement and interest of biology students with different learning styles as well as identifying the predominant learning style among biology students in Benue State. The study under review had both gender and age as dependent variables while the current study has achievement and interest as dependent variables, with gender as a moderating variable. The studies

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are however related because learning style was the independent variable in the two studies and the two studies took place in Benue state.

Ibe (2015), researched into the effect of learning styles on the performance of senior secondary school biology students in Imo State, Nigeria. The study adopted the quasi–experimental design. The sample consisted of 300 SS II Biology students comprising 150 males and 150 females, obtained through simple random sampling in three schools (100 students per school). Two research questions and two null hypotheses tested at 0.05 level of significance guided the study. Kolb Learning Style Inventory (LSI 1999 version) was used for identification of the students' learning style. The Biology Achievement Test (BAT) was used for the determination of the students' performance in both pre-test and post-test. Findings from the study showed that the four learning styles of Kolb were represented amongst the biology students; that many students preferred to learn by more than one mode of information presentation; learning styles varied from one group to another and there was no significant difference in the biology mean scores of the students with interaction between learning styles and gender. A similar study in different location involving gender with the relationship between achievement and interest with different learning styles using Fleming's VAK learning style theory will be carried out in this study.

Adeniji (2015) conducted a study titled "Comparative Analysis of Students' Learning Styles and Mathematics Performance at Tertiary level in Katsina State, Nigeria", using a randomly sampled 112 NCE II students from two Colleges of Education in the state. Five research questions which were answered and three null hypotheses tested at 0.05 level of significance guided the study. Two instruments were

used for data collection: an adopted Students Learning Style Rating Scale (SLSRS) and a researcher – developed Mathematics Achievement Test (MAT). The data collected were analysed by using mean, percentages, and standard deviation to answer the research questions and ANOVA and t-test to test the hypothesis. The findings of the study show that, the highest percentage of students prefer Read/Write learning style, followed by Auditory/Verbal then Visual/Graphic and Tactile/Kinesthetic. The study also found that male students favoured Visual/Graphic learning style much more than female students while the reverse was found for Read/Write learning styles. Auditory/Verbal and Tactile/Kinesthetic learning styles were almost equally distributed among the students. The study further revealed that students favoured learning styles do not have statistically significant influence on their mathematics performance and female students of pronounced multimodal learning styles were moderately likely to perform better than male students but gender could differentiate mathematics performance of students with pronounced single learning styles. The comparative analysis of students' learning styles and mathematics performance at NCE level was addressed and not in secondary schools. So there is a gap to be filled in this present study, in which attention will be focused on the relationship between achievement and interest of students with different learning styles in Secondary School Biology.

Mutua (2015) in a study which investigated correlation between learning styles and academic achievement among secondary school students in Kenya. The study was conducted in four schools in Machakos county, the schools were selected based on their academic achievement and specifically 2014, Kenyan Secondary Certificate

Examination (KCSE) and the consistency of achievement in the previous national examinations. The total population of the four schools, was 613, consisting of both boys and girls. Three research questions were raised to guide the study. The data collection instrument was the Barsch Learning Style Inventory (BLSI), which was used to identify the learning style preferences among the students based on Visual, (V), Auditory, (A) and Kinesthetic, (K) modalities. The findings indicated that majority of the students were trimodal learners, followed by bimodal (VA) learners and unimodal learners. The least preferred learning style was the single kinesthetic modality which was preferred by only 2 female students. The results showed that: there is no significant difference in learning style preference among male and female students and among high and low academic achievement groups and there is also strong positive and statistically significant relationship between learning styles and academic achievement for the trimodal learners and among male and female students. A similar study concerning learning styles of biology students investigated the relationship between achievement and interest is necessary to be carried out but in different geographical zone of Africa (Nigeria). In addition to this, gender of students is used as a moderating variable to see its interplay with achievement and interest.

Wilson (2011) conducted a study in Northwestern South Carolina districts of United States of America titled students' learning style preferences and teachers' instructional strategies: correlation between matched styles and academic achievement. This study examined the potential relationship between the degree of match and the academic achievement of eight grade students (equivalent of JSSII students in Nigeria secondary schools) shown by Palmetto Assessment of State Standard scores in four

academic content areas namely: English language, arts, mathematics, science and social studies. The researcher collected data from a sample of approximately 200 students from 3 schools. A quantitative approach utilizing a correlation design was used to analyse the data and produce Pearson (r) values for each content area respectively. These results demonstrate a lack of significant correlation between matched styles and academic achievements. Under the present study, the correlation between achievement and interest of different learning styles will be examined in a different geographical area. The study under review is related to the present study in exploring different learning styles among students, but different from this study in correlating the learning style and teachers' instructional strategies and the influence it has on academic achievement.

Oomen (2015) conducted a study in Keralla State of India, titled "Learning Style and academic achievement in biology in secondary school students using Fleming's VAK learning style theory". The sample consisted of 300 students from five selected secondary schools. Normative survey design was employed for the study and stratified sampling technique was used for sampling. The statistical tools used were Pearson's Product Moment, Correlation and t-test. The result from the analysis revealed that, there was a high correlation between learning style and academic achievement in biology and the relationship was significant. The result also showed that there was no significant difference between boys and girls in their learning style. Gender of biology students in another geographical zone of the world like in Benue state, Nigeria, West Africa will be introduced in the current study to make the study more encompassing and novel. Also, the interferences of gender on the relationship

between academic achievement and interest of different learning styles of biology students in secondary schools in Nigeria will be ascertained.

Rajshree (2013) investigated the learning style and academic achievement of secondary school students in Maharashtra State, India. This study was an analysis of learning styles prevalent among secondary school students; conducted three learning styles -Visual, Auditory and Kinesthetic (VAK). A sample of 200 students of classes 9th, 10th and 11th standard of Maharashtra State was selected for the study. These classes are the equivalent of JSS 3, S.S.1 and S.S II classes in Nigeria educational system. Findings of the study revealed that, kinesthetic learning style was found to be more prevalent than visual and auditory learning styles among secondary school students. There existed positive high correlation between kinesthetic learning style and academic achievement and the main effects of the three variables – visuals, auditory and kinesthetic were significant on academic achievement. The educational climate and cultural environment as well as norms and values of the societies in Nigeria and India are completely different and far apart. There is the need for the conduct of a similar study in Nigeria to discover the educational differences and similarities that exist in the correlation between students' achievements and interest based on their learning styles. Also, the influence of students' gender will not be overlooked in this study.

Esen (2007) worked with 265 tenth-grade students (SS I student in Nigeria educational system) enrolled in a chemistry course. Seven chemistry teachers also participated in the study titled: Learning style and High school students' chemistry achievement in Ankara, Turkey. Gracha-Riechmann students' learning style scale was

used to determine students' learning styles while the teaching style inventory was used to assess teachers' teaching style. Results showed that there was a statistically significant difference among students with different learning styles with respect to chemistry achievement. Students in facilitator/personal model/expert teaching style and delegator/facilitator/expert teaching style had better understanding of chemistry concepts but there was no statistically significant effect of matching between students' learning style and teachers' teaching styles on students' chemistry achievement. The effect of students' learning styles on chemistry (and other sciences), academic achievement still needed to be investigated in Nigeria. Turkey and Nigeria are two countries that are in many ways different from each other. It will be of great academic interest to see how learning styles influence the relationship between academic achievement and interest of students in biology in Nigeria.

Lorna (2013) in a study conducted in AMA International University, Bahrain, which centered on the relationship between learning style and academic performances of students in India. The participants consisted of all the freshmen who were accepted during the first trimester of the academic year 2012 – 2013. Three research questions and three hypotheses tested at 0.05 level of significance guided the study. The results demonstrated that generally the students were fairly well balanced in all four dimensions presented in the Index of Learning Style (ILS) questionnaire. Results also showed that there was no significant effect of gender, age and academic achievement on the learning style of the students. Based on the result, there was no statistical significant correlation between the academic achievement and the learning style preferences of the students. Therefore, it will be of great research interest if a related

study of this nature captures the relationship between achievement and interest of students with different learning style in biology is conducted at the senior secondary school level in Nigeria.

The relationship between learning style and academic status of Babol University Dental students, Babol, Iran, was put under scrutiny by Nasiri, Gharekhai and Ghasempour (2016).While conducting this study. A survey research design was used and a cross sectional study was conducted on 88 dental students studying in their 4th, 5th and 6th years. Data was collected using the visual – auditory – reading/writing – kinesthetic (VARK) learning styles questionnaire. Five research questions were answered and four hypotheses at 0.05 level of significance were tested. The data collected were analyzed using the chi-square test and the t-test. Of the 88 participants who responded to the questionnaire, 87 preferred multimodal learning style. There was no significant difference between the mean of the final exam scores in students who did and did not prefer the auditory learning style ($P = 0.86$), the reading/writing learning style ($P = 0.20$), and the Kinesthetic learning style ($P = 0.32$). There was no significant difference between the scores on the final clinical course among the students who had different learning styles. However, there was a significant difference between the mean of the final examination scores in students with and without visual learning style preference ($P = 0.03$), with the former having higher mean scores. There was no significant relationship between preferred learning styles and gender ($P > 0.05$). The majority of dental students preferred multi-modal learning styles and there was a significant difference between the mean of the final examination scores for students with and without the visual learning style. In addition, there were no

differences in the preferred learning styles between male and female students. Further and related studies of this nature could be conducted in secondary school level and in addition to achievement, interest of students could also be considered as one of the dependent variable with students' gender being considered as moderating variable in Benue State, Nigeria.

Turky (2015) carried out a research on the relationship between the learning style of medical students and academic achievement. A descriptive survey design was used when conducting the study among 600 medical students from October, 2012 to July, 2013. Four research questions were formulated and answered, while four hypotheses were tested at 0.05 level of significance to guide the study to a logical conclusion. The visual, aural, read/write and kinesthetic questionnaire (VARK) questionnaire was used to categorize learning style preferences. Descriptive and analytical statistics were used to identify the learning style of medical students and their relationship to academic achievement, gender, marital status, residency, different teaching curricula, and study resources. The results indicated that 261 students (43%) preferred to learn using all VARK modalities. There was a significant difference in learning style between gender ($P = 0.028$). The learning styles are not related to students' academic achievement, marital status, residency, or study resources. The current study is related to the work under review and will establish the correlation that exists between achievement and interest of biology students with different learning styles. The present study will be conducted in a different geographical zone of the world, the Sub-Saharan West African country, Nigeria. It will be of great research interest seeing findings and discoveries unfolding in the Nigeria context.

Matilde (2008) investigated the relationship between learning style and race, ethnicity and grades among minority students in a south Florida College biology classes, United State of America. A combination of student of 162 white Black-African American, Aispanic and Asian college students took part in the study. Descriptive survey research design was used in the study. Three research questions and 3 hypotheses guided the study and analysis of variance (ANOVA)and chi-square were used to analyse the data collected. Analysis revealed that students preferred sensing, Visual and sequential learning. Analysis of Co-variance (ANOVA).Analysis also showed that there is no significant differences between learning style preference and achievement, or between race – ethnicity, ethnicity and grades. Chi square analysis revealed that a significant relationship between Black – African students had the lowest passing rate in Biology courses, with Asians having the highest. It was recommended that increased educator and advisor knowledge of learning styles could result in social change and educational reform from. The study under review considered races and ethnicity among the variables and the relationship learning styles of students has on them. However, the current study is investigating the relationship between achievement and interest of Secondary School Biology students with different learning style without considering the races or ethnic background of the students. Therefore, it will be intriguing when the relationship between interest and achievement of different students learning styles is investigated and critically analysed in Nigeria context.

Thakka (2014) investigated the relationship between different learning styles and learning achievements of students studying at secondary school in western

Ahmedabad, India. Information about students learning styles were collected by using learning style questionnaire. Secondly, information about students' achievement was taken from the test conducted. The population of the study was students studying in class 9th (equivalent of J.S.S 3 classes in Nigeria) of 10 different schools of Ahmedabad. One thousand five hundred and eighty students were drawn by using multistage sampling technique. A survey research design was adopted, two research questions were answered and 2 hypotheses were tested at 0.05 level of significant. It was found that students did not preferred to study at their own, this means that the classroom activities were of no use to the students. This particular study had learning styles and achievements as variables; and 9th class which is the equivalent of J.S.S 3 classes in Nigeria as respondents; without a known theoretical base. This current study was anchored on Flemings learning style theory (1987), using S S 2 biology students as population from where sample was drawn from. Nigeria is a country in West Africa with different climate, culture and educational structures from that of India. The current research work will fill in the existing gap that is in the reviewed study with the introduction of interest as one of its variables.

Miaojie and Xianmin (2016) in their study examined the interaction effects of learning styles and interest on the learning concentration and academic achievement of students who were asked to learn conceptual knowledge via their mobile phones in a classroom. A total of 92 Chinese College students major in education participated in this study. The researcher adopted descriptive research design with the application of correlation analysis, regression analysis and analysis of variance (i.e one, two and three way), four main findings were obtained: (a) interest is significantly correlated

with concentration. (b) learning styles have no significant effect both on concentration an achievement, (c) learning styles and interest do not yield interaction effect on the learning concentration of students, but interest alone significantly affect the latter and (d) learning style, interest and concentration do not yield interaction effect on the academic achievement of students. Over all, these findings imply that low interest always leads to lower learning concentration. The study under review and the current study of research have their basis in learning styles of students, and also, in interest and achievement which are dependent variables in both studies.

However, the current study targeted students in a conventional classroom setting, with teacher – students interaction that is based on teaching and learning of 'ecology' a topic in biology in senior secondary school two (SSII) in Benue State, Nigeria. The study under review studied students in a non-conventional setting in China. The interaction effect of learning styles and interest on the academic achievement of students with the introduction of gender will be intriguing and interesting in Nigeria context.

Bhagat, Vyas and Singh 2015 conducted a study titled "students awareness of learning styles and their perception to a mixed approach for learning" was conducted among 1st year medical undergraduate students of Government College and Hospital, Chandigarh, India. Fifty students (34 females and 16 male) participated in the study. Quasi – experimental research design was used I this study. Neil Flemings Learning Style Inventory questionnaire was administered to the students to determine their learning styles. The questionnaire had three sections. Section 1 was for collecting demographic data, section 2 was for pre – and post – type assessment and section 3 of

the questionnaire was administered at the end of the study to determine the strength/challenge faced during the intervention. Four research questions were answered and 3 hypotheses were tested at 0.05 level of significant.

Quantitative data were analyzed using a grounded theory approach with constant comparative analysis. Mean VARK (Visual, Auditory, read/write, Kinesthetic) questionnaire scores before and after 3 months were revealed and the comparison of the pre – and post intervention VARK scores was done using Wilcoxin signed ranks test. It was revealed from this study that there was a significant increase in the number of students who were aware of learning style. The number of participants showing a change in VARK scores for various modalities of learning was also significant. The study under review and this current study shared a common ground in the identification and categorization of learning styles of students and how students perceived and approved their choice of learning styles for their learning. On the other hand, these two studies are contrasting on the basis of the geographical location where these studies were carried out.

Another study by Jafre, Abbas, Abidina and Singh (2011) is an investigation of the relationship between learning styles and overall academic achievement of upper secondary school students in an Islamic school in Malaysia.. A total of 317 students participated in this survey study, the learning styles survey (LSS) instrument which is based on Joy Reid's Perceptual Learning Style Preference Questionnaire (1987) was used. The statistical procedures employed in this study were one – way ANOVA and multiple regression analysis. The analysis of the data indicated a significant relationship between overall academic achievement and learning styles. It was also

found that the high, moderate and low achievers a similar preference pattern of learning in all learning styles.

Learning styles is the independent variable in the studies under review and the current research. Both studies are investigative in nature showing the relationship between students' learning styles and achievement in senior secondary schools. The current study is trying to fill the existing gap in the reviewed study with the introduction of interest, and gender as additional variables in biology class. In addition to this, the current study was anchored on Neil Fleming's learning style theory (1987) in a different geographical area of the world in Benue State Nigeria, West Africa.

Manurung (2013) conducted a research titled "students' learning style and academic achievement at one state University in Jambi, Indonesia". This study was conducted to analyze the correlation of students' learning style and academic achievement in English. In other to investigate the correlation between learning style and academic achievement, 65 students participated in this study and the investigation was done through the quantitative research design. Four research questions were answered and three hypotheses tested at 0.05 level of significant guided the study. The learning style survey (LSS) instrument which was based on Joy Reid's Perceptual Learning Style Preference Questionnaire was used to investigate the major, minor and negligible students' learning style. Demographic Questionnaire was used to know the students' personal characteristics such as age, gender and academic achievement. Pearson Product Moment Correlation was used to correlate learning style and grade point average, which is the index of students' achievement.

After the analysis, it was revealed that the Kinesthetic learning style was the major learning style, while Visual, Auditory, Tactile; individual and group learning styles were revealed as minor learning style.

Like other reviewed studies, learning styles is the determinant and independent variable in this particular study under review. Learning style of students formed the basis upon which these studies were built. The theories which focused on the physiological aspect of man like Visual, Auditory and Tactile/Kinesthetic were used in both studies.

However, gap exists in the reviewed study which needs to be filled in the current study. The introduction of interest as an additional dependent variable and gender as another variable will be novel in another part of the world.

Sophra, Ali, and Mohammed (2013) investigated the relationship between learning style and the academic performance of students who attended an English class to learn English as a second language in secondary schools in Iran. A randomly selected group of 488 high school students (248 male and 240 female) participated in this study. The descriptive survey design was formed suitable for this study.

Two instruments were used to collect information, Kolb's learning style inventory was used to identify four basic learning types: accommodating, diverging, assimilating and converging. Achievement test in English Language was also used to evaluate the academic performance of students in English Language. The researcher answered 4 research questions and tested 4 hypotheses at 0.05 level of significant. The survey results indicated significant relationship between the different learning styles and students' performance in an English test, and the performance resulted differently

in four groups with different preferred learning styles. The results also indicated gender differences in the performance in English test for convergent and divergent learners and did not for students who preferred accommodating and assimilating learning styles. The results of the study led to the conclusion that learning styles can be considered as a good predicator of any second language academic performance.

Learning styles, in the study under review and in the current study is considered apparently as students' interest enhance, provided the learners' learning need are adhered to and considered during teaching – learning process. Also, learners' achievement and gender are variables in both studies.

However, interest was introduced in the current study to really ascertain the learners level of interest under different categories of learning styles as categorized by Fleming learning style theory (1987). In addition to this, the relationship between interest and achievement under each learning styles in Nigeria, West Africa will be unraveled, thereby filling the gaps that are existing in the reviewed study.

Audu (2018) investigated the influence of teaching styles on students' achievement and interest in Biology in secondary schools in Taraba State, the study was guided by two research question and two hypotheses. The study adopted the survey and quasi experimental designs. A sample of 336 senior secondary two students from 10 secondary schools was drawn using stratified sampling techniques. The instruments 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 styles were identified either as students centered or teacher centered using teaching style check list. The data

collected were analyzed using mean, and standard deviation to answer the two research question while analysis of covariance (ANCOVA) was used in teaching the two hypotheses at 0.05 level of significance. The finding indicated that there was a significant difference in the mean achievement scores of students taught Biology using students' centered teaching styles and those taught using the teacher-centered teaching styles. The students that were taught using students – centered teaching style achieved higher than their counterparts that were taught with teacher –centered teaching style. The study under review studied the influence of teaching styles on students' Achievement and Interest, while the current study looked at the categorization of students' learning styles and the relationship it has on Achievement and Interest of students. The studies are however related because interest and achievement are common variables in the two studies.

A study by Shaw (2012) focused on the relationship among learning styles, participation types, and learning performance for programming-learning supported by an online forum using survey research design. Kolb's learning style inventory was used in the study to determine a learner's learning type: Diverger, Assimilator, Converger and Accommodator. A total of 144 Bulgarian students participated in this experiment as part of a half semester programming language learning courses. In this study, learning score and satisfaction were used to measure learning performance. Two research questions were answered and 3 hypotheses tested at 0.05 level of significance guided the study. The results of the study among others shows that: different learning styles were associated with significantly different learning scores and that the 'Accommodator' style was associated with superior learning scores and

that there is no significant association between learning styles and participation types. This study was conducted in Bulgaria, an European country, where distance and mobile learning have been developed over the years and it is part of their educational system which made learning easier and accessible to the citizens. In Africa, a lot still need to be done to measure up to the European level of educational system. In the current study, a conventional classroom setting with biology students with the theoretical concepts of Fleming's learning style theory was looked into and the correlation between interest and achievement of different learning styles was investigated.

The aim of a study by Stephney, Reidar, David, Christopher, Samara, and Mark (2014) was to measure the learning style preferences of chiropractic students and to assess whether they differ across 5 years of chiropractic study. Chiropractic practice is a method of treating people who are sick or in pain by pushing and moving bones in the spine and joint.

A total of 407 undergraduate students enrolled in an Australian chiropractic programme agreed to participate in a cross – sectional survey, and the Visual, Aural, Read/Write, Kinesthetic (VARK) questionnaire which identifies a four different subscales: Visual, Aural, reading/writing and kinesthetic were administered to the students while 4 research questions and 4 hypotheses were used to guide the study. Multivariate analysis of Variance and t – test were used to check for differences in continuous (VARK Scores) and categorical (VARK Category preference) outcome variables.

The results of the study shows that the majority of chiropractic students were found to be multimodal learners, compared to the other learning styles preference. Kinesthetic learning, was preferred by a significantly greater proportion of students. This study under review shared a common ground with the current study in ascertaining the predominant learning style among students by using Fleming's learning style theory. Considering the geographical part of the world where the reviewed study was carried out and the types of students involved in this study, a lot still needs to be desired and gap needed to be filled in the current study.

In addition to this, the researcher in the present study introduced interest and achievement scores of senior secondary school biology students to see how these correlates with each other under students' learning style categories and how this contributes to classroom teaching – learning process.

Bethel – Eke and Eremie (2017) investigated learning style and academic performance of junior secondary school students in River State Nigeria with implication for counselling. The correlational research design was adopted for the study. The population of the study was 2,554 respondents while the Taro Yamane formula was used to obtained a sample size of 345 respondents. Three research questions and three null hypotheses guided the study, mean was used to answer the research questions while the inferential statistics of Pearson Product Moment Correlation was used as the tool in testing the formulated hypotheses at 0.05 level of significance. The result of the statistical analysis showed that a significant relationship exist between visual learning styles and academic performance of students. Auditory

learning style and kinesthetic learning style were also found to have significant relationship with academic performance of students.

The current study and the one under review anchored their work on Neil Fleming's theory of learning styles and both studies seek the relationship that exist between achievement and learning styles of students. Both studies took place in secondary schools in Nigeria, although the later took place in senior secondary school while the former in junior secondary in Benue and River states respectively. In the current study, the relationship between interest and achievement of senior secondary Biology students with different learning style will be examined to show how students' learning category influences overall academic output. The introduction of interest, and gender accounts for the missing gap that existed in the reviewed work.

The innovation in learning style of students in different secondary schools in the city of Ghaen, Iran was investigated in this study. The main aim of this study by Masume, Mohammed and Afsanegh (2016) is to identify the differences of learning styles of individuals in different academic majors and the rate of creativity of individuals in each learning style. Descriptive correlational research design was employed in this study. The statistical sample consisted of 115 girls and 117 boys selected by classified sampling. Kolb's learning style inventory was used to collect the required data. To analyze the data obtained by chi-square tests, one – way analysis of variance, Pearson Covariance and step wise regression were employed. The result show that there is a meaningful difference between the creativity of the students with diverging (Auditory) and assimilator (Visual) learning styles. The study also revealed

that learning styles of students of differential secondary school branches are also different.

The categories of learning styles as revealed in the study under review are also one of the main objectives of the current study. The categories of learning styles discovered in both studies are related by their characteristics under different learning style theories of Kolb's (1984) and Fleming's (1987). The different learning styles and their categorization varies from one environment to another and it could be influenced by a lot of factors such as age, moral stand point culture, teachers teaching method or strategies and gender. In the present study, the relationship between interest and academic achievement of biology students will be looked into, their gender are also put into consideration to see which of the learning styles is synonymous or are attributable to a particular gender.

Jayanama (2012) in another study examined the learning style of low and high proficiency students studying Foundation English at Srinakharinwirst University, Thailand. This research carried out a study of the relationship between learning styles and academic achievement of low and high proficiency students compared the learning styles between groups and investigated the relationship between learning style and demographic variables. A total of 425 students participated in this study and the study employed a mixed method of research design which was both quantitative and qualitative. The Perceptual Learning Style Questionnaire was used to investigate the learning style of students. One research questions were answered and 3 Null hypotheses were tested at 0.05 level of significance. Mean, percentages, pearson

product moment correlation co-efficient and t – test were the statistical analysis tools used in analyzing the data collected.

The results showed that both low and high proficiency students had four major learning styles which included auditory, group, kinesthetic and visual. For low proficiency students, a significant relationship was found between Visual learning style and academic achievement and for high proficiency students, a significant relationship was found between tactile learning style and academic achievement. There was a significant relationship between tactile learning style and gender as well as Kinesthetic learning style and gender for low proficiency students.

The current research work took its principle of learning style from Fleming's learning style theory (1987) where learning styles are categorized into Visual, Auditory and Kinesthetic learners. Similarly, the study under review used the same theoretical background as its base. In addition to this, the relationship between learning style and achievement was also carried out in both studies.

However, the current study will be carried out in another geographical location of the world which is Nigeria, West Africa. Also, interest will be introduced as one of the variables in the current study, this is to unravel the relationship between interest and achievement of students with different learning styles in senior secondary schools biology in Benue State, Nigeria.

2.5   Summary

The review of literature shows that there are several learning style theories and models that aim to account for differences in individuals learning. These theories

proposed that all people can be classified according to their style of learning. Although the various theories and models present differing views on how the styles should be defined and categorized, a common thread is that individuals differ in how they learn. Fleming's VAK theory of learning categorized students' learning style into three groups, Visual Learners (V), Auditory Learners (A) and Kinesthetic or Tactile (K). Kolb's Experiential Learning Theory proposed a four stage learning cycle, where learners are classified into four categories; Accommodator, Diverger, Assimilator and Converger: Honey and Mumford's Theory of learning styles was built on Kolb's theory to establish four learning styles; Activist, Reflector, Theorist and Pragmatist while Dunn and Dunn's learning style theory identified five key dimensions on which students' learning style differed: Environmental, Emotional support, Sociological composition, Physiological and Psychological elements.

Different concepts of learning style were reviewed ranging from the perspectives of students' processing, comprehending, retaining, recall of information, regulation of strategies, mental modes of learning, students' characteristics cognitive, affective, social and physiological behaviour and how students perceive, interact and respond to the learning environment. Also, learning styles concepts are also viewed on physiological ground of human sensory programming which summarizes learning style in a visual graphical way, students' hand-on-activities, providing students with feedback among other things. Achievement may be described as the realization and attainment of specific aims, goals and objectives by making effort for a long time, while interest on the other hand is the factor within an individual which attract him to or repel him from various objects, persons and or activities within the environment.

The review shows that some researches have been carried out in the area of learning styles and academic achievement of students in secondary schools and institutions of higher learning in some regions of the world and the correlation that exist in between them revealed. Review of related previous empirical studies around the world shows that there is a strong and positive relationship between learning styles and academic achievement of students. Also, there was a statistically significant difference among students with different learning styles as regards to achievement in secondary schools. There was no significant difference in learning style preference among male and female students and also among high and low ability groups in schools. A few researches had been conducted on the relationship between learning styles and academic achievement and interest of students in Europe, Asia, America, and Australia and very scanty in East Africa. Also, most of the researches conducted were on learning styles theories different from Fleming's VAK learning style theory. Therefore, a lot still needs to be done by conducting related studies where the interest in biology need to be captured as well, among Senior Secondary School students in Nigeria, West Africa. In addition to this, gender influence was explored and used as variables to see how it affect the relationship between interest and achievement of biology students with different learning styles particularly among the Senior Secondary School students in Benue State, Northern Nigeria.

CHAPTER THREE

RESEARCH METHOD

3.1 Introduction

In this chapter, the research design, area of study, population, sample and sampling and instrumentation, are discussed. Validation and reliability of instruments are also explained as well as the method of data collection, experimental procedure and method of data analysis.

3.2 Research Design

Correlational survey research design was employed in this study. Correlational survey studies typically employ questionnaire, observation and interview to elicit information and to determine the options, preferences, attitudes and perceptions of people about issues (Emaikwu, 2006). The correlational survey research design was considered appropriate for this study because information elicited from students was through the administration of questionnaires without any treatment given to the students in their natural setting.

3.3 Area of Study

According to Wikipedia (2018), Benue State is one of the middle belt states in the north central region of Nigeria with a population of about 4,253, 641 in 2006 census. It is inhabited predominantly by the Tiv, Idoma and Igede people, who speak Tiv, Idoma and Igede languages respectively. There are other ethnic groups, including the Etulo, Abakwa, Jukun, Hausa, Igbo, Igala people, Akweya and Nyifon. With its

capital at Makurdi, Benue is a rich agricultural region; popularly grown crops includes potatoes, cassava, soya bean, guinea corn, flax, yams, sesame, rice and groundnuts, palm tree.

Furthermore, Benue State is named after the Benue River and was formed from the former Benue – Plateau State in 1976 along with Igala and some part of Kwara State. The state has 23 local governments spread across 3 educational zones A, B and C. Zone A is made up of seven local government areas which are Katsina –Ala, Kwande, Logo, Ukum, Ushongo and Vandeikya. Zone B consists of Buruku, Gboko, Guma, Gwer East, Gwer West, Tarka and Makurdi local government areas while Zone C has Ado, Agatu, Apa, Obi, Ogbadibo, Ohimini, Okpokwu, Oju and Otukpo local government areas. Additionally, Benue State has 3 Universities; Federal University of Agriculture, Makurdi, Benue State University, Makurdi, and University of Mkar, Mkar Gboko. It has two polytechnics: Benue State Polytechnic Ugbokolo and Fidei Polytechnic, Gboko as well as the Akperan Orshi College of Agriculture, Yandev. There are about two Colleges of Education which are College of Education Oju, and College of Education, Katsina – Ala. Benue State as it exists today is a surviving legacy of an administrative entity which was carved out of the protectorate of northern Nigeria at the beginning of the 20th century. The territory was initially known as "Munshi" province until 1918 when the name of its dominant geographical feature, the "Benue River" was adopted.

Recent studies in Benue State affirmed that the interest and academic achievement of biology students about a decade has been poor and not impressive in public examinations such as West African School Certificate Examination. Such

studies include; Ityokaa & Adejoh (2014): Evaluation of the implementation of biology programme in secondary schools in Benue State of Nigeria, Taiwo, (2008): An empirical study of the use of instructional materials in biology curriculum implementation in Benue State. Also, Idoko, Anyebe, Ngwu and Iwebo (2018); Evaluation of factors affecting learning in secondary school in Otukpo Local Government Area of Benue State, Nigeria, Sharehu, Achor and Onah (2015); Drug use and Anti – Social Behaviour as correlates of secondary school students' achievement in biology in Makurdi Local Government Area of Benue State, buttressed the non-impressive interest and achievement of students in biology in Benue State.

3.4   Population

The population for this study comprises of all the Senior Secondary School Two   (SS II) students numbering 15,361 which comprises of 8,630 males and 6,731 females in all the 310 secondary schools in Benue State (Benue State Teaching Service Board, 2017).

3.5   Sample and Sampling

Multi-stage sampling technique was used to select the Senior Secondary Schools Two (SS II) students. A sample of 1,570 students (859 males and 711 females) from 36 secondary schools were used for this study. Emaikwu (2015), asserted that each element of the population in a survey study has equal and independent chance of being included through purposive sampling. This is the selection process that not only

gives each element in the population an equal chance of being included in the sample but also makes the selection of every possible combination of the desired number of cases equal. The purposive nature of this sampling method was based on specific elements which satisfied some predetermined criteria by the researcher. The researcher exercised his judgment in relation to what was needed for the research purposes; fresh or very recent classroom teaching of Ecology, a topic in Senior School II (SS II) biology curriculum by the biology teacher was needed by the researcher for a school to be selected and included as part of the sample for this study.

In addition, stratified and purposive sampling techniques were used to select the school sample for the study. Stratified sampling technique was adopted to select the schools to be used based on the education zonal levels in the state. The purposive sampling technique was used to select the schools base on whether the school is co-educational or single sex school. out of the total 15,361 secondary schools in the state, 75 schools are single sex schools while the remaining 15,286 are co-educational or mixed schools. (Benue State Teaching Service Board, 2017). Therefore only co-educational secondary schools across the 3 education zones were considered and by using purposive sampling technique, 36 secondary schools were selected as sampled schools used in this study. The number of secondary schools in each education zone was considered based on the information from Teaching Service Board (2017), education zone A has 114, (37.5%) schools, zone B, 88 (28.9%), zone C, 102 (33.6%). Based on these percentages, 14, 10 and 12 schools represented education zones A, B and C respectively as samples for the study. Secondly, purposive sampling technique was used at this stage and single sexed schools were not considered in the sampling

process. Only co-education or mixed schools were considered and this was applied to each of the education zones, a total number of 36 schools were selected. Appendix U (page 176)shows the list of Secondary Schools used in this research work.

3.6 Instrumentation

Three instruments were used to collect data. They are:

a. Barsch Learning Style Inventory (BLSI).

b. Biology Achievement Test (BAT).

c. Biology Interest Questionnaire (BIQ).

a) The Barsch Learning Style Inventory (BLSI)

The BLSI is an adaptation of Fleming's VAK learning style model created by Jeffrey Barsch in 1982. This inventory was adapted by the researcher by introducing gender of the respondents. Also, the responses after each of the statements were replaced with clearer and meaningful words, which the respondents will comprehend more easily without stress. The word "often" was replaced with "usually", while "seldom" was also replaced with "Not usually", but the word "sometimes" remained unchanged.

In the original Barsch Learning Style Inventory (BLSI) created by Jeffrey Barsch, there are 24 items as seen in appendix R (page 174). Some of these statements were further splitted due to their double barrel nature. Examples of these is seen in items 5 and 7. In addition to these, some of the complicated and ambiguous words and statements were modified, for easy and quick understanding by the respondents.

Example of these is seen in items 4, 6, 8 and 17, where words, phrases and sentences like "bear down extremely hard", "tools", "I can tell of sound match when presented with pair of sounds" and "finger spelling the words" were replaced with "press very hard", "instruments", "I can tell if a pair of sound match" and "using my fingers" respectively. In items 15, the word, smoke was removed; this is aimed not to encourage the target respondents, who are teenagers from smoking. Also, items 14 was removed because the same was repeated in statements 21. As a result of all these adaptations, and modifications, the number of items in this inventory increased from 24 to 30.

This inventory is a self- reporting instrument that provides the secondary school students with an indication of the relative strengths and weaknesses in learning through different sensory channels – Auditory, Visual, and Kinesthetic. There are 30 statements, each of which has been assigned scores: 3 points for usually, 2 points for sometimes and 1 point for not usually. The students read the description statements and thereafter, the point values were placed on the line next to its corresponding item number and the points were added to obtain the preference scores under each heading. Statements 2, 3, 7, 8, 11, 16, 20, 22, 27, and 29 are visual, statements 1,5,9,12,14,18,21,25,28 and 30 are Auditory, while statements 4, 6, 19, 13, 15, 1, 19, 23, 24 and 26 are Kinesthetic. Scoring procedure is clearly explained in Appendix D.

b) Biology Achievement Test (BAT)

The Biology Achievement Test is a 25-item multiple choice objective question on Ecology which had been newly taught in SS II biology classes as at the time of administering the questionnaire. The BAT was administered to the students for them

to answer by ticking the correct options from the available options provided after each question (options A – D).The achievement test was scored out of 100. The biology achievement mean score of students was computed and converted to be at the same level with the mean interest rating for easy statistical analysis. The Biology Achievement Test questions were developed by the researcher on the topic of ecology such as basic ecological concepts, components of an ecosystem, local biotic communities, ecological factors, relationship between soil types and simple measurement of ecological factors.

c) Biology Interest Questionnaire (BIQ)

The Biology Interest Questionnaire (BIQ) is an adapted 5-point 26-item Likert scale type questionnaire consisting of students' opinions and feelings towards biology. The 26 items that were used in this interest questionnaire were considered appropriate because they covered a wide range of areas of students' interest, like and dislike in biology to quantify the responses. From the Biology Interest Questionnaire, the following ratings; Strongly Agree = 5 points, Agree = 4 points, Not sure = 3 points, Disagree = 2 points and strongly Disagree = 1 point were assigned.

The original instrument as seen in appendix W (page 181) was designed by Russel and Hollander (1975). This instrument was adapted to suit the needs of the researcher in this study. The Biology Interest Questionnaire (BIQ) as seen in appendix W has been used in related studies e.g the survey of Senior Secondary School biology student interaction pattern and relationship with interest and achievement in biology in Makurdi metropolis (Mathew, 2014), the Relationship between students interest and achievement in biology in Kaduna metropolis. (Ahmed, 2010). It contains sub

heading such as class and age which were expunged from the modified version used for the study. This is because the class of students under focus for this study had already been stipulated earlier in this work. Statement 2 was reconstructed to make it to be more direct and appropriate and not confusing to the students. Items 3, 5, 6, 20, 21 and 23 in the original questionnaire were double barreled so the statements were separated and some modified to make them to be more efficient and meaningful. Some of the statements that were not personalised in the original Biology Interest Questionnaire were personalised by the use of words like 'My' and 'I'. The usage of these personal pronouns make the statements to be more meaningful and make the students have attachment and a sense of belonging as part of the process, while reading and filling the questionnaire. These examples are seen in items 1, 15, 16, 21, 22, 23, 24. At the end of the modification of the adopted instrument, a total number of 26 items with 13 negative and 13 positive statements were arrived at for use as Biology Interest Questionnaire in this study. Statements 1,2,7, 8, 11, 16, 17, 19, 20, 22, 23, 25 and 26 are positive statements while statements 3, 4, 5, 6, 9, 10, 12, 13, 14, 15, 18, 21 and 24 are negative statements.

3.6.1 Validation of Instruments

The Barsch Learning Style Inventory (BLSI), Biology Achievement Test (BAT) and Biology Interest Questionnaire (BIQ) were given to 3 professionals and experts in science education and measurement and evaluation of Benue State University, Makurdi not below the rank of Associate Professor for criticisms, modifications and suggestions in order to ensure face and content validity of the instruments. The

criticisms, modifications and suggestions made by the validators on each of the instruments were as follows:

Barsch Learning Style Inventory (BLSI)

There should be a brief introduction or information to the respondents on the issue immediately after the headings of the instruments. A sub-heading reading "students' name" was strucked out for upholding the confidentiality of the students that are respondents to the study. Also, the caption "class" on the instrument was also strucked out to avoid repetition of the class of respondents which had already been mentioned in the body of the work and should be replaced with "sex". The use of personal pronoun "I" should be introduced at the start of each description statements to make them personal to the respondents. The word 'direction' in description statement 2 was changed to "instruction" and the word "my" was inserted on description statement 13 to make the statement more meaningful.

Furthermore, the word 'head' in statement 16 was modified to "mind" to make the statement more meaningful. Similarly, the phrase "see it" was modified to become "to read about it". The description statement number 30 was modified because it carried two ideas. It was therefore modified and recommended to carry only one idea for better understanding of the students' respondents. At the end of the criticisms, suggestions and modification, the 24 items that were initially presented to the validators increased to 30 descriptive items.

Biology Achievement Test (BAT)

It was suggested that introductions about the study should be given at the beginning of section A. "Students' name" was strucked out and replaced with "sex" as in other instruments. Questions 2 and 18 were similar due to an error on the part of the researcher, questions 2 were however changed to "The living component of an ecosystem is (a) Abiotic (b) Biotic (c) Synecology (d) Autecology". In a real sense of it, the word "biotic" and "living" are actually the same. It was also suggested that multiple choice objective questions 19 should be recasted as "An ecosystem consists of (a) Non-living material, (b) consumer (c) producers, consumers (d) producers, consumers and decomposers".

A total number of twenty five items were initially presented to the validators, and after the validation process the same 25 items were returned for use as the Biology Achievement Test.

Biology Interest Questionnaire (BIQ)

The third instrument that was used for the collection of data was the Biology Interest Questionnaire (BIQ). The following criticisms, suggestions and modifications were made: "Students name" was expunged from the introductory part of the instrument and was replaced with "sex". Statement number 2 was modified and recasted to make it meaningful, many field of specialization that were stated were also modified to biology related courses. Some of the statements were personalized with the introduction of the word "my", these statements are; statement 16, 17, 19, and 20.

The researchers will like to state here that the validation of the three instruments used for this study was a collaborative effort between the validation and

the supervisors. Twenty five statements were initially presented to the validators, but at the end of the validation procedure, 26 statements were arrived at. The 26 statements consist of 13 positive and 13 negative statements. After the validation, modifications and changes were made on the instruments as recommended.

3.6.2 Reliability

The validated instruments were subjected to a trial testing: The study was conducted with 175 students from 6 secondary schools in Ushongo, Makurdi and Otukpo Local Government Areas of Benue State, which represents senatorial zones A, B and C respectively. These six secondary schools were not included in the final sample of schools used in this research. At the end of the trial testing, the internal consistency reliability Cronbach Alpha Co-efficients of adapted Barsch Learning Style Inventory (BLSI) was established to be 0.84, the reliability co-efficient of the Biology Achievement Test (BAT) was found to be 0.78 using Kuder Richardson KR 21while that of Biology Interest Questionnaire (BIQ) was Cronbach Alpha 0.75.All the instruments were therefore considered reliable.

The most suitable internal consistency reliability estimate is given by Cronbach Alpha ($\propto$). The co-efficient Cronbach alpha is an internal consistency index designed for use with test containing items. This is a very useful tool in educational research where the researcher asks respondents to rate the degree to which they agree or disagree with a statement on a particular scale.

3.7   Method of Data Collection

3.7.1 Training of Research Assistants

Six research assistants were trained on the method and procedure of data collection so as to assist the researcher. The six research assistants were made up of three teacher colleagues of the researcher at Air Force Secondary school Makurdi and 3 members of the National Youth Service Corps serving in the same school who are all trained teachers and holders of Bachelor's degree certificate in Education from various universities in Nigeria. A one day training session was organized for the research assistants by the researcher. The research assistants were acquainted with how to douse the tension that is always surrounding the filling and responses to questionnaires by the respondents and also learnt how to gain the confidence and trust of the respondents. The confidence and trust that students' responses to the questionnaire would have nothing to do with their school progress and evaluation report but purely for research purposes. After this, the researcher explained how to guide the respondents to fill the introductory part of the questionnaires appropriately. Such sections include, Name of school, sex and serial number. There were also practical training on how to guide the respondents to answer and fill the instruments and to tick appropriately where applicable. Lastly, the sorting, enveloping and packaging of the already filled instruments were explained and shown to the trainees. The process of data collection lasted for about 2 months.

3.7.2 Data Collection

The researcher and his assistants gave detailed instructions to the students on how to answer and fill the questionnaires while the students were allowed to ask questions on any sections they were in doubt. The respondents were also assured that the result of the study would be applied to research work only and their responses would have nothing to do with teachers' evaluation of them in the classroom or in the school.

The adapted Barsch Learning Style Inventory (BLSI) was administered to the biology students to fill under the guidance of the researcher or the research assistants. This enabled the researcher to identify students' learning styles. After this, the Biology Achievement Test (BAT) and the Biology Interest Questionnaire (BIQ) were administered to the students one after the other to elicit information on their achievement and interest in Biology.

3.8   Method of Data Analysis

Data analysis was done by using frequencies and percentages to answer the research question while Pearson's Product Moment Correlation Coefficient were used to test the hypotheses at 0.05 level of significance. Frequencies and percentages were used to answer the Research Question while Pearson's Product Moment Correlation Co-efficient was used to answer hypotheses 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13.

CHAPTER FOUR

4.1   Introduction

This chapter deals with data presentation, analysis, interpretation and discussion of findings.

4.2   Data Presentation, Analysis and Interpretation

The data analysis and findings on the relationship between achievement and interest of Senior Secondary School biology students with different learning styles in Benue State are presented here. The presentation of the results is in order of twelve research questions and eleven hypotheses.

4.2.1 Research Question 1

What are the learning styles among biology students in secondary schools?

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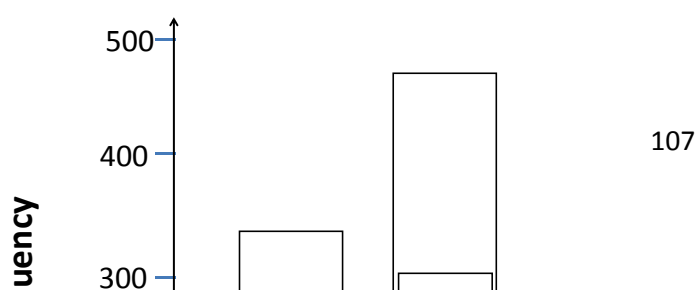
Figure 2: Graphical Representation Showing Details of Students Learning Styles by Frequency.

Fig. 2 shows that most students 474 (30.2%) prefer Auditory learning style, 339 students (21.6%) are of Visual learning style while only 110 students (7%) are of Kinesthetic learning style. The predominant major learning style among the students is Auditory. It is also noticeable that students show a variety and combination of learning styles (Multimodal Learning Styles) for example, 298 students (19%) of the sample are of Visual /Auditory Learning Style, 56 students (3.6%) are of Visual/Kinesthetic learning style while 109 and 184 students (6.9% and 11.7%) are of Auditory/Kinesthetic and Visual/Auditory/Kinesthetic learning styles respectively. This indicates that the Visual/Auditory is predominant among other learning style

combinations among the students Appendix T, page 152 also shows details of learning styles distribution among the sampled students.

4.2.2 Hypothesis 1

There is no significant relationship between mean interest rating and mean achievement scores of biology students with Visual learning styles.

Table 1: Relationship Between Mean Interest Rating And Mean Achievement Scores of Biology Students With Visual Learning Styles.

		Visual BAT	Visual BIQ
Visual BAT	Pearson Correlation	1	0.30
	Sig. (2 tailed)		.000
	N.	339	339
Visual BIQ	Pearson Correlation	0.30	1
	Sig. (2 tailed)	.000	
	N.	339	339

Table 1 shows that value of r = 0.30, n = 339 and p (0.000) < 0.05, this implies that there is a significant but low positive relationship between mean interest rating and mean achievement scores of biology students with Visual learning styles. The null hypothesis which stated that there is no significant relationship between mean interest rating and mean achievement scores of biology students with Visual learning styles is thus rejected.

4.2.3 Hypothesis 2

There is no significant relationship between mean interest rating and mean achievement scores of biology students with Auditory learning styles.

Table 2: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Biology Students With Auditory Learning Styles.

		Auditory BAT	Auditory BIQ
Auditory BAT	Pearson Correlation	1	.44
	Sig. (2 tailed)		.000
	N.	474	474
Auditory BIQ	Pearson Correlation	.44	1
	Sig. (2 tailed)	.000	
	N.	474	474

Table 2 reveals the values of r = 0.44, N = 474 and p(0.000)<0.05, this means that there is a significant relationship between mean interest rating and mean achievement scores of biology students with Auditory learning styles. Therefore, the null hypothesis that there is no significant relationship between mean interest rating and mean achievement scores of biology students with Auditory learning styles is rejected.

4.2.4 Hypothesis 3

There is no significant relationship between mean interest rating and mean achievement scores of biology students with Kinesthetic learning styles.

Table 3: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Biology Students With Kinesthetic Learning Styles.

		Kinesthetic BAT	Kinesthetic BIQ
Kinesthetic BAT	Pearson Correlation	1	.004
	Sig. (2 tailed)		.963
	N.	110	110
Kinesthetic BIQ	Pearson Correlation	.004	1
	Sig. (2 tailed)	.963	
	N.	110	110

Table 3 shows the values of r = 0.004, N = 110 and p(0.963) > 0.05, this is an indication that there is no significant relationship between mean interest rating and mean achievement scores of biology students with Kinesthetic learning styles. The null hypothesis which states that there is no significant relationship between mean interest rating and mean achievement scores of biology students with Kinesthetic learning styles is hereby not rejected.

4.2.5 Hypothesis 4

There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Visual learning styles.

Table 4: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Male Biology Students With Visual Learning Styles.

		Male Visual BAT	Male Visual BIQ
Male Visual BAT	Pearson Correlation	1	.41
	Sig. (2 tailed)		.000
	N.	199	199
Male Visual BIQ	Pearson Correlation	.41	1
	Sig. (2 tailed)	.000	
	N.	199	199

In table 4, the value of r = 0.41, N = 199 and p(0.000) < 0.05, thus, there is a significant relationship between mean interest rating and mean achievement scores of male biology students with Visual learning styles. The null hypothesis that there is no significant relationship between mean interest rating and mean achievement scores of male biology students with visual learning styles is rejected.

4.2.6   Hypothesis 5

There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Visual learning styles.

Table 5: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Female Biology Students With Visual Learning Styles.

		Female Visual BAT	Female Visual BIQ
Female Visual BAT	Pearson Correlation	1	.10
	Sig. (2 tailed)		.220
	N.	140	140
Female Visual BIQ	Pearson Correlation	.10	1
	Sig. (2 tailed)	.220	
	N.	140	140

Table 5 shows clearly the values of $r = 0.10$, $N = 140$ and $p(0.220) > 0.05$, this indicates a non-significance of the relationship between mean interest rating and mean achievement scores of female biology students with Visual learning styles. Therefore, the null hypothesis of no significant relationship between mean interest rating and mean achievement scores of female biology students with Visual learning styles is not rejected.

4.2.7   Hypothesis 6

There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Auditory learning styles.

Table 6: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Male Biology Students With Auditory Learning Styles.

		Male Auditory BAT	Male Auditory BIQ
Male Auditory BAT	Pearson Correlation	1	.46
	Sig. (2 tailed)		.000
	N.	254	254
Male Auditory BIQ	Pearson Correlation	.46	1
	Sig. (2 tailed)	.000	
	N.	254	254

Table 6 reveals the values of r and N to be 0.46 and 254 respectively, and p (0.000) < 0.05 thus; there is a significant relationship between the mean interest rating and mean achievement scores of male biology students with Auditory learning styles. The null hypothesis that states that there is no significant relationship between the mean interest rating and mean achievement scores of male biology students with Auditory learning styles is rejected.

4.2.8   Hypothesis 7

There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Auditory learning styles.

Table 7: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Female Biology Students With Auditory Learning Styles.

			Female Auditory BAT	Female Auditory BIQ
Female BAT	Auditory	Pearson Correlation	1	.41
		Sig. (2 tailed)		.000
		N.	220	220
Female BIQ	Auditory	Pearson Correlation	.41	1
		Sig. (2 tailed)	.000	
		N.	220	220

In Table 7, the values of r = 0.41, N = 220 and p (0.000) < 0.05, this therefore means that there is a significant relationship between mean interest rating and mean achievement scores of female biology students with Auditory learning styles. This implies that the null hypothesis which states that there is no significant relationship between the mean interest rating and mean achievement scores of female biology students with Auditory learning styles is rejected.

4.2.9   Hypothesis 8

There is no significant relationship between mean interest rating and mean achievement scores of male biology students with Kinesthetic learning styles.

Table 8: Relationship Between Mean Interest Rating And Mean Achievement Scores Of Male Biology Students With Kinesthetic Learning Styles.

			Male Kinesthetic BAT	Male Kinesthetic BIQ
Male Kinesthetic BAT		Pearson Correlation	1	.08
		Sig. (2 tailed)		.515
		N.	67	67
Male Kinesthetic BIQ		Pearson Correlation	.08	1
		Sig. (2 tailed)	.515	
		N.	67	67

In Table 8, the values of r = 0.08, N = 67 p (0.515) > 0.05, this is an indication that there is no significant relationship between mean interest rating and mean achievement scores of male biology students with Kinesthetic learning styles. Thus, the null hypothesis of no significant relationship between mean interest rating and mean achievement scores of male biology students with Kinesthetic learning styles is not rejected.

4.2.10   Hypothesis 9

There is no significant relationship between mean interest rating and mean achievement scores of female biology students with Kinesthetic learning styles.

Table 9: **Relationship Between Mean Interest Rating And Mean Achievement Scores Of Female Biology Students With Kinesthetic Learning Styles.**

		Female Kinesthetic BAT	Female Kinesthetic BIQ
Female Kinesthetic BAT	Pearson Correlation	1	.12
	Sig. (2 tailed)		.438
	N.	43	43
Female Kinesthetic BIQ	Pearson Correlation	.12	1
	Sig. (2 tailed)	.438	
	N.	43	43

Table 9 shows the values of $r = 0.12$, $N = 43$, $p (0.438) > 0.05$, this means that there is no significant relationship between mean interest rating and mean achievement scores of female biology students with Kinesthetic learning styles. The null hypothesis that there is no significant relationship between the mean interest rating and mean achievement scores of female biology students with Kinesthetic learning style is not rejected.

4.2.11 Hypothesis 10

There is no significant relationship between male students with multimodal learning styles and their mean interest rating and mean achievement scores in biology.

Table 10: Relationship Between Male Multimodal Learning Styles Students' Mean Interest Rating And Mean Achievement Scores In Biology.

		Male Multimodal BAT	Male Multimodal BIQ
Male Multimodal BAT	Pearson Correlation	1	.41
	Sig. (2-tailed)		.000
	N	339	339
Male Multimodal BIQ	Pearson Correlation	.41	1
	Sig. (2-tailed)	.000	
	N	339	339

Table 10 shows that value of r = 0.41, n = 339 and p(0.000) < 0.05, this implies that there is a significant relationship between male multimodal learning styles students' mean interest rating and mean achievement scores in biology. The null hypothesis which stated that there is no significant relationship between male multimodal learning styles students' mean interest rating and mean achievement scores in biology is thus rejected.

4.2.12 Hypothesis 11

There is no significant relationship between female students with multimodal learning styles and their mean interest rating and mean achievement scores in biology.

Table 11: Relationship Between Female Multimodal Learning Styles Students' Mean Interest Rating And Mean Achievement Scores In Biology.

		Female Multimodal BAT	Female Multimodal BIQ
Female Multimodal BAT	Pearson Correlation	1	.31
	Sig. (2-tailed)		.000
	N	308	308
Female Multimodal BIQ	Pearson Correlation	.31	1
	Sig. (2-tailed)	.000	
	N	308	308

Table 11 shows that the value of r = 0.31, n = 308, and p(0.000) < 0.05, this indicates that there is a significant relationship between female multimodal learning styles students' mean interest rating and mean achievement scores in biology. The null hypothesis which stated that there is no significant relationship between female multimodal learning styles students' mean interest rating and mean achievement scores in biology is therefore rejected.

4.2.13 Hypothesis 12

There is no significant relationship between male students with unimodal learning styles and their mean interest rating and mean achievement scores in biology.

Table 12: Relationship Between Male Unimodal Learning Styles Students'

Mean Interest Rating And Mean Achievement Scores In Biology.

		Male Unimodal BAT	Male Unimodal BIQ
Male Unimodal BAT	Pearson Correlation	1	.37
	Sig. (2-tailed)		.000
	N	520	520
Male Unimodal BIQ	Pearson Correlation	.37	1
	Sig. (2-tailed)	.000	
	N	520	520

Table 12 reveals the value of $r = 0.37$, $n = 110$ and $p(0.000) < 0.05$, this shows that there is a significant relationship between male Unimodal learning styles students' mean interest rating and mean achievement scores in biology. The null hypothesis which states that there is no significant relationship between male Unimodal learning styles students' mean interest rating and mean achievement scores in biology is hereby rejected.

4.2.14 Hypothesis 13

There is no significant relationship between female students with unimodal learning styles and their mean interest rating and mean achievement scores in biology.

Table 13: Relationship Between Female Unimodal Learning Styles Students' Mean Interest Rating And Mean Achievement Scores in Biology.

		Female Unimodal BAT	Female Unimodal BIQ
Female Unimodal BAT	Pearson Correlation	1	.27
	Sig. (2-tailed)		.000
	N	403	403
Female Unimodal BIQ	Pearson Correlation	.27	1
	Sig. (2-tailed)	.000	
	N	403	403

Table 13 shows that the value of r = 0.27, n = 403 and p(0.000) < 0.05, this is an indication that there is a significant relationship between female Unimodal learning styles students' mean interest rating and mean achievement scores in biology. The null hypothesis which states that there is no significant relationship between female Unimodal learning styles students' mean interest rating and mean achievement scores in biology is rejected.

4.3   Discussion of Findings

This study investigated the relationship between achievement and interest of Senior Secondary School biology students with different learning styles in Benue State, Nigeria. The study also examined the interplay of gender as a moderating variable in between the learning styles and bring it under focus. The results of the study are discussed based on the variables examined in this study in accordance with the research question and hypotheses that guided the study.

4.3.1 Learning styles among biology students in Benue State

The main learning styles as shown in figure 2 were found to be Visual, Auditory and Kinesthetic, this was due to the fact that this study was premised on Fleming's VAK theory of learning styles whose the main learning styles under focus are visual, auditory and kinesthetic. The predominant learning style among the three main ones is the auditory learning style as clearly shown in figure 2 with a frequency of 474 which represents 30.2% , visual learning style with a frequency of 339 (21.6%), kinesthetic, 110 (7%), visual-auditory, 298 (19%), visual-kinesthetic 56 (3.6%), auditory – kinesthetic 109 (6.9%) and visual – auditory – kinesthetic 184 (11.7%) of the total sample size.

The graphical representation in the bar chart clearly showed the auditory learning style towering over all other learning styles. Most biology teachers teach scientific concepts abstractly without concretizing it and not make provision for students to practicalise and interact with the teaching aids and materials. This also resulted in the least kinesthetic learning style that was revealed in this study. This corroborate the findings of Obiefuna and Oruwari (2015) where auditory learning style is the major learning style when a study about the students learning styles and their performance in Biology in secondary schools was conducted. Based on this finding the predominant learning style among the students was a divergent learning style (Kolb's Learning Style Theory) which is the equivalent of auditory learning style in Fleming's VAK learning theory and the least learning style is the accommodator, which is the equivalent of kinesthetic learning style in Fleming's Learning Style Theory.

The findings of this study is also in tandem with Wichuda, Chasiri, Manoch, Athavudth and Juntima (2015) who discovered that Auditory learning style is predominant among the undergraduate medical students in Thailand, while the visual and kinesthetic learning style shared the least predominant learning styles among the students.

Furthermore, Adeniji (2015) agrees with the finding in this work when he revealed that tactile/kinesthetic learning style has the least preference when finding out the distribution of learning styles among mathematics students. Mutua (2015) found that students least preferred kinesthetic learning style to visual and auditory learning style when conducting a correlational study between learning style and academic achievement among secondary school students in Kenya, most secondary school teachers preferred traditional lecture method where learners are passive in the teaching – learning process and teachers do little or nothing to explore and make use of the science laboratories where students can touch or feel the teaching aids and materials as well as the apparatus.

Alade and Ogbo (2014), Albert (2016) and Famland (2010) disagree in their findings, that the predominant learning style among secondary school students was Visual learning style. This could be attributable to the much higher population of boys than girls that took part in their research work. This portrayed that males were shown to be better at handling of dangerous items, chemicals and lab equipment as well as chart and drawings than girls.

Apart from the major learning styles, other combinations of learning style exist among secondary school students as seen in Figure 2. The visual/auditory learning style is the dominant combination and the VAK learning style is the least among other multimodal learning styles that exist. This discovery probably represents the type of teaching methods the students are used to in the classroom. Learning styles are innate tendencies but might be influenced by some factors including gender, culture, brain processing, age and type of learning environment the students are exposed to. This is in agreement with Tung and Xiamy (2018), Abdul and Ansari (2017) whose findings of their different researches revealed that the visual/auditory learning style is the most predominant among all other possible combinations which could be as a result of the effect of learning content, and motivation students are exposed to. The visual, auditory and kinesthetic (VAK) is the least under the existing multimodal learning style. It is apparently evident that the teaching methods of most biology teachers are not properly addressing the learning need of students, especially those methods that address the needs of visual, auditory and kinesthetic learners. This is in sharp contrast with Mutua (2015) that the majority of students that were under investigation preferred visual, auditory, kinesthetic (VAK) as their learning style followed by visual/auditory and auditory/kinesthetic as the least learning style combination.

4.3.2 Relationship between mean interest rating and mean achievement scores of biology students with Visual Learning Styles.

There exists a relationship between mean interest rating and mean achievement scores of students with Visual Learning Style as shown in Table 1. The visual learners

learn through the eyes, the use of aids, graphs, charts, diagrams, picture and many other visual objects. With the usual kind of teaching method and environment students were exposed to, it is expected that they toe along this line of action.

This finding revealed the Visual learning style to be the second predominant learning style after Auditory learning styles; this probably resulted in the moderate relationship that existed between the interest rating and their mean achievement scores. This corroborates the findings of Rahmani (2012) where visual learning style of students correlate with academic achievement of students in empirical sciences (i.e Biology, chemistry and physics). The academic achievement also shows significant correlation with Visual learning style. Zahra and Bashir (2014) is also in tandem with the finding of this study when it was revealed that the Visual learners have more motivation and interests in sciences with a positive correlation between them and also a significant relationship exist between Visual learning styles and interest. It was also revealed further that interest is significantly correlated with concentration and achievement. Tung Lu and Xiamy (2018) also buttressed this in their study that the visual learners achieved higher scores with high correlation and generally students often achieve better performance when they focus highly on the learning contents and activities.

4.3.3 Relationship between mean interest rating and mean achievement scores of biology students with Auditory learning style.

Auditory learning style being the major predominant learning style preferred by students in this study exposed the learning environment they have been adapted to and

exposed to over a long period of time. Following this trend, it is naturally expected that students should be able to thrive well under this particular learning style. The strong relationship that exist between students' interest rating and mean achievement scores did not just happen overnight and is not surprising at all. With the largest number of students who preferred Auditory learning style and with a strong correlation co-efficient between the mean interest and mean achievement score, the null hypothesis of no significance between the mean interest rating and mean achievement scores was rejected.

Tung and Xiamy (2018) agree with the finding in this study through the revelation in his research that Auditory learners obtained better scores and learning outcome with low concentration in sciences. The findings in this work is also in agreement with Obiefuna and Oruwari (2015), whose findings show that students with Auditory (Diverging) learning style are the majority and Divergers (Auditory) learners are concrete experience people, learning from specific experience, relating to people, sensitive to feelings and people, open-minded and adaptable to changes any time Wichuda, Chasiri, Manoch, Athavudth and Juntima, (2015) with their findings when studying learning styles and academic achievement among undergraduate medical students also made similar findings that the Auditory (Reflective) learning style was the predominant learning style and there was a significant relationship between interest and academic achievement of students under this same learning style.

4.3.4 Relationship between mean interest rating and mean achievement scores of biology students with kinesthetic learning style.

The kinesthetic learning style as revealed in figure 2 is the least predominant among the main learning styles under focus. This translated into very few numbers of students that selected this particular learning style. This is an indication that students had not been taught or exposed to learning processes through touching objects, moving, interacting with space, teaching aids, or material, doing active experimentation, projects and others. Learning through these ways are alien to these students. These, among other factors, could be responsible for students very low preference for Kinesthetic learning style and this could also be responsible for the very weak relationship between mean interest rating and mean achievement scores recorded in biology as shown in table 3.

It was also shown that the relationship between interest and achievement was not significant as seen in Table 3. Omoniyi and Olurinola's (2015) findings agree with this work when they found out in their work titled "Educational media and learning style preference" that there is no significant relationship between kinesthetic learning style and students' achievement scores in sciences. At the same time disagree with the finding of this study in recording highest mean achievement score under Kinesthetic learning styles.

McFarland (2010) is not in tandem with the finding of this study in his work titled "The relationship between learning style perception preferences and attitudes towards computer Assisted Instruction in Secondary School Biology". He asserted

that there is a significant correlation between kinesthetic learning and the interest of students and he reported that the use of Computer Assisted Instruction in Biology makes learning easy and meaningful during teaching learning processes. Ibe, (2015) also, disagrees with the findings of his research titled "Effects of Learning styles on the performances of secondary school biology students that the (Converging) Kinesthetic. Learning style correlates strongly with mean achievement scores by explaining that the highest mean for the converging (Kinesthetic) students could be due to the fact that biology is a student that involves application of the sense and that it uses facts and figures to build ideas. It was further explained that learning biology involves problem solving i.e being practical and students do a lot of calculations in form of practical work. It could also be because biology students learn by doing and working on problems and cases that allow them to evaluate alternatives and to arrive at answers logically.

4.3.5   Relationship between mean interest rating and mean achievement scores of male and female biology students with visual learning styles.

The result in Table 4 revealed that there exists a fairly strong relationship between the mean interest rating and the mean achievement scores of male visual biology students. The general psychological and biological explanation is that the male gender are usually attracted and fascinated by what they see and the female gender by what they hear (Sawer, 2017). This reason might probably be responsible why the male visual learners recorded strong Correlation Co-efficient of 0.409 for the relationship between mean interest rating and mean achievement scores than that of

the female visual students of 0.104, in Table 5, which is a weak correlation co-efficient. Although there are some exceptions where some female learners are naturally Visual learners and they prefer visual learning style in other to perform excellently well in their studies. The same goes for some male learners who are naturally auditory learners and they tend to learn more by listening to instructions. The relationship between the mean interest rating and mean achievement scores of male Visual biology learner is strong and is statistically significant in Table 4, while that of female visual learners is weak and has no significant relationship in Table 5.

These findings agree with Middleton, Rick, Wright and Graut (2013) in examining the relationship between learning style preference, and attitude towards Science, Technology, Engineering and Mathematics (STEM) in secondary schools. It was discovered that the males preferred Visual learning style than their female counterparts. He posited further that female students do not need to see the big picture as much when it comes to learning, they can complete problems within a vacuum, whereas their male counterparts need to see how what they are doing relate to the overall grand scheme. Also, Yemane, Ambaye, Alehegi, Sahile, Dinitsy, Kebede, Geratu and Girma (2014) in their Assessment of Gender differences on learning style among biology undergraduate students, buttressed the fact that the majority of students are Visual learners and the male students are more of Visual learners than any other learning style. It was also discovered that there is a significant relationship between mean interest and achievement scores of the male students. Matilde (2008), reiterated that male students are Visual learners and unfortunately techniques that cater to Auditory learning are not addressing the Visual learners, students are not

getting as much as they would if Visual technique were used in class. If both Visual and Auditory technique were employed in class, the process of information might be maximized.

In contrast to all these findings, Jeane (2011) is of a different stance after finding out that the majority of male students strongly preferred Kinesthetic learning style while women prefer a multimodal learning style, when conducting a research on differentiating instruction with regard to gender and learning styles in biology class.

4.3.6   Relationship between the mean interest rating and mean achievement scores of male and female biology students with Auditory learning style.

Table 6 revealed the relationship between the mean interest rating and mean achievement scores of male and female biology students with Auditory learning style. The male auditory students' interest rating and the mean achievement scores correlated strongly and positively, the same goes for the female auditory students in Table 7. The predominant learning styles among the students are the unimodal auditory and the multimodal Visual – Auditory learning style, this could be the determinant factor why both gender shared the preference for auditory learning style and their resultant interest and achievement scores. Apart from the fact that the biology teachers are used to teaching through the traditional lecture method, the teachers seems not considering the ways individual students wish to be taught or learn and the overall implication of this is that male students were likely to be forced to adapt to teachers style of teaching, thereby over riding that uniqueness of learning style which we ought to see in individual students. Based on these, the true picture

concerning the male learning style is not visible but a routine of teachers' teaching method and student compatible ways of learning what the teachers teach.

Nuzhat, Salam, Al Hamdan and Ashour (2013), Souda, and Seraladevi (2014) in their separate studies concerning Gender difference in attitude towards Biology Teaching and Learning styles among Government Secondary Schools, corroborated the finding of this work that male science students are more of auditory learning style and the null hypothesis of no significant relationship between mean interest rating and mean achievement scores biology male auditory student is rejected as also revealed in Table 6.

Contrastingly, Sabine, and Geert (2004), Mark, and Nicole (2014) in their separate studies disagree with the finding that male are Auditory, but the empirical results revealed that the majority of male biology students under investigation were more of Visual and not Auditory learning style.

Table 7 shows the relationship between the mean interest rating and mean achievement scores of female biology student with auditory learning style to be positively strong. Naturally, the majority of female gender though with some exception prefers auditory learning styles. This is stemmed down from the fact that the female gender are attracted to what they hear or listen to (Saver, 2017).

Bosman, (2015), Mark and Nicole (2014), Souda and Saraladevi (2014) agree with this findings that female students are more of Auditory learning style and there is a statistically relationship between their interest rating and performances in biology and sciences, as also shown in Table 7.

However, Alade and Ogbo (2014), Nuzhat, Salam, Al Handan and Ashour (2013), while conducting a study on comparative study of chemistry students learning style in selected public schools and Gender differences in learning styles and academic performance of undergraduate science students respectively did not concur with the findings of this study in that female students prefer Visual and Kinesthetic learning styles rather than Auditory learning styles and the Visual and Kinesthetic learning styles aids their interest and achievement more than any other learning styles.

4.3.7   Relationship between mean interest rating and mean achievement scores of male and female biology students with kinesthetic learning style.

The result in Table 8 shows a very weak relationship existing between the mean interest rating and the mean achievement score of male biology student with kinesthetic learning. This emanated from the earlier findings that kinesthetic learning style is not popular among the students and it is the least predominant among the three major learning styles under focus. This means that the teaching of biology in most secondary schools in the state lacks activities practicalisation and experiments. This might probably be as a result of some factor like inadequate biology laboratories, insufficient teaching and laboratories equipment, lack of teaching aids, lack of qualified biology teachers. The number of male students who preferred kinesthetic learning are very few only 67 out of 859 which is the total number of male biology students that participated in this study. This shows that the kinesthetic learning style is alien to the students and the interest rating and the subsequent mean achievement score in biology is not really strange. Apparently, the resultant effect of all these

above mention factors culminated in a very weak and the non-significant relationship between the mean interest rating and the mean achievement score of this category of male students.

Many previous researches pointed out in their findings that male students preferred kinesthetic and visual learning styles in order for them to perform better especially in sciences and Engineering. Some of these research works include Souda, and Saraladevi (2014). Teaching and learning style among Adolescent in secondary school, Mark and Nicole (2014), Do music and biology student have the same learning, Wei, Hoo and See (2011); Relationship between learning style and content. Based Academic Achievement among student, Angela (2005); The development of an inventory to Assess the learning styles of adult with difficulties: These aforementioned studies found out that male students are more of kinesthetic and Visual learning style. Unfortunately the male students under focus are not exposed to learn under these type of teaching and learning strategy.

Similarly, with only 43 female students who preferred Kinesthetic learning style and under the above mentioned circumstances, there is also a weak relationship between the mean interest rating and the mean achievement score of female biology students with kinesthetic learning style but not as weak as that of male biology students of the same learning style as seen in Table 9. There is no statistically significant relationship between the mean interest rating and the mean achievement scores, this shows that female biology students are more of Kinesthetic learning style than their male counterparts. Abdul and Ansari (2017), disagrees and asserted that visual and Auditory learning styles are predominantly dominated by science

female/students. On the other hand Jeanne (2011), posited that female students prefer more than one mode of learning (i.e multimodal learning style) while Mark and Nicole (2014) agrees that less female biology students prefer kinesthetic learning but auditory, and he also found out that there is a relationship between Auditory learning style and interest as well as achievement and the relationship between the interest and achievement is statistically significant.

4.3.8 Relationship between mean interest rating and mean achievement scores of male and female biology students with multimodal learning style

Table 10 shows the relationship between the mean interest rating and mean achievement scores of male biology students with multimodal learning styles. It was shown that there is a positive relationship co-efficient between the mean interest rating and mean achievement scores and the relationship is significant. The findings reveals in Table 10 that the male students preferred multimodal learning styles more than their female counterparts which are less in number in Table 11. The reason for this trait in male gender may not be far from the fact that the male genders are restless and explorative in nature than the female gender. This might probably be responsible for the preferences for more than one learning style as seen in male biology students. This is in tandem with the findings of Wehrwein, Dicarlo and Lujan (2007) where 87.5% male students out of the total 100 respondents preferred multimodal learning styles. A majority of male students preferred multimodal learning styles while a majority of female students preferred single learning style.

Yemane, Ambaye, Sahile, Kebede, Geretu and Gurma (2017) also corroborate the findings of this study that male students preferred multimodal learning style than their female counterpart. This also established the fact that female students less preferred multimodal learning style. Male students tend to be more kinesthetic, tactile and visual, they need to interact with the space around them and need more mobility and exploration to be able to learn appropriately. This also account for male being multimodal learners. Tatarintseva (2002).

Furthermore, when students' interest and learning needs are identified, properly understood and adhered to by the teacher, students' achievement automatically takes a positive turn-around and a better achievement will be achieved. (Anwar, 2014). The analysis in Table 10 revealed a statistical significant correlation between the mean interest rating and mean achievement score of male biology students with multimodal learning styles. Ponam, Prajint, Manicho and Vishram (2013), Aiyesha, Raheem, Naseer and Nadi (2013) and Mutua (2015) corroborate the findings of this study in their separate discoveries in researches about the relationship between learning styles and achievement in medical sciences, Nursing and biology respectively. It was discovered that multimodal learners have better attitude and interest towards learning which translated into higher Cumulative Grade Point Average (CGPA) and higher mean achievement score than their female counterpart. This is an indication that biology male students with multimodal learning style possessed a better mean interest that culminates into better academic achievement. The relationship between the mean interest rating and mean achievement score is significant.

However, Muhammed, Ansar, Sadia, Faiza, Ushna, Javeria and Ehsam (2015) and Salithip, Natchaya and Natchaphrim (2016) in their findings disagrees that the preference for multimodal learning styles is not gender based. The learning style preference is however based on the ability of the teacher to move and arouse students' interest and also on the students' classroom environment as well as students' innate abilities and tendencies. The preference for the multimodal learning styles is not associated with high mean interest rating or high mean achievement scores of students. Teachers' quality, availability of teaching materials and teachers' motivation are responsible for students' interest and achievement in biology. (Gohwa, 2015).

In addition, result in Table 11shows that less number of female students preferred multimodal learning style than that of male students. The reason for this apparently may not be far from the fact that the females are more calm and reserved in nature, unlike their male counterpart who are restless and mobile. Kray and Thompson (2004) is in tandem with the finding of this study by revealing that girls learn to co-operate in small groups in which mutual liking is important. Also, the female genders are able to sit passively and are more comfortable with unimodal learning style during teaching – learning process. Wehrwein, Dicarlo and Lujan (2007) corroborated this finding by the number of respondents that responded to the research questionnaires used in the study. Forty five point eight percent (45.8%) female students preferred multimodal learning style which is far less than 87.5% of male students who preferred the similar learning style.

Yemane, Ambaye, Alehegn, Sahile, Dimistsy, Kebede, Geretu and Gurma (2017) however showed in their findings that there was no significant difference in

learning preferences between the two genders. This was different comparing to other studies which showed significant different as seen in two of the studies in America and Saudi – Arabia by Wilfred and Allan (2010) and Rajshree (2013) which showed very nearly significant relationship between gender and learning preferences. There was a significant gender differences in the percentages of males and female students who preferred multimodal or unimodal styles of learning but there were no significant gender differences in the specific multimodal preferences. This means that there were no significant gender differences in the specific multimodal preferences, this is an indication that there were no gender differences of males and female students who preferred bimodal or trimodal learning styles. (Yemane, Ambaye, Alehegn, Sahile, Dimistsy, Kebede, Geretu & Gurma, 2017).

Furthermore, Alyssa (2007) also disagrees with the findings of this study by the outcome from a study, where 250 first year medical students' learning style was evaluated. It was discovered that female students preferred multimodal learning styles than their male counterparts. Table 11 shows a significant relationship between the mean interest rating and mean achievement scores of female biology students with multimodal learning styles. Students having more than one learning styles are at an advantage in other to learn and cope with any teaching approaches or strategies that a teacher might adopt and use. The interest of the students is aroused when students' learning needs are met through the use of appropriate teaching strategies that addressed the need of students' multimodal learners. Mutual (2015) agrees with the findings of this study that a significant relationship exist between the interest and achievement of female multimodal learners. Ponam, Prajina, Manicho and Vishram

(2013), Ayesha, Raheem, Nasser and Nadi (2013) also corroborate the findings of this study in separate findings in their researches about the relationship between interest and achievement of multimodal learners in medical sciences and nursing respectively. It was discovered that multimodal learners have high interest rating, high Cumulative Grade Point Average (CGPA) and higher achievement scores than their unimodal learners' counterpart.

Multimodal learners possess the unique abilities to learn through more than one learning styles and sensory channels. Multimodal learners portray an advantage over unimodal learners that learn through only one learning style and only one sensory channel or receptor. There is high appeal, positive attitude and interests as well as high academic achievement in multimodal learners. Alyssa (2007) is in tandem with the findings of this study by revealing that female students are less of multimodal learning styles than their male counterparts. Also, the relationship between the interest and achievement of female multimodal learners is significant

On the contrary, Mohammed, Ansar, Sadia, Faiza, Ushna, Javeria and Ehsam (2015), Salithip, Natchaya, Natchaprim (2016) and Gohwa disagrees in their separate findings that the preference for multimodal learning styles was not associated with interest and achievement of and there is no significant relationship between interest and achievement of multimodal learners.

4.3.9 Relationship Between Mean Interest Rating And Mean Achievement Scores of Male And Female Biology Students With Unimodal Learning Style.

Table 12 reveals more numbers of male biology students with unimodal learning styles than their female counterpart in table 13.Table 12 also shows a significant relationship between the mean interest rating and mean achievement scores of the students. Based on the theoretical anchor of Fleming learning styles (1987), students' unimodal learning style could be either visual, auditory or kinesthetic/tactile. Male and female gender showed preferences for some particular learning styles, this unique preference have consequential effects on the interest rating which further translates to students' academic achievement.

Table 13 reveals that female biology students are less of unimodal than their male colleagues. This probably might have stemmed from the fact that some male students are able to sit passively and are more focused in the conventional classrooms than some female students who are restless and readily available to explore. Kray and Thompson (2004) agree with the findings of this study by reporting that males learn to compete in hierarchical groups while the female learn to co-operate on small groups with mutual understanding within themselves. This consequentially leads to the maintenance and sustenance of a definitive and particular learning pattern in some male students. The case is not the same in some female students who are more non-conforming and peer – motivated. (Tatarintseva, 2002).However, Hamidon (2015) disagrees with the findings of this study in saying that the male prefer competitive learning style which means that male students more prefer multimodal learning which is more than one learning style and female students prefer single mode of learning

style only. Though it was revealed earlier in this study in table 4 that the majority of male students preferred visual learning styles and the relationship between the mean interest rating and the mean achievement score is significant. On the other hand, in table 7, it was revealed that the majority of female students have preference for auditory learning style and the relationship between the mean interest rating and the mean achievement score is significant. It is important to state here that, the male biology students also have strong preference for auditory learning style as shown in table 6. Moreover, the aggregation and the total number of students that preferred unimodal learning styles based on gender differences as well as the relationship between their interest and achievement are shown in Table 12 and 13. The result of the finding revealed that the relationship between the mean interest rating and the mean achievement score is significant. This could be as a result of the type of learning style biology students have been exposed to by the teacher over a long period of time. This could also means that the biology teacher use lecture method which favour auditory learning style in females and male students. The resultant effect of this is in the large positive relationship between the interest and achievement of biology students.

Abudu and Gbadamosi (2014) agreement with the findings of this study when it was found in a study carried out in Ijebu – Ode, Ogun State Nigeria titled "Relationship between attitude and academic in senior secondary school chemistry", that there is a significant relationship between attitude and students' academic achievement in chemistry. It was further discovered that the achievement of students depend on the attitude and interest displayed by the students and the teachers during

teaching and learning in the classroom. However, it was discovered that there is a significant difference in the mean chemistry achievement scores of male and female students. This means that gender has effect on the achievement of students in senior secondary school chemistry.

Geetha and Praveena corroborated this finding by established the fact that a positive relationship exist between dominant learning style and students' interest in biological sciences in secondary schools in South Africa. The study also inferred that there is a significant relationship between dominant learning styles and interest among secondary school students. The reverberating effect of this finding is that since the interest of student is achieved and established, it automatically translates into achievement of students. This fact is in agreement with Shaw and Marlow (1999) who established a correlations between interest and students' achievement as well as interest and students' perceptions in computer education in secondary schools.

In contrast to findings in this study, Liew, Sidhu and Barua (2015) is of a different stance after finding out in the study which involved undergraduate medical students that the learning styles of the students did not contribute significantly towards their interest and learning outcomes. The relationship between interest and achievement of students is also not significant. In addition, Chandhary, Ayub, Aftab, Faiza, Ahmed, Khursheed and Ullah (2015) also is of a different opinion in that learning style preference is not associated with academic achievement of students across Pakistan.

The learning environment and the teachers' ability to identify and understand students' learning needs of students with the use of appropriate teaching methods and experiences are essential morale booster that aids the interest and afterwards the achievement of students. The positive relationship between interest and achievement is achievable when a particular learning style addresses the students' learning needs irrespective of their gender.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1   Introduction

In this section, the summary of the study is presented. Also presented in this chapter are the recommendations, conclusion, limitations, suggestions for further studies and contribution to knowledge.

5.2   Summary

This study investigated the relationship between senior secondary school students with different learning styles and their achievement and interest in biology in Benue State, Nigeria. The study was anchored on Neil Fleming's Learning Style Theory (1987).

Twelve research questions and eleven hypotheses guided the study and the design was a survey research design. The population for the study was all senior secondary school two (SS II) students in Benue State, which has 23 local government areas that are spread over three educational zones A, B, and C. Out of the 15,361 SS II students from 310 secondary schools in the state which was the population for the study, 1,570 students from 36 secondary schools formed the sample for the study. The sampled schools cut across the three education zones of the state. Three instruments namely: Biology Learning Style Inventory (BLSI), Biology Achievement Test (BAT) and the Biology Interest Questionnaire (BIQ) were administered to the students in their natural setting without any treatment given to them. Data generated, from the instruments were analysed using mean, standard deviation, frequencies, percentages

and Pearson's Product Moment Correlation Co-efficient. Frequencies and percentages were used to answer research question and Pearson's Product Moment Correlation Co-efficient was used to test the hypotheses at 0.05 level of significance. The following findings were made:

The predominant learning styles among biology students in the state was the Auditory Learning Style and there was a significant relationship between mean interest rating and mean achievement score of biology students with this style of learning.

Kinesthetic and Visual – Kinesthetic learning styles are the least preferred among the biology students and there was no significant relationship between students mean interest rating and mean achievement scores.

Male biology students preferred Visual learning styles with high interest rating and achievement scores than their female counterpart.

Male and female biology students shared the preferences for Auditory learning style, with higher interest rating and mean achievement scores that were significantly correlated. Female biology students were found to be more Kinesthetic than the male biology students.

The relationship between mean interest rating and mean achievement scores of both male and female biology students with multimodal learning styles is significant.

The relationship between mean interest rating and mean achievement scores of both male and female biology students with unimodal learning styles is also significant.

5.3   Conclusion

In conclusion, it has been revealed that the ways in which students learn vary greatly and each student has a unique way through which he/she learns. This study revealed that most biology teachers in Benue State use lecture method of teaching in the classrooms, which culminated in students' preference for auditory learning style which were exhibited and identified with the students. Visual and auditory learning styles are the most preferred by the male and female biology students respectively. The relationship between the mean interest ratings and the mean achievement test of biology students with these preferred learning styles is significant. Kinesthetic learning style is the least preferred by biology students of both gender and the relationship between mean interest rating and mean achievement score is not significant. Although, more male biology students have preference for multimodal learning style than their female counterpart, the relationship between mean interest rating and mean achievement scores of male and female biology students with multimodal learning styles is significant.

5.4   Recommendations

This study has shown that individual students have unique ways of receiving, processing and interpreting information based on their exposure, environment and personalities. Based on the findings, it is recommended that:

1.   Teachers need to take into cognizance their students diverse learning styles, design instructional methods that take care of those diversities and remain sensitive to such during the teaching process.

2. Teachers should help their students to identify and understand their learning styles and make use of such to develop the learning abilities of their students.

3. School administrators need to provide learning aids and materials which can bring diversity in the classrooms, by employing visual, auditory and kinesthetic materials such as the use of technology like Computer Assisted Instruction based teaching, interactive marker board, music laboratories, project writing, concept mapping, and power point presentation among other methods.

4. Biology teachers should try as much as possible to concretize the teaching of abstract biology concepts and make it more real for the students.

5. More time duration needs to be allocated to the teaching of biology and other science subjects so as to accommodate the activities of teachers in addressing the diverse learning needs of students.

5.5   Suggestions for Further Studies

The following suggestions are made for further investigation:

1. This study was limited to the interplay of gender being a variable, between learning styles and the relationship between interest and achievement. Further studies could be carried out using ethnic affiliation or culture as a moderating variable.

2. This study could be replicated using another learning style theory different from the one used in this work as its premise.

3. This work could still be carried out in other states or regions of the country to authenticate the findings reported for Benue State.

5.6   Contribution to Knowledge

Through this study, teachers' identification and proper understanding of biology students' learning styles was found to be an important factor that aid students' learning interest and achievement. It is an eye opening finding that more students than imagined are Auditory learners who will enjoy lecture method of teaching.

Therefore, teachers need not condemn lecture method but learn to compliment it with other teaching strategies that will cater for Visual and Kinesthetic learners. With these findings teachers could be advised to boost their teaching with variety of teaching methods that will accommodate the wide variety of learners.

Teachers are also encouraged to make science teaching real, practical oriented, student-centred and interesting.

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APPENDIX A

Achievement of Students in Biology in Senior Secondary School Certificate Examination (WAEC) between 2006 – 2016.

		Raw mean score	Standard Deviation (S.D)	General Comment
MAY/JUNE 2006	BIO 1 BIO 2	20 22	12.41 11.31	Poorer than previous year Poor
MAY/JUNE 2007	BIO 1 BIO 2	16 21	11.49 9.38	Poorer than previous year Poorer than previous year
MAY/JUNE 2008	BIO 1 BIO 1	17 20	11.52 12.39	Better than that of previous year Poorer than previous year
MAY/JUNE 2009	Paper 2	18	09.95	Poor
2010	Paper 2	19	10.05	A bit better than previous year
2011	Paper 1 (Practical) Paper 2 (Essay)	20 19	11.27 09.54	Poor Poor
2012	Paper 1 Paper 2	20 16	11.18 09.06	Almost the same like previous year Poorer than previous year
2013	Paper 1 Paper 2	18 25	10.05 10.30	Poorer than the previous year Poor but better than previous year
2014	Paper 1	29	12.37	Poor but a little bit better than previous year
2015	Paper 1	25	11.87	Performance poorer than that of previous year
2016	Paper 1 Paper 2	31 31	10.91 11.79	Better than previous year Better than the previous year

GCE NOV/DEC 2006	BIO 1	18	8.94	Poorer than previous year
	BIO 2	28	7.64	Poor
GCE NOV/DEC 2007	BIO 1	17	8.77	Poorer than previous year
	BIO 2	24	12.7	Poorer than previous year
GCE NOV/DEC 2008	BIO 1	22	11.32	Fair
	BIO 2	19	8.95	Poorer than the previous year
GCE NOV/DEC 2009	Paper 2 (Alternative to Practical)	21	08.54	Poor
	Paper 3 (Essay)	21	11.58	Poor
GCE NOV/DEC 2010	Paper 2	18	08.06	Poorer than previous year
	Paper 3	18	08.54	Poorer than previous year
GCE NOV/DEC 2011	Paper 2	22	07.22	Poorer than previous year
	Paper 3	28	11.66	Better than previous year
GCE NOV/DEC 2012	Paper 2	21	08.72	Poorer than previous year
	Paper 3	22	09.38	Poorer than previous year
GCE NOV/DEC 2013	Paper 2	19	10.25	Poorer than previous year
	Paper 3	29	09.33	Better than previous year
GCE NOV/DEC 2014	Paper 2	18	08.06	Poorer than that of previous year
	Paper 3	27	11.28	Poorer than that of previous year
GCE NOV/DEC 2015	Paper 2	23	11.22	Better than the previous year
	Paper 3	29	8.25	Better than that of previous year

Source: Chief Examiner's Report, West African Examination Council 2016

LETTER OF INTRODUCTION

> Department of Curriculum &
> Teaching,
> Faculty of Education,
> Benue State University,
> Makurdi,
> …………….2017.

The Principal,

…………………………………………

…………………………………………

Dear Sir/Madam,

PERMISSION TO ADMINISTER QUESTIONNAIRE IN YOUR SCHOOL

I wish to ask for your permission to administer my questionnaire to the students of this school to supply information in a study.

I am a postgraduate student of Benue State University studying Science Education (Ph.D in Science Education). The topic of my study is "The relationship between Senior Secondary School students' learning styles and their achievement and interest in biology in Benue State, Nigeria".

This study is strictly for academic purpose. Therefore, responses and information obtained will be treated as highly confidential.

Thanks for your co-operation.

> Yours faithfully,
>
> **FAKOLADE, BENJAMIN AYODELE**

BARSCH LEARNING STYLE INVENTORY (BLSI)

Dear Student,

This form is about how you prefer to learn, there are no right or wrong answers, your responses will only be used for research purpose and it will be treated with a high level of confidentiality.

SECTION A

Instruction: Please fill in all the information required in this section.

Name of School:………………………………………………………………………...

Serial Number:………………………………………………………………………….

Sex:………………………………………………………………………………………

SECTION B

Instructions: Put a tick (Ö) on the appropriate line after each statement below:

	Usually	Sometimes	Rarely
1. I can remember more about biology lesson through listening than reading.	----	----	----
2. I follow written directions better than oral instructions.	----	----	----
3. I like to write things down (take notes) for a visual review.	----	----	----
4. I press very hard with a pen or pencil when writing.	----	----	----
5. I need explanations of diagrams during lessons.	----	----	----
6. I enjoy working with tools (instruments e.g hammer).	----	----	----
7. I am skillful with (good at) making graphs during lessons.	----	----	----
8. I enjoy developing charts during lessons.	----	----	----
9. I can tell if a pair of sounds matches.	----	----	----
10. I remember best by manipulating (touch) object.	----	----	----
11. I can understand and follow directions on maps.	----	----	----

12. I do better in my biology lesson by listening to lectures and tapes.   ----   ----   ----

13. I play with coins or keys in my pockets during biology lesson.   ----   ----   ----

14. I learn to spell better by repeating the letters out loud than by
    writing the word on paper.   ----   ----   ----

15. I chew gum during biology lesson   ----   ----   ----

16. I feel the best way to remember is to picture it in my mind.   ----   ----   ----

17. I learn spelling by using my fingers.   ----   ----   ----

18. I would rather listen to a good lecture or speech than read
about the same material in a book.   ----   ----   ----

19. I am good at solving and working on jigsaw puzzles.   ----   ----   ----

20. I grip objects in hands during learning period.   ----   ----   ----

21. I prefer listening to news on the radio rather than reading
    about it in a newspaper.   ----   ----   ----

22. I obtain information on an interesting subject by reading
    relevant materials.   ----   ----   ----

23. I feel very comfortable touching others all the time.   ----   ----   ----

24. I follow oral directions better than written ones.   ----   ----   ----

25. I need explanations of visual directions during my biology lessons.   ----   ----   ----

26. I prefer teachers who get us to do something than those who do not. ----   ----   ----

27. I get distracted in biology class if I see something outside the window ----   ----   ----

28. I would prefer to read a story rather than to listen to it.   ----   ----   ----

29. I prefer lessons where there is something to look at
     (like a picture, chart) than just to listen.   ----   ----   ----

30. In my spare time, I would prefer to listen to music.   ----   ----   ----

BARSCH LEARNING STYLE INVENTORY (BLSI)

SCORING PROCEDURES AND EXPLANATIONS

SCORING PROCEDURES

USUALLY = 3 POINTS   SOMETIMES = 2 POINTS   RARELY = 1 POINT

Place the point value on the line next to its corresponding item number. Next add the points to obtain the preference scores under each heading.

Visual		Auditory		Kinesthetic	
No.	pts	No.	Pts	No.	Pts
2	_____	1	_____	4	_____
3	_____	5	_____	6	_____
7	_____	9	_____	10	_____
8	_____	12	_____	13	_____
11	_____	14	_____	15	_____
16	_____	18	_____	17	_____
22	_____	21	_____	19	_____
27	_____	24	_____	20	_____
28	_____	25	_____	23	_____
29	_____	30	_____	26	_____
	_____		_____		_____
	VPS		APS		KPS

VPS = Visual Preferences Score
APS = Auditory Preferences Score
KPS = Kinesthetic Preferences Score
Pts= Points

When a particular learning style has been identified by a student, the strength of the students should be built around it and the weaknesses addressed. Most students have one dominant learning style. If the scores are close or tied, either of the learning style could be equally used. To be flexible to meet any academic situations, students need to use their strengths and also built on their weaknesses. Those students who learn to adapt study skills to incorporate all 3 learning styles learn faster and remember longer.

A **VISUAL LEARNER** by all means sees and uses all study materials and learning aids like charts, maps, filmstrips, notes and flashcards. Students practice visualizing or picturing spelling words in their heads and write out everything for frequent and visual review. It is obvious that students learn best when seeing things.

AN AUDITORY LEARNER uses tapes, sit in front of the lecture hall or classroom where the learner hears best and review the lecture frequently.

An auditory learner records or tapes lecture notes and also summarizes the reading of a text on tape. A learner review spelling words, lectures or text material witha classmate or a study group.

A KINESTHETIC LEARNER involves the body in the process of learning. A learner traces words as being said and facts that have been learnt during teaching are written several times in scratch papers that has been kept for that purpose. Taking and keeping lecture note is very important to the learner. A kinesthetic learner takes a walk and study notes at the same time.

BIOLOGY ACHIEVEMENT TEST (BAT)

This achievement test is on ecology in SS II biology curriculum. This test is purely for research purposes and not for any kind of students' assessment and it will be treated with high level of confidentiality.

SECTION A

Instruction: Please fill in all the information required in this section.

Name of School:………………………………………………………………………………...

Serial Number:………………………………………………………………………………….

Sex:……………………………………………………………………………………………

SECTION B

Instructions: Please answer the following questions by putting a tick (√) in the correct box:

1. The study of living organism in relation to their environment is: (a) Ecology ☐ (b) Adaptation ☐ (c) Tolerance ☐ (d) Cytology ☐

2. The living component of an ecosystem is called (a) Biotic (b) Abiotic ☐ (c) ☐ Synecology ☐ d) Horticology ☐

3. The non-living component of an ecosystem is called (a) Entomology ☐ (b) Abiotic ☐ (c) Toxicology ☐ (d) Biotic ☐

4. The non-living components of an ecosystem include the following except (a) Edaphic ☐ factor (b) Climatic factor ☐ (c) Turbidity ☐ (d) Producers. ☐

5. Excessive use of fertilizer has the following adverse effects on the ecosystem except (a) May kill useful soil organisms that come into direct contact with it ☐ (b) May lead to algal bloom ☐ (c) pollute the water ☐ (d) kill the plants inside water. ☐

6. A place where an organism lives is called: (a) Habitat ☐ (b) Population ☐ (c) Community ☐ (d) House. ☐

7. The green plant in the ecosystem are: (a) The consumer ☐ (b) The decomposers ☐ (c) The producers ☐ (d) The heterotrophs ☐

8. In an ecosystem, the autotrophs are the (a) rats ☐ (b) insects ☐ (c) green plants ☐ (d) lizards. ☐

9. The soil will lose its fertility most rapidly through (a) Use of compost ☐ (b) Grain farming ☐ (c) Erosion ☐ (d) Root farming. ☐

10. Chemical compounds that are artificially prepared for increasing soil fertility are known as (a) pesticides ☐ (b) farmyard manure ☐ (c) fertilizers ☐ (d) cow dung. ☐

11. The total surrounding of an organism is known as its (a) Habitat ☐ (b) Community ☐ (c) Environment ☐ (d) Area. ☐

12. Edaphic factor in an ecological system is referred to as (a) Soil factor ☐ (b) Turbidity ☐ (c) Rainfall ☐ (d) Temperature. ☐

13. The following constitutes (make up) the edaphic factor of an ecosystem except (a) soil structure ☐ (b) soil texture ☐ (c) soil depth ☐ (d) rainfall. ☐

14. The type of soil that has the highest retaining water capacity is the (a) clay soil ☐ (b) loamy soil ☐ (c) sandy soil ☐ (d) sandy loamy soil. ☐

15. All organisms that rely and depend on green plants in an ecosystem are called (a) Heterotrophs ☐ (b) Autotrophs ☐ (c) Producers ☐ (d) Decomposers. ☐

16. The feeding levels among different levels of organisms in an ecosystem are called (a) trophic level ☐ (b) Nastic level ☐ (c) tactic level ☐ (d) Eating level. ☐

17. Which of the soil sample or type has a fine texture? (a) Clay ☐ (b) Sand ☐ (c) Loamy ☐ (d) Sandy-loamy. ☐

18. The biotic component of an ecosystem includes the following except (a) Producer ☐ (b)Consumer ☐ (c) Decomposer ☐ (d) Humidity. ☐

19. An ecosystem consists of (a) Non-living materials ☐ (b) Consumer ☐ (c) Producers, consumers ☐ (d) Producers, consumers and decomposers. ☐

20. Consumer in an ecosystem consists of the following except (a) primary ☐ (b) Subordinate ☐ (c) Secondary ☐ (d) Tertiary. ☐

21. Earthworm improves the percolation and aeration of the soil by (a) destroying the crumb structure ☐ (b) Burrowing and making tunnels in the soil ☐ (c) By moistening the soil ☐ (d) By turning the soil black. ☐

22. Micro-organism which break down dead organisms and absorb their content are called: (a) Decomposers ☐ (b) Consumers ☐ (c) Parasites ☐ (d) Commensals. ☐

23. The following are the adverse effect of pesticide on the ecosystem except (a) pollute the atmosphere ☐ (b) cause the death of useful soil organisms ☐ (c) plants may absorb pesticide and become contaminated ☐ (d) lead to algal bloom. ☐

24. One of the following is not a type of habitat (a) aquatic ☐ (b) arboreal ☐ (c) terrestrial ☐ (d) swamp. ☐

25. Which of the following factors affect the quantity of water retained by the soil? (a) Rainfall ☐ (b) Exposure ☐ (c) Humus content of the soil ☐ (d) Clay content of the soil. ☐

BIOLOGY INTEREST QUESTIONNAIRE (BIQ)

Dear Student,

This questionnaire is concerned about your interest in biology.

Please fill in all the information required as honestly as possible. There are no rights

nor wrong answer. All information given will be treated in strict confidence.

Name of School …………………………………………………………………………….

Serial Number:………………………………………………………………………..

Sex: …………………………………………………………………………………

Instruction: Read the following statements carefully and tick (√) in the appropriate column.

S/No		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1.	I find biology to be a very interesting subject.					
2.	I need to study biology in order to specialize in biology related courses.					
3.	The concepts used in biology make the subject uninteresting to me.					
4.	I forget biology terms easily.					
5.	I hate biology because it deals with abstract concepts.					
6.	I do not like biology because the practicals are stressful.					
7.	I like biology because it is beneficial to man.					
8.	I find biology to be a simple subject to study.					
9.	Biology involves a lot of memory work to understand it well.					
10.	I find biology to be a very difficult subject.					

No.	Statement					
11.	I like biology because it does not involve much mathematical calculations.	178				
12	I study biology only because it is compulsory at the senior secondary school level.					
13.	I find biology textbooks to be very difficult to understand.					
14	I gain nothing from studying biology.					
15	My lack of interest in biology is because my biology teachers are very unfriendly.					
16	My biology teachers explain scientific concept and principles very well.					
17	The biology teachers make the subjects very interesting to me.					
18	The biology teachers are usually disorganized.					
19	The study of biology helps to improve my health.					
20	The biology teachers explain biology concepts very well.					
21	My biology teachers are too strict in awarding marks and thereby killing my interest in the subject.					
22	My biology teachers supervise my work regularly.					
23	My biology teachers are very resourceful.					
24	My biology teachers rush over the subjects to complete the bulky syllabus, without my understanding.					
25	I have well equipped biology laboratory which help me to understand biology.					
26.	I like biology because our biology teachers are friendly.					

FACULTY OF EDUCATION,
BENUE STATE UNIVERSITY,
MAKURDI.

VALIDATION FORM

You are requested to critically examine and assess all the items of the instrument with reference

to the following.

The Project/Dissertation/Thesis Titled

Relationship between Senior Secondary School Students'
learning styles and their achievement and Interest in
Biology in Benue State, Nigeria.
Name of the candidate FAKOLADE, BENJAMIN AYO Matric No: BSU/CU7/PH.N/14/4005

1. Whether or not the items conform to the subject matter they are supposed to assess

Candidate has effected corrections related to this so everything is okay now

2. Whether or not the items are clear, readable and free from ambiguity.

Items are very straight forward and easy to understand.

3. Whether or not the items assess the basic area of the study.

yes

4. If the instrument is capable of achieving the purpose for which it is designed.

Very nice

Name _____ Regnr. M. O. Combs

Rank _____ Professor

Signature _____

Date _____ 22/01/2017

FACULTY OF EDUCATION,
BENUE STATE UNIVERSITY,
MAKURDI.

VALIDATION FORM

You are requested to critically examine and assess all the items of the instrument with reference

to the following.

The Project/Dissertation/Thesis Titled

RELATIONSHIP BETWEEN SENIOR SECONDARY SCHOOL STUDENTS' LEARNING STYLES AND THEIR ACHIEVEMENT AND INTEREST IN BIOLOGY IN BENUE STATE, NIG.

Name of the Candidate *Benjamin A. Fakolad* Matric No: *BSU/CUT/PHD/14/4005*

1. Whether or not the items conform to the subject matter they are supposed to assess

Yes, except few ones that are modified

2. Whether or not the items are clear, readable and free from ambiguity.

They are clear, readable and free from ambiguity

3. Whether or not the items assess the basic area of the study. *They do.*

4. If the instrument is capable of achieving the purpose for which it is designed. *If the few modifications are addressed, yes they are okay*

Name *Peter O. Agogo*

Rank *Professor (Science Education)*

Signature _____

Date *03/02/2017*

FACULTY OF EDUCATION,
BENUE STATE UNIVERSITY,
MAKURDI.

<u>VALIDATION FORM</u>

You are requested to critically examine and assess all the items of the instrument with reference

to the following.

The Project/Dissertation/Thesis Titled

RELATIONSHIP BETWEEN SENIOR SECONDARY SCHOOL STUDENTS LEARNING

STYLES AND THEIR ACHIEVEMENT AND INTEREST IN BIOLOGY IN BENUE STATE, NG.

Name of the Candidate FAKOLADE BENJAMIN AYODELE Matric No: BSU/CIT/PhD/14/4005

1.   Whether or not the items conform to the subject matter they are supposed to assess

The Items conform

2.   Whether or not the items are clear, readable and free from ambiguity. The items
are readable and unambiguous

3.   Whether or not the items assess the basic area of the study. The Items
are good if corrections are effected

4.   If the instrument is capable of achieving the purpose for which it is designed. If
Instrument is good if corrections are effected

Name   DR IMOKO Benjamin

Rank   Associate Professor

Signature

Date   03 - 02 - 17

Reliability for Kinesthetics

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	155	90.1
	Excluded[a]	17	9.9
	Total	172	100.0

3. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.846	10

Item Statistics

	Mean	Std. Deviation	N
Four	1.97	.697	155
Six	1.66	.760	155
Ten	2.53	.687	155
Thirteen	1.26	.520	155
Fifteen	1.56	.790	155
Seventeen	1.81	.771	155
Nineteen	1.70	.594	155
Twenty Three	2.12	.792	155
Twenty Four	2.26	.703	155
Twenty Six	2.56	.635	155

Scale Statistics

Mean	Variance	Std. Deviation	N of items
19.44	9.637	3.104	10

Reliability for Visual

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	166	96.5
	Excluded[a]	6	3.5
	Total	172	100.0

2. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.764	10

Item Statistics

	Mean	Std. Deviation	N
Two	2.07	.743	166
Three	2.69	.602	166
Seven	2.19	.791	166
Eight	1.97	.664	166
Eleven	2.42	.724	166
Sixteen	2.37	.673	166
Twenty	1.94	.906	166
Twenty Two	2.54	.500	166
Twenty Seven	1.69	.791	166
Twenty Nine	2.19	.783	166

Scale Statistics

Mean	Variance	Std. Deviation	N of items
22.07	6.911	2.629	10

Reliability for Auditory

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	172	100.0
	Excluded[a]	0	.0
	Total	172	100.0

2. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.678	10

Item Statistics

	Mean	Std. Deviation	N
One	2.73	.571	172
Five	2.54	.670	172
Nine	2.21	.743	172
Twelve	2.80	.399	172
Fourteen	2.26	.777	172
Eighteen	2.15	.807	172
Twenty One	2.20	.714	172
Twenty Five	2.51	.617	172
Twenty Eight	2.00	.725	172
Thirty	1.81	.752	172

Scale Statistics

Mean	Variance	Std. Deviation	N of items
23.20	8.292	2.880	10

APPENDIX M

Reliability for All Learning Styles

Scale: ALL VARIABLES

Case Processing Summary

		N	%
	Valid	149	86.6
Cases	Excluded[a]	23	13.4
	Total	172	100.0

5. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.772	30

Item Statistics

	Mean	Std. Deviation	N
One	2.73	.589	149
Two	2.07	.736	149
Three	2.69	.614	149
Four	1.97	.711	149
Five	2.66	.555	149
Six	1.68	.763	149
Seven	2.21	.832	149
Eight	1.85	.597	149
Nine	2.32	.717	149
Ten	2.51	.694	149
Eleven	2.47	.749	149
Twelve	2.85	.363	149
Thirteen	1.27	.528	149
Fourteen	2.30	.777	149
Fifteen	1.54	.801	149
Sixteen	2.38	.694	149
Seventeen	1.85	.769	149
Eighteen	2.28	.763	149
Nineteen	1.73	.589	149

Twenty	1.97	.940	149
Twenty One	2.27	.723	149
Twenty Two	2.52	.501	149
Twenty Three	2.13	.808	149
Twenty Four	2.23	.701	149
Twenty Five	2.51	.633	149
Twenty Six	2.58	.638	149
Twenty Seven	1.66	.785	149
Twenty Eight	2.03	.757	149
Twenty Nine	2.13	.791	149
Thirty	1.78	.804	149

Scale Statistics

Mean	Variance	Std. Deviation	N of items
65.18	33.528	5.790	30

Reliability for All

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	253	99.2
	Excluded^a	2	.8
	Total	255	100.0

a. Listwise deletion based on all variables in the
procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.783	2

Item Statistics

	Mean	Std. Deviation	N
BAT	68.6443	14.57220	253
BIQ	69.8019	11.70752	253

Scale Statistics

Mean	Variance	Std. Deviation	N of items
138.4462	432.266	20.79101	2

Reliability for BIQ

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach'sAlpha[a]	N of Items
.750	20

a..

Item Statistics

	Mean	Std. Deviation	N
One	4.20	.951	20
Two	4.05	.826	20
Three	4.00	.725	20
Four	4.20	.894	20
Five	4.05	.686	20
Six	4.15	.587	20
Seven	4.05	.759	20
Eight	4.05	.826	20
Nine	4.00	.795	20
Ten	4.00	.918	20
Eleven	4.05	.887	20
Twelve	3.95	.887	20
Thirteen	4.20	.951	20
Fourteen	4.15	.587	20
Fifteen	4.05	.759	20
Sixteen	4.20	.696	20
Seventeen	4.15	.875	20
Eighteen	4.15	.671	20
Nineteen	4.25	.550	20
Twenty	4.25	.639	20

APPENDIX P

Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
BAT	68.6443	14.57220	172
BIQ	69.9573	11.79214	172

Correlations

		BAT	BIQ
	Pearson Correlation	1	.643[**]
BAT	Sig. (2-tailed)	11.79214	.000
	N	172	172
	Pearson Correlation	.643[**]	1
BIQ	Sig. (2-tailed)	.000	
	N	172	172

[**]. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX Q

The table below summarizes the VAK dimensions, how students learn and what the teachers need to do to ensure that learning is maximized:

Dimension	Learners tend to:	Teachers need to encourage learners to:	Teaching methods:
Visual	Learn through seeing; Think in pictures and need to create vivid mental images to retain information; Enjoy looking at maps, charts, pictures, videos, and movies; Have visual skills which are demonstrated in puzzle building, reading, writing, understanding charts and graphs, a good sense of direction, sketching, painting, creating visual metaphors and analogies (perhaps through the visual arts), manipulating images, constructing, fixing, designing practical objects, and interpreting visual images.	Use graphics to reinforce learning, Colour code to organize notes and possessions, Use colour to highlight important points in text, Take notes, Illustrate ideas as a picture before writing them down, Ask for written directions, Use flow charts and diagrams for note taking, Visualize spelling of words or facts to be memorized.	Reading, power point presentation, concept mapping, charts, maps, diagrams.
Auditory	Learn through listening; Have highly developed auditory skills and are generally good at speaking and presenting; Think in words rather than pictures; Learn best through verbal lectures, discussions, talking things through and listening to what others have to say; Have auditory skills demonstrated in listening, speaking, writing, storytelling, explaining, teaching, using humour, understanding the syntax and meaning of words,	Read aloud; Recite information to learn; Use tunes or rhymes as mnemonic devices; Read aloud and tape test questions or directions; Use verbal analogies and storytelling to demonstrate their point.	Lecture, audio and (radio, tapes, discussion, story telling, mnemonics).

	remembering information, arguing their point of view, and analyzing language usage.		
Kinesthetic	Learn through moving, doing and touching; Express themselves through movement; Have good senses of balance and eye-hand coordination; Remember and process information through interacting with the space around them; Find it hard to sit still for long periods and may become distracted by their need for activity and exploration; Have skills demonstrated in physical coordination, athletic ability, hands on experimentation, using body language, crafts, acting, miming, using their hands to create or build, dancing, and expressing emotions through the body.	Make models or role play to physically experience learning; Skim through reading material before reading it in detail; Annotate text and write questions while reading; Translate information into diagrams or other visual study tools; Recite a list of items by counting on fingers; Memorize or drill while moving e.g. when walking; Listening to music while studying.	Demonstration, experiments, practical

Source: Flemings (2011).

APPENDIX R

BARCH LEARNING STYLE INVENTORY

Please check the appropriate line after each statement

		Often	Sometimes	Seldom
1.	Can remember more about a subject through listening than reading.	-----	------	-----
2.	Follow written directions better than oral directions.	-----	-----	-----
3.	Like to write things down or take notes for a visual review.	-----	-----	-----
4.	Bear down extremely hard with a pen or pencil when writing.	-----	-----	-----
5.	Require explanations of diagrams, graphs or visual directions.	-----	-----	-----
6.	Enjoy working with tool.	-----	-----	-----
7.	Are skillful with and enjoy developing and making graphs and charts.	-----	-----	-----
8.	Can tell if sounds match when presented with pairs of sounds.	-----	-----	-----
9.	Remember best by writing things down several times.	-----	-----	-----
10	Can understand and follow directions on maps.	-----	-----	-----
11	Do better at academic subjects by listening to lectures and tapes.	-----	-----	-----
12	Play with coins or keys in pocket.	-----	-----	-----
13	Learn to spell better by repeating the letters out loud than by writing the word on paper.	-----	-----	-----
14	Can better understand a news article by reading about it in the paper than by listening to radio.	-----	-----	-----
15	Chew gum, smoke or snack during studies.	-----	-----	-----
16	Feel the best way to remember is to picture it in your head.	-----	-----	-----
17	Learning spelling by "finger spelling" the words.	-----	-----	-----
18	Would rather listen to a good lecture or speech than read about the same material in a book.	-----	-----	-----
19	Are good at solving and working on jigsaw puzzles and mazes.	-----	-----	-----
20	Grip objects in hands during learning period.	-----	-----	-----
21	Prefer listening to the news on the radio rather than reading about it in a newspaper.	-----	-----	-----
22	Obtain information on an interesting subject by reading relevant materials.	-----	-----	-----
23	Feel very comfortable touching others, hugging, handshaking, etc.	-----	-----	-----
24	Follow oral directions better than written ones.	-----	-----	-----

RELATIONSHIP BETWEEN LEARNING STYLE THEORIES

Learning Style Theories	Equivalent Learning Styles/Categories			
Flemings VAK	Visual,	Auditory,	Kinesthetic	
Kolb's Theory	Assimilator	Diverger	Accommodator	Converger
Honey and Mumford	Theorist	Reflector	Activists	Pragmatist
Dunn and Dunn	Physiological preferences			

APPENDIX T

GENDER AND LEARNING STYLE DISTRIBUTION OF SAMPLE

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	859	54.7	54.7	54.7
	Female	711	45.3	45.3	100
	Total	1570	100.00	100.00	

Learning Styles

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Visual	339	21.6	21.6	21.6
	Auditory	474	30.2	30.2	51.8
Kinaesthetic		110	7.0	7.0	58.8
	Visual/Auditory	298	19.0	19.0	77.8
	Visual/Kinesthetic	56	3.6	3.6	81.3
	Auditory/Kinesthetic	109	6.9	6.9	88.3
	Visual/Auditory/Kinesthetic	184	11.7	11.7	100.0
	Total	1570	100.0	100.0	

APPENDIX U

NAMES OF SECONDARY SCHOOLS USED FOR THE STUDY

ZONE A

S/N	Names	Male M	Female F	Total T
1	GI Kajo Comprehensive College, Adikpo	17	13	30
2	Mbaikya Progressive Secondary School, Ushongo	18	12	30
3	Mbera Comm. Sec. School, Ihugh	26	31	57
4	NKST Sec. School, Vandeikya	8	22	30
5	Adikpo Comprehensive College, Adikpo	25	15	40
6	NKST Sec. School, Zaki-Biam	11	39	50
7	Mbakaange High Sec. School, Vandeikya	17	13	30
8	Govt. Comm. Sec. School, Ihugh	27	8	35
9	Govt Sec. School, Afia	15	23	38
10	Ucha Community Sec. School, Afia	27	43	70
11	Mbanlenge Comm.Sec. School, Ihonam	22	36	58
12	Mbavaa Comm. Sec. Sch., Amua	29	19	48
13	Ikyobo Comp. College, Ikyobo	13	37	50
14	Kasar-Ijer Mem. Sec. Sch., Mbangur	33	32	65
	ZONE B			
1.	Community Sec. Sch., Yandev	25	6	31
2	Padopads Harmony Sec. Sch., Makurdi	30	42	72
3	Mbaakpough Comm. Sec. Sch., Tyodugh	16	14	30
4	Anglican Sec. Sch., Makurdi	15	19	34
5	Methodist High Sch., Makurdi	14	15	29
6	NKST Sec. Sch., Bristow Gboko	17	13	30
7	Apur College Gboko	24	6	30
8	Community Sec. Sch., Bunaka	31	6	37
9	Jato Anchaver Mem. Sch, Mase	29	28	57
10	Yion Day Sec. Sch., Orya	29	25	54

	ZONE C			
1	St. Paul Sec.Sch., Otukpo	17	18	35
2	Apa Comm. Sec. Sch., Apa	24	16	40
3	Otukpa Comm. Sec. Sch, Otukpa	27	13	40
4	Govt. Sec. Sch., Oju	34	20	54
5	Muslim Community College, Otukpo	21	29	50
6	Ejega Mem. Sec. Sch, Okpaflo	9	18	27
7	Govt. Sec. Sch., Orokam	20	10	30
8	Onyagede Comm. Sec. Sch., Onyagede	14	21	35
9	Ekenobi High Sch., Ekenobi	20	33	53
10	Agila Comm. Sec. Sch., Agila	20	31	51
11	Govt. Sec. Sch, Ikachi	29	21	50
12	Ito Comm. Sec. Sch., Okpokwu	37	33	70
		859	**711**	**1,570**

LIST OF SAMPLED SCHOOLS WITH THEIR ZONES AND LOCAL GOVERNMENT AREAS

ZONES	LGA	SCHOOL NAME
A	Kwande	GI Kajo Comprehensive College Adikpo
"	Ushongo	Mbaikya Progressive Sec Sch.Ushongo
"	Vandeikya	Mbera Comm. Sec. Sch., Ihugh
"	Vandeikya	NKST Sec. Sch., Vandeikya
"	Kwande	Adikpo Comprehensive College, Adikpo
"	Ukum	NKST Sec. Sch, Zaki-Biam
"	Vandeikya	Mbakaange High Sch., Vandeikya
"	Vandeikya	Govt. Comm. Sec. Sch., Ihugh
"	Ukum	Govt. Sec. Sch., Afia
"	Ukum	Ucha Comm. Sec. Sch., Afia
"	Kwande	Mbanenge Comm. Sec. Sch., Ihonam
"	Logo	Mbavaa Comm. Sec. Sch., Amua
"	Ushongo	Ikyobo Comp. College, Ikyobo
"	Katsina – Ala	Kasar-Ijer Mem. Sec. Sch., Mbangur
"B	Gboko	Community Sec. Sch., Yandev
"	Makurdi	Padopads Harmony Sec. Sch., Makurdi
"	Gboko	Mbaakpough Comm. Sec. Sch.,Tyodugh
"	Makurdi	Anglican Sec. Sch., Makurdi
"	Makurdi	Methodist High School, Makurdi
"	Gboko	NKST Sec. Sch., Bristow Gboko

"	Gboko	Apur College, Gboko
"	Gwer West	Community Sec. Sch., Bunaka
"	Makurdi	Jato Anchaver Mem. Sch, Mase
"	Gboko	Yion Day Sec. Sch., Orya
C	Otukpo	St. Paul Sec. Sch., Otukpo
"	Ado	Apa comm. Sec. Sch., Apa
"	Ogbadibo	Otukpa Comm. Sec. Sch., Otukpa
"	Oju	Govt. Sec. Sch., Oju
"	Otukpo	Muslim Comm. College, Otukpo
"	Otukpo	Ejega Mem. Sec. Sch., Okpaflo
"	Ogbadibo	Govt. Sec. Sch., Orokam
"	Ohimini	Onyagede Comm. Sec. Sch., Onyagede
"	Okpokwu	Ekenobi High Sch, Ekenobi
"	Ado	Agila Comm. Sec. Sch., Agila
"	Oju	Govt. Sec. Sch., Ikachi
"	Obi	Ito Comm. Sec. Sch., Okpokwu

APPENDIX W

BIOLOGY INTEREST QUESTIONNAIRE (BIQ)

Dear Students,

This questionnaire is concerned about your interest in biology.

Please fill in all the information required as honestly as possible. There are no rights or wrong answer. All information given will be treated in strict confidence.

School ……………………………………………………..

Class ……………………………………………………………..

Sex ……………………… Age ……………………..

Instruction: Read the following statements carefully and tick (√) in the column.

S/No		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	Biology is a very interesting subject					
2.	I need to study biology in order to become a medical doctor ( ), Nurse, ( ) an agriculturist ( ), a research biologist ( ), a teacher ( ). **NB** Put a tick in the bracket of the profession of your choice before filling agree or disagree					
3.	The long names used in biological terms make the subject boring and uninteresting					
4.	I forget biological terms easily					
5.	I hate biology because it deals with messy and smelly preserved specimen					

6.	I do not like biology because the practicals are usually laborious and exposes one to danger					
7.	I like biology because it is beneficial to man's survival					
8.	Biology is a very simple subject and I like it					
9.	Biology involves a lot of memory work					
10.	Biology is a very difficult subject					
11.	I like biology because it does not involve much mathematical calculations					
12.	I study biology because it is compulsory					
13.	Biology textbooks are difficult to understand					
14.	I gain nothing from studying biology					
15.	My lack of interest in biology is because the biology teacher is very unfriendly					
16.	The biology teacher knows his subject well					
17.	The biology teacher makes the subject very interesting					
18.	The biology teacher is usually unprepared, disorganized and inefficient					

19.	The study of biology helps to improve our health					
20.	The biology teacher explains biological concepts and principles quite well					
21.	The biology teacher is too strict in awarding marks and so kills my interest in the subject					
22.	The biology teacher supervises my work regularly					
23.	The biology teacher is energetic, resourceful and helpful					
24.	The biology teacher rushes over the subject to complete the syllabus					
25.	We have a well-equipped biology laboratory which helps us to understand biology					