

**EFFECT OF CLASS SIZE ON TEACHING AND LEARNING OF BIOLOGY  
AMONG SENIOR SECONDARY SCHOOLS IN BOSSO LOCAL GOVERNMENT  
AREA OF NIGER STATE**

**BY**

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2017/3/69281BE**

**BEING A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF  
SCIENCE EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENT  
FOR THE AWARD OF BACHELOR IN TECHNOLOGY IN SCIENCE EDUCATION  
(B. TECH) IN THE DEPARTMENT OF SCIENCE EDUCATION; SCHOOL OF  
SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF  
TECHNOLOGY, MINNA NIGERIA.**

**AUGUST, 2021**

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## ABSTRACT

*The study investigated the effect of class size on teaching and learning of biology among senior secondary schools in Bosso local government area of Niger state. The study employed a quasi-experimental design, specifically the pretest-posttest nonequivalent group design. One hundred two (102) students from which comprised of male and female selected from senior secondary school students. Subject matter experts validated the data collection instrument; Biology Achievement Test (BAT). Three research questions were raised and answered and three hypotheses were tested. The data were analyzed using mean, standard deviation. The results revealed that students taught in small classes performed better than students taught in large classes; female students performed better than their male counterparts in Biology. There was a significant difference in the achievement mean score of students taught in small classes and those taught in large classes; there was no significant difference in the mean achievement scores of male and female students in Biology. Based on the findings and implications, it was recommended amongst others that Government should make provision for more instructional materials such as laboratories, conducive and serene learning environment for the purpose of optimizing the teacher's and student's output in Biology.*

## CHAPTER ONE

### 1.0

### INTRODUCTION

#### 1.1 Background to the Study

Teaching and learning is important in any educational setting, it is the foundation of formal education; Wekke and Hamid (2013) defined teaching and learning as the main activity in enhancing students' capacities. Science Education is one of the fundamental aspects of national development that is to say; the development of a nation depends largely on Science Educators for such they should strive to ensure that young scientists are given the best basic scientific knowledge by providing good approaches of instructions and more conducive learning environment (Atadoga *et al.*, 2016). Hirschfeld (2016) explained that the function of Science Educators is to lay any possibilities for students to excel in science subjects.

Biology as a science subject deals with the study of variety of living organisms, their interaction with one another and with their environment (Dan-Olege & Shitu, 2012). It entails what is life, what life needs to survive and how life forms interrelate with each other. The knowledge of Biology plays a vital role in national development. It benefits individual citizens and other corporate organizations in many ways. Biology therefore plays an important role on how humans interact with the biotic and abiotic components of their environment (Weber, 2016). It helps the individuals to understand the functioning and working of their body system, provide knowledge on nutrition and proper feeding habit, knowing the essence of Immunization against infectious diseases as well as the importance of environmental sanitation. The knowledge of Biology also prepares an individual for professional careers such as Nursing, Medicine, Agriculture and Teaching.

Despite the tremendous roles of Biology to the nation, reports of poor students' achievement were recorded from West African Examination Council chief Examiners reports over the years (WAEC 2011, 2012, 2013 and 2014). Part of the failure of poor academic achievement of Biology students in secondary schools is attributed to environmental settings of the classes specifically, class sizes (Hirschfeld, 2016).

Class size refers to the number of students in a given classroom being taught by individual teacher, it can be large, medium or small. A large class size is considered as a class of large population of student's which teachers find it difficult to teach and manage. It is a class whose numerical size does not allow smooth participation of the teacher to reach every student (Magdalene 2014). Class size refers to the actual number of pupils taught by a teacher at a particular time(Efeetal.,2016). Class size as the number of students for whom a teacher is primarily responsible for during a school year. The class size could be large or small. Badures (2006) opined that class size is the number of students or individual in a particular classroom. He also opined that number of the students required in particular class should be below 40. Any class that has a total of 40 and above students is large class. The effectiveness of class size on students' achievement and motivation, and its synchronous relation to teaching process and teachers' workload, attitudes and motivation, is probably the most written about but however a least explored topic in the educational field. Yet, there is no consensus definition in literature to what constitutes a large class as material developers, teachers and students in different parts of world have various perceptions of what frames large, small or ideal classes. According to Hayes (2007) there is no numerical determination of what shape a large class as teachers' perceptions of large classes differs from one context to another.

Badures (2006) believed that regardless of the number of students in a class, it is a teachers' perceptions towards the class size in a certain context with particular tools and facilities which are provided that make classes either small or large. Hence, we can say that large classes are those with a specific number of students that teachers cannot handle and resources are not enough to facilitate the teaching and learning process and can pose insurmountable problems for both teachers and students. Mulryan-Kyne (2010) also shares that view and points to a large class as "a class that is too large for effective teaching to occur". Bahanshal (2013), on the other hand, believed that an ideal class should not exceed 12 students. In another word, a class should be big enough to offer variation and allow interaction and small enough to provide students with opportunities for participating and receiving individual attention.

Thng (2017) revealed that class size has great effects on students' social and academic involvement in the class and on the teachers' personality as well. That is to say that students in small classes, on contrary to their peers in large ones, are always under pressure to participate in class activities as "they are on the frying line", by being more visible to the teacher and may be called upon at any time to answer questions or to participate in a class activity". On a similar view, Bahanshal (2013) claimed that smaller classes elevate students' achievement as teachers in such context pay greater attention to each and every student, leaving students with no time to either be destructive or distracted by any means. Consequently, students in small classes encounter continuous pressure to engage in various activities and become active class. On a similar view, Bahanshal (2013) conclude that classes of a small size positively influence the teaching process as they encourage students and teacher engagement, allow students to be more cognitively engaged, offer ample time for teachers to cover the whole materials and provide safe school environment with fewer misbehaved students.

Yelkpiri *et al.* (2012) opined that some teachers hold negative views against large classes as they believe having many students in one class can cause some problems that affect them and their students. Some commonly comments heard by teachers are: there is no communication, the class is out of control, lack of individual attention and difficult to set effective group activities. Other teachers always emphasize that it is impossible to concentrate on all students and therefore not enough reinforcement will be made to encourage all to participate in different activities. In words, such context makes some students, especially the shy or weak ones to be neglected or left behind.

On the contrary, teachers in small classes are able to pay great attention to their students and the benefit from the presented activities is considered to be high. From that, we can say that it is abundantly evident that English teachers encounter great challenges when teaching large classes as they encounter difficulties in knowing all students in the class, having time for all individuals or presenting effective activities and therefore many students, especially the weak ones, tend to lose concentration. Another problem which is borne out in the words of the teachers, and hinders the learning process in large classes is identifying and controlling students who tend to distract their classmates from concentrating on the lesson.

Sun and Shek (2012) assumed that if a student misbehaves and begins disturbing the class, the teacher has to attend the disturbance and control the noise. Such action from one student or more in a large class will block the learning of that moment and demolish the capability of others to learn. Usman (2016) confirms: in larger classes, more time is needed for non-academic activities related to administrative and organizational procedures and to the management and control of discipline. Reductions in the quantity of learning opportunities constrain teachers from achieving the necessary pace, depth and breadth of curriculum coverage as class size increases (Usman,

2016). Noise level of some students is also considered to be a problematic issue as it will produce disturbance and prevent their classmates from learning. Ayeni and Olowe (2016) recorded that "large class sizes inhibit small group activities and individualized instruction, because of the noise level and lack of space in the classroom). Admittedly, some researchers have found that classroom noise is a result of students' boredom, vague instructions of activities presented in class and teachers' low voice (Zhang, 2008)

However, Sparks (2010) noted that class can be said to be large when the student number is more than 25 while Ruffina *et al.* (2018) defined class size may be defined as the number of students per teacher in a given class or the population of a class. Studies have shown that class size is an important factor that affects student's performance in Biology (Majia & Jafaru, 2021). In Nigeria, Class size in public secondary schools is far above the recommended 30 or 40 students per classroom. Yusuf *et al.*, (2016) reported in Oyo State that average class size in most secondary school exceeds 50. Nigerian schools that have as many as eighty (80), hundred (100) or above 100 students per class have also been reported (Osim, 2011). These class sizes are considered to be too large for optimum academic achievement of students. This among other factors might have prompted Yusuf (2012) to conclude that a number of things are wrong with the educational systems in Nigeria.

Different researchers (Adeyemi, 2012) have reported that large class sizes have negative effect on academic task. Yusuf and Onifade (2016) has included that class size ranks amongst the most important factors that have strong and direct influence on academic performance of schools. Similarly, Filges (2018) have reported that students in small classes have greater achievement level than those in large classes. Ruffina *et al.* (2018) established an inverse correlation between class size and student's achievement concluding that the larger the class, the lower the student's

achievement. Therefore, academic performance is directly an exhibition of attitudes of the learners. It is expected that large classes reduce effective classroom control. It thus has a potential to instigate distraction and disruptive behaviors or attitudes amongst the students. Folmer-Annevelink *et al.* (2010) remarked that students in small classes display less disruptive behavior than those in large classes. Chingos and Whitehurst (2011) asserted that class size significantly affects the level of students' cognitive skills in the classroom. According to Yusuf *et al.* (2016), small classes improved both the students' performance and learning behavior as well as it yields fewer classroom disruptions and discipline problem. In view of the above, research has suggested that smaller classes are usually preferred by both instructors and students.

Olatunde (2010) advised an educational policy of class sizes less than 30 while National Policy on Education (FRN, 2004) recommended the teacher-student ratio of 1:40. More so, students' engagement has been enlisted amongst key elements of educational success. Evidences have shown that it affects pupils' achievement. Meanwhile, Student engagement has been defined as the level of participation and intrinsic interest that a student shows in school (Delfino, 2019).

Ro *et al.* (2013) equated student's engagement to students' involvement and concluded that the greater it is, the greater is his or her level of knowledge acquisition and general cognitive development. It has also been reported that engaged students learn more, retain more, and enjoy learning activities more than students who are not engaged (Hancock and Frank, 2002).

Sangangula (2016) opined that large classes are simply not as effective as small classes for retention of knowledge, critical thinking and attitude change. Since large class has been found more prominent in secondary school, poor attitudinal change is expected. This may be due to ineffective classroom management and control by the teachers who are already inundated by the exploded learners' population. This may be the reason why Yusuf (2012) remarked that teachers

in public secondary schools feel no concerned about affective development of the students. Hence, the effect of class size on attitudes related to study is still opened for an in-depth and more decisive analysis.

As the world population continues to increase, the class sizes are also affected. Class size is often mentioned by experts in the educational literature as having effect on student's feelings and performance, quality of school budgets and on administration as well (Owoeye and Yara, 2011). It is considered as one of the important determinants of academic performance over which teachers in schools have little or no control. Class size may be defined as the number of students per teacher in a given class or the population of a class (Ajayi *et al.*, 2017). Mokobia and Okoye (2011) explained that educators universally have identified class size as important and desirable attribute of effective educational system. Consequently, debate has continued in the educational literature stakeholders such as academics, policy makers and parents over the educational consequences of class size. Some researchers have maintained that class size is a tool which can be adopted in measuring performance of educational system (Kedney, 2013).

Imoke (2006) asserted that optimum class size implies rational coordination of educational infrastructures, subject to available number of students in order to attain high level of productivity. Doyle (2014) observed that in modern day education, the focus is on the needs, interest and comfort of the students. Thus, managing class size allows students to learn effectively without disturbing one another (Garret, 2008). While a number of studies have found support for the importance of class size on student achievement, others strongly disprove this claim concluding that class size has little or no impact on objective student outcomes. Copious studies have investigated the influence of class size on student attitudes, behaviors, and outcomes. The devastating issue is that limited number of these studies has focused on

elementary school effects of class size on student achievement (Altinok and Kingdon, 2012). The orthodox wisdom among parents, teachers, school administrators, and policy makers is that, smaller class size translates to improvements in student learning and outcomes. This orthodox wisdom, however, has not been universally supported by realistic evidence (Aturupane *et al.*, 2013).

It has been argued that increasing the intake of senior secondary school students in a large class has numerous benefits for the schools and the country as a whole. It helps to reduce the cost of building additional classrooms of which few schools as well as the country have the resources to fund additional classrooms and teachers. Also, there is usually high energy, fun and excitement in large class size in public senior secondary schools. In addition, students learn to work well in groups since group work is a necessity in large class size (Azigwe *et al.*, 2016; Owolabi *et al.*, 2012).

In Nigeria however, the class size is becoming increasingly unmanageable, putting teachers in an impossible position of giving individual student required attention. In Nigeria public schools, the teachers' eye contact with the students in class has become so reduced that some of the poorly motivated students can form number of committees at the back of the class while teaching is going on to engage in non-school discussion. Regular assignments and home works are dreaded by teachers considering the staggering number of books to mark and to record. A research by Bosworth (2014) revealed that, the correlation between class size and student achievement is complex with many disagreeing results. The study concluded that class size has tiny impact on student achievement. The findings were inconsistent with the results of Rubin (2012) in that the later indicated that as the class size increases, student achievement declines. Contributing to exiting studies, conclusion from a study by Allen *et al.* (2013) was that 62 students per teacher

was a threshold number and once class size went beyond 62, learning effectively stopped. Thus, as the number of students in a class was more than 62, teachers find it difficult to teach effectively and efficiently leading to students not being able to also learn effectively since low participation of class activities were possible. Despite this finding, Allen *et al.* (2013) indicated that large class sizes do have moderate adverse effect on teaching and learning. The finding however contradicts the earlier studies and conclusions by Bosworth (2014).

In a related study, Evans and Popova. (2015) established that there is a negative nonlinear relationship between class size and student evaluations stronger than the relationship to student achievement, and with less concavity. This supports findings including an analysis of studies which revealed a similar negative relationship between class size and student evaluation, particularly in regards to instructor interactions with students as demonstrated by Altinok and Kingdon (2012). Besides, the literature has argued that pedagogies specifically designed for teaching smaller classes sometimes overlap with pedagogies employed when teaching larger classes but have distinct characteristics that differentiate them from those.

Employed when teaching larger class (Aturupane *et al.*, 2013; Azigwe *et al.*, 2016). Small class pedagogies can include project work where students are individually monitored and provided with continuous feedback on investigative tasks designed to develop higher order thinking skills (Altinok and Kingdon, 2012; Bosworth, 2014). Additionally, these studies suggested that advantage should be taken of having fewer students in a class to provide learning experiences that facilitate increased collaboration and communication among students, provide helpful learning opportunities and foster student meta-cognitive skills through the development of information discovering and help-seeking behaviors According to Amadahe (2016), one of the most essential parts of the teaching and learning process is assessment and evaluation of

students. Large classes call for large volumes of marking to be done and feedback given to students. This is a major challenge, especially in Nigeria public senior secondary schools. In the face of large classes, instructors are upset with the workload and resort to traditional teaching and assessment methods. Teachers are unable to finish marking assignments, exercises and examinations on time, and this delays the feedback given to students.

From the social perspective, studies on large class size exist in developing countries but the results are often questionable. Aturupane *et al.* (2013) reviewed 96 studies that tried to link various educational inputs to student performance in developing countries and found out that nearly a third (31) of the reviewed studies specifically considered the effect of pupil-teacher ratio. Out of the investigation, only eight found reduction in class size to significantly explain improved academic achievement. This study is consistent with Stephens *et al.* (2014) study on learning competencies in five francophone sub-Saharan African countries (Burkina Faso, Cameroon, Cote d'Ivoire, Mali and Senegal) which demonstrated that an inverse relationship existed between class sizes and learning outcomes. That is, student learning decreased as class sizes increased. This means that the higher the total number of students in a class, the lower the level of concentration which leads to poor performance of the students. Azigwe *et al.* (2016) revealed that students' engagement, behavior, and retention are affected in so many ways by the size of the class. This conclusion was drawn when reviewing studies on the link between student engagement and class size conceptualized student engagement in two forms, namely, social engagement (how a student interacts socially with other students and teachers in either pro-social or anti-social ways) and academic engagement (students' attitude towards schooling and the learning process). The study indicated that when students are placed in smaller classes, they

become more engaged, both academically and socially, and argue that with strong social academic engagement, academic achievement improves.

In spite of all these benefits, large class size may generate a lot of controversy due to the difficulty of teachers to work with large class size. These controversies may serve as thorns that crumble the performance of students in biology at the senior secondary school level. Some of these problems may be; teachers may find it difficult to use varied teaching methodology in teaching, students may find it difficult to concentrate in the class, teachers may find it difficult to control the students in class and there may be insufficient teaching and learning resources. Hence the quality of teaching, assessment of students and quality of learning may be affected. Basically, earlier one of the subjects in the Nigerian public senior secondary schools which requires demonstrations and much student attention is biology.

Hence, this draws the attention of the researcher to find out the effect of class size on teaching and learning of biology among senior secondary schools in Bosso local government area of Niger state.

## **1.2 Statement of Research Problem**

The problem of poor performance of senior secondary school students in Biology is concerned with poor infrastructures (conducive sizeable classroom) which constitute the problem of large classes. Hornsby (2013) noted that teaching a large class is a can be challenging. The government of Nigeria is it federal or state as stakeholders in education contribute to the problems of schools and make the schools what they are today. The poor funding of the education sector has reduced the teaching/learning programme into a mere struggle for survival between the teachers and their students. The insufficient dilapidated school buildings are used to compress large number of students for learning activities. The meager salary paid to teachers and

incessant strike actions have always disrupted adequate concentration of teaching/learning programme.

The dismay expressed over the poor performance of students in senior secondary schools in Nigeria over the years by the chief WAEC examiner are evident in the release of senior secondary school examination (SSCE) results. The chief WAEC examiner counsel the teachers to diversify methods and give more attention to the teaching of Biology to students so as to reduce the level of poor performance for good ones, by engaging the students in writing activities in other subjects. The poor performance of students in Biology is a big concern hence the researcher aims to determine the effect of class size on teaching and learning of Biology among secondary schools in Bosso Local Government Area of Niger State.

### **1.3 Aim and Objectives of the Study**

This study investigates the effect of class size on teaching and learning Biology among senior secondary schools in Bosso Local Government Area of Niger State. The specific objectives were to determine the:

1. Effect of large class size on the teaching and learning of Biology in senior secondary schools Bosso Local Government Area of Niger State.
2. Effect of class size on the achievement of male and female students in Biology.

### **1.4 Research Questions**

The following research question was formulated to guide this study:

1. What is the mean difference between the achievement of student taught Biology in the large class setting and those taught Biology in the small class setting?
2. To what extent does class size affect the mean achievement scores of male and female students in Biology?

### **1.5 Research Hypothesis**

The following Hypothesis were formulated and tested at 0.05 level of significance.

**HO<sub>1</sub>:** There is no significant difference in the mean achievement scores of students taught Biology in the large class setting and those taught Biology in the small class setting in Niger State.

**HO<sub>2</sub>:** There is no significant difference in the mean achievement scores of male and female students in Biology.

### **1.6 Significance of the Study**

The findings of this study will also be of great benefit to teachers, students, curriculum planners, government and non-governmental organizations.

This study provided information to the teachers in secondary schools since teachers recognize, through this study that teaching small class size in Biology is more effective; the teacher can then adopt the shift method and group her large class into small sizes, though this may increase her contact time.

Students can benefit more in Biology through small class sizes when the teacher adopts the shift method in teaching class, because this shift method will improve personal contact between the teacher and her students.

The curriculum planners can suggest average class size to government on the teaching of some aspects of Biology for effective teaching and clear understanding during teaching and learning.

The study finding provided information to the government and non-governmental organizations about the effect of large size in teaching/ understanding of Biology in schools. The government

can make use of this information to make policy adjustments on class size in schools for effective teaching and learning.

### **1.7 Scope of the Study**

This research work investigates the effect of class size on teaching and learning of Biology among senior secondary schools in Bosso Local Government Area, Niger State. This study covers secondary schools situated in Bosso Local Government Area in North Central of Minna, Niger state. The subject scope of this study is Biology in Bosso local government area of Niger state. The study is will last for four weeks.

### **1.8 Operational Definition of Terms**

**Teaching and learning:** is the main activity in enhancing students' capacities

**Biology:** as a science subject deals with the study of variety of living organisms

**Class size:** the number of students in a given classroom being taught by individual teacher, it can be large, medium or small

## CHAPTER TWO

### 2.0

### LITERATURE REVIEW

The major areas reviewed under this project work have been classified under: Conceptual framework, Theoretical framework and Empirical studies.

#### 2.1 Conceptual Framework

##### 2.1.1 Nature and Scope of Biology

Biology can be defined as the science of life (Singh *et al.*, 2021). It is a science subject offered in all the senior secondary schools in Nigeria, which is compulsory for both the science, and Arts oriented students. Hussaini (2014) pointed out that, the teaching of biology is important because, it equips the students to comprehend the world around them and equips them with necessary skills to build a progressive society. Biology provides a platform for teaching students the ability to apply learning of science concepts and principles in solving every day's problems.

Biology remains one of the basic sciences whose teaching and learning is universally known to be efficient and successful, if only undertaken simultaneously with the help of adequate instructional resources and facilities. Biology plays a vital role in the field of biochemistry, medicine, physiology, ecology, genetics, and molecular biology and as such, biology has been made a central focus in most human activities including being a solution to the problem of food scarcity, health, hygiene, family life, poverty eradication, management and conservation of natural resources, biotechnology, ethics, various social vices and as well lack of appropriate infrastructural materials.

Biology is one of the science subjects that senior secondary students offer in senior secondary certificate examinations in Nigeria (FRN, 2004). Interestingly, it is a popular subject among students and its popular nature among other science subjects has made it distinct choice

for all students (Lawal, 2011). Biology is a very important science subject and a requirement for further studies of other science related professional courses such as medicine, agriculture, pharmacy, biotechnology, genetic engineering, etc. Biology is the key to economic, intellectual, sociological, human resource development and well-being of any society. It is of importance in many ways for both individual and societal development as seen in biotechnology and genetic engineering (Adeleye, 2020). Based on these assertions on the importance of biology, there is need for it to be properly taught in the secondary schools to improve students' achievement in the subject.

### **2.1.2 Biology Curriculum in Nigeria**

Learning cannot take place without a planned of programme of activities; and the document that contain the totality of activities that take place in schools is termed curriculum. Akintola (2017) defined Curriculum as an educational programme of what goes on in the school and outside the school. Thus, science curriculum can be operationally defined as carefully planned and intended learning outcomes. In Nigeria, the sciences are taught in school subjects as Biology, Chemistry and Physics.

Akintola (2017) stated the objectives of teaching science to include obtaining the knowledge of science academic discipline, acquiring scientific methods and skills, acquiring clear knowledge and convincing explanation on societal issues through scientific literacy and societal goals, making provisions for personal needs and creation of career awareness. The objectives of teaching science identified by Ajala (2007) are meant to make relevant knowledge in science subject available to an individual. Such subjects in senior secondary schools include Biology, Physics, Chemistry and Mathematics. Also, scientific skills of observation, identification, classification, recording, experimenting, measurement, making inference etc. will be developed by an individual. Furthermore, explanations to some societal issues that could only

be answered through scientific knowledge will be provided. Among the objectives of science teaching is to cater for the personal needs of an individual. The invention of solar power, Television, Radio, mobile phones etc. were to provide for personal needs of an individual among others. Various careers in medicine, engineering, agriculture, communication is provided through science teaching.

### **Objectives and Content of Senior Secondary School Biology Curriculum**

Biology is the branch of science that involves the study of life. Biology is such a broad field, covering the minute working of chemical inside our cells, to broad scale concept of ecosystem and global climate change. Biology covers all the life processes such as movement, respiration, nutrition, irritability, growth, excretion and reproduction. The life processes are characteristics of all living things either plant or animal regardless of races and geographical distributions.

According to the National Policy on Education (FRN, 2013), learning of Biology will provide the students with suitable laboratory and field skills in biology, meaningful and relevant knowledge in Biology, scientific knowledge that is applicable, in health, agriculture, personal and community daily life matters and development of functional scientific attitudes.

To make objectives of teaching and learning of Biology achievable, emphasize should be placed on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking in the curriculum. In pursuance of the stated objectives, the (2009) edition of the Biology curriculum (NERDC, 2009) has organization of; life, work, environment and continuity of life as its themes.

### **2.1.3 The Effect of Class-Size on Academic Achievement**

Classrooms are designated into sizes for teaching learning activities. A size is the measurement of the degree of something in form of small, large or very large of which a standard is based for any use. Furthermore, a normal class size for effective teaching learning is the one which accommodates forty children as proposed by the National Policy on Education (NPE) and All Nigeria Conference on secondary schools (ANCOPSS), any number above forty students is regarded as a large class which may eventually constitute classroom congestion and low classroom utilization rate, a situation whereby a teacher of English fails to go to class to teach all the periods allotted to the subject per week.

Large class poses a lot of barriers on the/learning outcome. Asodike (2016) analyses the characteristics of large class as follows:

- Crowding – crowding depends on a number of cultural and behavioral factors which involve human value judgment.
- Noise – this takes away concentration and also pollutes the environment.
- Indiscipline – Hinders effective control of the class room.
- Inaccessibility – Teacher not being able to reach students on individual basis.
- Poor performance – Evaluation, feedback and grading are seldomly done.
- Bully and truancy – students hide under number, to threaten the weaker ones and also absent themselves from school unnoticed.

In the view of Aina (2010) “Classroom is an important dimension of teaching because management activities lead to the establishment and maintenance of those conditions in which instruction can take place effectively and efficiently”. Effectiveness in this sense generally refers to the extent to which the teachers achieve their teaching purposes. Ruffina (2018) is of the

opinion that large class has negative co-efficient with examination performances of students. He states further that “the relationship between class-size and academic performance is a major controversy; the lower teacher-student ratio allows for more effective communication between the learner and the teacher. Lodge *et al.* (2018) confirms that teaching large class calls for group dynamics, and only resourceful teachers can teach effectively in such a situation by some techniques of large class management. Learning in large class settings may be a particularly difficult adjustment for learners transitioning from sizeable classrooms to secondary schools where large classes are used. The sheer size and anonymity of large classes seem to militate against the very elements that promote students’ involvement and intellectual developments learning and success, inattention or absence from class and mediocre student; performance seem to be tolerated simply as unfortunate realities.

Large class size increases reliance on method of instruction. This naturally leads to the question of how learning outcomes achieved by subjects taught with method. Findings on the method strongly suggests that students’ attention and concentration tend to drop off dramatically after 10-20 minutes of continuous instructor discourse. Large classes reduce student’s level of active involvement in the learning process. It can be simply put that the student’s involvement or engagement in academic work or in the academic experience of school, the greater the level of knowledge acquisition and general cognitive development. Large class size reduces the frequency and quality of instructor interaction with feedback to students.

In large classes, it is likely that the vast majority of students in class will go through the entire term without experiencing a single interactive episode with the subject teacher; where it is person-to-person verbal exchange of ideas outside the classroom. This is particularly disturbing given that student faculty interaction is a school experience variable, which is strongly

associated with host of positive student's outcomes such as: Student retention; Academic achievement; Critical thinking; and Educational aspiration.

Large Class settings reduce student's depth of thinking inside the class. the synthesis of the existing evidence indicates that smaller classes are more effective than larger ones when the goals of instruction are motivational, attitudinal or higher-level cognitive progress. Large class size limits the breadth and depth of subject objectives, subject assignments and subject related learning outside the classroom. Since summary assignments involve writing, they are less likely to be employed by teachers who teach large classes thus, it may be expected that students in large classes will more likely adopt surface learning rather than deep learning strategies when preparing for subject's examinations. This suggests that large class size not only reduces the quality of student studying and learning outside the classroom.

Student's academic achievements (learning and academic performance (grades) are lowered in subjects with large class size loose attention more easily, become distracted by classroom noise and student's conversation, they are less motivated because of the impersonal nature of the class and lack of individual accountability. Harackiewicz (2016) observed that, students in large classes always complain of losing focus and interest in their studies. This is due to various factors which include: long periods in activity and sometimes from the teacher as well as lack of varieties involved in the process.

#### **2.1.4 Effect Gender on Academic Achievement**

Adigun *et al.* (2015) noted that gender is one of such factors also mentioned in literature to have considerable effects on students' academic performances especially in science subjects. Gender is the range of physical, biological, mental and behavioral characteristics pertaining to and

differentiating between the feminine and masculine (female and male) population. The importance of examining performance in relation to gender is based primarily on the socio-cultural differences between girls and boys. Some vocations and professions have been regarded as men's (engineering, arts and crafts, agriculture etc.) while others as women's (catering, typing, nursing etc.). In fact, parents assign task like car washing, grass cutting, bulbs fixing, climbing ladders to fix or remove things etc. to the boys. On the other hand, chores like dishes washing, cooking, cleaning and so on is assigned to the girls. In a nutshell, what are regarded as complex and difficult tasks are allocated to boys whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking the larger society has tended to see girls as a weaker sex". Consequently, an average Nigerian girl goes to school with these fixed stereotypes. In view of the belief that students' gender may have impact on the students' academic performance, this study will study the relationship between them if any.

Hdii and Faground (2018) defined achievement as attained success in any act. Achievement is the ability of an individual to reach a set goal through effort, skill or courage. In fact, academic achievement is the outcome of a good education and indicates how well a student or class of students is doing academically (Ali, 2013). In the same vein, Ganai and Muhammad (2013) defined academic achievement as knowledge attaining ability or degree of competence in school tasks usually measured by standardized tests and expressed in a grade or unit based on pupils' performance. Academic achievement is commonly measured by continuous assessment and examinations. It is, actually, the results of these examinations that have been used for the purpose of the present research. It is worth mentioning that students' academic achievement is affected by a host of factors. Among these are factors classified by Ocho (2005) as student factors, teacher factors, environmental factors, and economic factors.

First, academic achievement is generally affected by students' personal characteristics, namely their conscientiousness, personal efforts and motivation in addition to their intellectual abilities, learning strategies and awareness of academic goals. Moreover, family support, social economic background, family income, parents' education, family participation and involvement and siblings in school have also a considerable effect on the academic success or failure of students (Abubakar & Bada 2012). Additional factors according to Khurshid (2014) involve institutional support, institutional environment, effective teachers, teachers' expectations and behaviors, quality of lecturers and their instructional strategies, and class size. A determinant element that is closely related to all the previous factors and that is discussed in the present study is gender. The gender gap in academic achievement is an important issue to explore as it is a significant aspect of educational inequality.

Many studies on gender discrepancies (Lai 2010; Abubakar, Bada 2012; Eze *et al*, 2015) focused on differences in performance related to different science subjects. There are many different points of view, a fact which makes it a contested area (Ding 2010). Some of these studies have shown significant gender achievement gaps, with boys generally outperforming girls in Math and Science (Else-Quest *et al*. 2010) and girls excelling at literacy subjects. Others noted that these differences were not consistent. Ajai and Imoko (2015) undertook a study to assess gender differences in mathematics achievement and retention. The study proved that male and female students did not significantly differ in achievement and retention scores, which showed that they are capable of competing in mathematics.

Likewise, Voyer and Voyer (2014) conducted a research from 1914 through 2011 using a meta-analytic model and found out a small but significant female advantage that was largest for language courses and smallest for math and science. In this vein, Voyer and Voyer (2014) stated,

“Although gender differences follow essentially stereotypical patterns on achievement tests, for whatever reasons, females generally have the advantage on school marks regardless of the material.” This implies that in spite of the stereotypical belief that boys perform better than girls in tests as far as logical reasoning is concerned, we, as educators, observe a tendency from the part of females to excel in scientific subjects which require logic and reasoning. In fact, our study intends to confirm the extent to which this observation can be valid. The gender gap in academic achievement has been extensively examined in the U.S. and many other Western countries, yet virtually no rigorous studies of the gender achievement gap have been conducted in developing countries because of the limited availability of these countries’ secondary education data. Therefore, the present study is an attempt to show gender differences in academic achievement. It is worth noting that the paper does not aim to reinforce these gender differences but rather to explore them in order to find out major problems and obstacles that both males and females face to eventually reach gender equality

## **2.2 Theoretical framework**

### **2.2.1 Cognitive Development Theory**

The psychologist, Jean Piaget in 1963, propounds the Cognitive development theory which refers to all those activities that relates to thinking, reasoning, problem-solving which are characterised by complementary adaptive functions of assimilations and accommodation (Simatwa, 2010). One event that symbolises this period is the child’s transition from the limited atmosphere of the family to the wider and more demanding world of the school. Developing skills through learning begins with developing the cognitive power; the cognitive theorists are primarily concerned with developing of functioning of the mind. The Piaget theory of assimilation and accommodation refers to the incorporation of new knowledge into existing

scheme; while accommodation refers to the modification of the child's existing scheme to incorporate new knowledge.

Brown and Deolache (1983) describe, "Cognitive power as meta cognition which refers to learner's ability to actively monitor and exercise control over the use of his knowledge on skills in several activities of life which are goal oriented". Meta cognitive skills are required as strategies for studying, learning and memorising as aid in the classification and obtaining feedback which should lead to possible modification of the strategies. Furthermore, Meta cognitive skills are self-regulatory skills; they enable the individual to remember what is needed and to use appropriate retrieved information to solve problems.

### **2.2.2 Behavioral Learning Theory**

Graham (2010) noted that Behaviorist viewed learning as a process in which experience with the environment leads to a relatively permanent change in behavior or the potential for a change in behavior. Behaviorism is a philosophy of psychology that focuses on observable behaviors and requires an objective, observable behavior to demonstrate a state of mind or learning. It stresses that psychological events are confirmed and observed by behavioral measures. It dismisses the inner experience in learning and focuses learning as nothing more than gaining a new and observable behavior. To the behaviorists, "learning occurs when new changes in Behavior are acquired as a result of an individual response to the antecedent and consequent stimuli. The external environment shapes an individual's behavior by presenting antecedent stimuli that reinforces behavior" (Cognitive Design Solution, 2003). The Stanford Encyclopedia of Philosophy (2014) points out the three basic commitments of Behavioral Theory:

1. Psychology is a science in behavioral psychology. Psychology is also not the philosophy of mind.

2. Behavior may be described and explained without regard to mental experiences or internal psychological mechanisms. Behavior origins are external (environmental) and not internal (internal) (in the mind).

3. In the process of theoretical evolution of psychology, whether, in a sense, mental words or principles are used to define or justify behavior, either:

i. These terms or concepts should be eliminated and replaced by behavioral terms or

ii. They can be translated or paraphrased into behavioral concepts.

This shows that the Behavioral theory was mostly concerned with behavioral concepts rather than the cognitive or mental concepts. The Behaviorism Theory was developed by the work of B. F. Skinner 1951. (The theory of Operant Conditioning). Operating conditioning takes place as reinforcements are used to train a stimulus response. A Skinner box was developed and used to instruct pigeons to perform different behaviors by rewarding actions as naturally occurred until the pigeons responded to the stimuli with the reward action. Ivan Pavlov's Classical Conditioning Theory is another major theory of Behaviorism (1927). Pavlov's Classical Conditioning Principle discusses natural biological reactions and cue reflexes. The stimulus that is inserted does not teach a new behavior, it is used to induce a current behavior to occur. Pavlov (1927) used salivating dogs at the sight of food to prove his classical conditioning hypothesis. Cognitive Design Solution (2003) argued the importance of behavioral theory, they noted that many instructional arrangements seem 'contrived', but there is nothing wrong with that. It is the teacher's function to contrive conditions under which students learn. It has always been the task of formal education to setup behavior, which would prove useful or enjoyable, cater in a student's life. To the behaviorists, behaviors that the teacher wishes to encourage will be reinforced with positive stimulus or removal of negative stimulus. If behavior followed a positive

stimulus, it is more likely that it will be repeated in the hope of eliciting the same positive stimulus. Teacher has to be consistent. Teacher should also reward students for their work with treats, play privileges or grades (good or bad) for positive and negative behaviors. McNeeley (2007) used the behaviorist theory to teach students lesson on milk production. Here are the steps and procedures she followed:

1. “The teacher begins the lesson by having the children gathered during group time on large carpet. As the children sit on the larger carpet facing the teacher only, he or she presents the book ‘The Milk Makers’ by Gail Gibbons. The children face only the teacher to avoid undesirable reinforcement that could distract from goal of the lesson”
2. “The teacher uses the picture book to explain the topic because the children are engaged with the visual material as the teacher narrates the pictures. As the children listen to the story, they receive a summary of the information they are expected to learn. When the teacher finished reading the story, he or she re-explains the four stages of milk production.
3. “As the teacher summarizes the information, he passes to each child set of pictures to view. The teacher tests the children on their understanding by having them hold up the pictures in sequential order”.

This assessment, according to McNeeley (2007), was based on both classical and operant conditioning. Each child will hold up a picture, the Unconditioned Response, when the teacher asked for a certain card, the Unconditioned Stimulus. The teacher positive feedback, a Conditioned Stimulus will prompt the choice, the Conditioned Response, according to the lesson. Operant Conditioning is utilized as the children are reinforced with stickers and chosen activities. During the teacher’s assessment, the children hold up one picture at the time. The children face the teacher so each child is focusing on appropriate picture and the teacher’s feedback. Each

child who holds up the appropriate picture receives a star. When a child receives four stars in a row, he or she may leave the group area for a chosen activity. The teacher retests the remaining children until each has mastered the material.

The Behaviorist theory simply focused the child's attention on the materials displayed by his teacher. The teacher must also remain focus to avoid any distraction. The Behaviorist's Teaching Machine Phase, The Programmed Instruction Motivation Movement, Individual's Instructional Approach, Computer-Assisted Instruction and The Systems Approach are basic versions of what educational software and computer can accomplish now. The teaching machine, according to Ebert (2009), could be compared to a box that sat on students' desk that each individual student could use to record answers to certain prompted question. In using the device, the student refers to the numbered items in a multi-choice test. He presses the button corresponding to his first choice of answer. If he or she is right the device move on to the next item, if he or she is wrong, the error is tallied and he must continue to make choice until he or she is right. The example by Ebert (2009) has further buttressed the assertions that there were similarities between The Skinner's Teaching Machine and today's Instructional Computer Software designed for reinforcing students' behavior. Skinner (1974) as quoted by Cognitive Design Solution (2003) referred to the Teaching Machine as "devices, which arrange optimal condition for self-instruction".

### **2.2.3 Constructivism Theory**

The constructivism theory was propounded in 1978 by Vygosky (McLeod, 2019). Constructivism is 'an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner' (Elliott *et al.*, 2000, p. 256). Constructivism believes in personal construction of meaning by the learner through experience, and that meaning is influenced by the interaction of prior knowledge and

new events. Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning.

This prior knowledge influences what new or modified knowledge an individual will construct from new learning experiences. The passive view of teaching views the learner as 'an empty vessel' to be filled with knowledge, whereas constructivism states that learners construct meaning only through active engagement with the world (such as experiments or real-world problem solving).

Information may be passively received, but understanding cannot be, for it must come from making meaningful connections between prior knowledge, new knowledge, and the processes involved in learning.

Learning is a social activity - it is something we do together, in interaction with each other, rather than an abstract concept (Dewey, 1938). Vygotsky (1978), believed that community plays a central role in the process of "making meaning." For Vygotsky, the environment in which children grow up will influence how they think and what they think about. Thus, all teaching and learning is a matter of sharing and negotiating socially constituted knowledge.

The primary responsibility of the teacher is to create a collaborative problem-solving environment where students become active participants in their own learning. From this perspective, a teacher acts as a facilitator of learning rather than an instructor. The teacher makes sure he/she understands the students' preexisting conceptions, and guides the activity to address them and then build on them (Oliver, 2000). This theory is relevant is a smaller class size allows for collaboration and for effective learning to take place.

### **2.2.4 Experiential Learning Theory**

Learning by doing is the basis for the experiential learning theory, this theory was propounded by David Kolb in 1984 (WGU, 2020). Experiential learning focuses on the idea that the best ways to learn things is by actually having experiences. Those experiences then stick out in your mind and help you retain information and remember facts. For teachers, creating opportunities for students to have experiences based on the things they are learning about is key. Teachers can help create environments where students can learn and have experiences at the same time.

If you're a current teacher, or studying to become one, it's important to get a degree that will give you qualifications and knowledge for your career, and help prepare you to be licensed. Additionally, it's key to understand how different students learn and understand how different learning theories impact education. Teachers who understand learning theories can better optimize their classroom and help more students learn in ways that work for them. Being a successful teacher means focusing on how best to help students succeed.

The experiential learning theory works in four stages—concrete learning, reflective observation, abstract conceptualization, and active experimentation. The first two stages of the cycle involve grasping an experience, the second two focus on transforming an experience. Kolb argues that effective learning is seen as the learner goes through the cycle, and that they can enter into the cycle at any time. This theory promotes teamwork, motivation and immediate application of knowledge gained.

Concrete learning is when a learner gets a new experience, or interprets a past experience in a new way. Reflective observation comes next, where the learner reflects on their experience personally. They use the lens of their experience and understanding to reflect on what this

experience means. Abstract conceptualization happens as the learner forms new ideas or adjusts their thinking based on the experience and their reflection about it.

Active experimentation is where the learner applies the new ideas to the world around them, to see if there are any modifications to be made. This process can happen over a short period of time, or over a long span of time. Kolb went on to explain that learners will have their own preferences for how they enter the cycle of experiential learning, and that these preferences boil down to a learning cycle.

### **2.3 Empirical Studies**

Class size is a very important factor in the teaching/learning activities as it relates to student academic performance. Researchers such as Ruffina *et al.* (2018) investigated the impact of class size on students' academic performance across selected public senior secondary schools in Idemili North Local Government Area of Anambra State. In this study, the effect of class size directly on students' performance; psychological effect of class size on students' performance and social effect of class size on students' academic performance were analyzed. Self-administered questionnaire was used as instrument for data collection in the study. A sample of one hundred and fifty (150) students in three selected public senior secondary schools was used. Senior secondary two (SS2) and three (SS3) students were used for the study. The students were selected randomly and one hundred and forty (140) questionnaires was correctly filled and collected, ten (10) questionnaires was either not collected or wrongly filled, thereby rendered invalid by the respondent. The analysis was done using descriptive statistics, percentage and frequencies. It was found that large class size had negative effect on students' academic performance in biology. It was also observed that class size has psychological and social effect on students' academic performance. Where the class size cannot be reduced in a given time due

to challenges beyond the control of the school authorities, it is recommended that teachers and management of the school should employ rotational students' group formation and study.

Uhrain (2016) examined whether class size in secondary school predicted student achievement as measured by teacher-issued end-of-course numerical student grades (TIECNSG). The study used a correlation design with a sample of 17,582 TIECNSG from 5 secondary schools in the district. The effect of smaller class sizes on TIECNSG was determined through the use of a linear regression model. For 9 course offerings, an increase in class size resulted in a decrease in TIECNSG, whereas for 8 course offerings, an increase in class size resulted in an increase in TIECNSG. The results of this study, therefore, were inconclusive, suggesting that other unaccounted confounding variables may have affected student achievement. This study can be used to promote positive social change by creating a dialogue between parents and school administrators who often have opposing points of view in terms of the effects of class size. In addition, it is recommended that a district's school board should authorize additional studies prior to taking any course of action that would affect class size at the secondary school level.

Ayeni and Olowe (2016) provide views of both lecturers and students on large class size and how it affects teaching and learning in tertiary institutions in Ekiti State of Nigeria. The study employed survey design; the population consisted of all lecturers and students in College of Education in Ikere-Ekiti, Ekiti State, University of Nigeria, Nsukka, Ikere Campus and Ekiti State University, Ado Ekiti, Ekiti State. The total populations of thirty (30) lecturers were used for the sample, while five hundred and twenty (520) final year students were randomly selected. The research instruments used in data collection were questionnaire. The findings of this study revealed that large class size has negative implications on effective teaching and learning of Business Education in tertiary institutions. The relationship between large class and effective

teaching and learning is very low. The authors recommended among others that management should employ more lecturers for the teaching of Business Education in tertiary institutions if they want to admit large number of students because of income, also the institution should make extra effort to provide more resources and facilities to promote effective teaching and learning of Business Education.

Obiakor and Oguejioffor (2020) examined the impact of classroom size on academic performance of secondary school students in Nigeria. The specific objectives studied include the following: To investigate the effect of class size on the educational performance of secondary school students, to determine the extent to which the class size affects the manner in which teaching and learning is mediated in secondary schools. The research design used in this study is the survey research design. The design of the study was carefully carried out to suit the purpose of the research project using primary source of data. The population of this study consists of teachers in public secondary schools in Enugu North Local Government Area. The population, according to the census figure released by the Post Primary School Management Board (PPSMB) in 2015 is given as, nine (9) secondary schools in Enugu north LGA, seven hundred and sixty-one (761) teachers. (PPSMB 2015), Data treatment method was by use of tables. Based on the findings of this study, this study concludes that large class size contributes to poor academic performance, it results to poor teaching methods, instructional materials are not used properly in a large class size because, it is very hard for the teacher to show the students the instructional material especially those at the back. Some of the recommendations made in the study include that; Policy makers should consider as a matter of priority the issue of increased funding of secondary school education in Nigeria. Increased funding will help to ameliorate problems facing academic performance in secondary schools, School supervisors and inspector

should concentrate more on the number of students in each class and avoid overcrowding in classes.

Olayemi (2017) investigated the effect of class classification, class size and gender on academic performance. Specifically, the objectives of the study were to evaluate the effect of class classification, class size and gender on academic performance of senior secondary school students in Mathematics and English Language. However, three research questions and hypothesis were designed to guide the study. The study employed expo-facto research design and purposeful sampling technique which is stratified in nature in selecting all one-hundred and eighty-nine (189) Grade II (SSS II) students participated in the Unified Promotion Examination (UPE) conducted by Osun State Ministry of Education in May, 2017. In this regards, Grade II students' scores in Mathematics and English Language was used to proxy academic performance which are disaggregated into three strata such as class stream (Science, Art and Commercial), gender (female and male) and class size (large class size and small class size). Inferential statistics such as t-statistics was used to analyses the generated data. It was concluded that the explanatory variables such as class classification, class size and gender are not only the necessary condition in determining academic performance among students but also work hand-in-hand with other factors in order to guarantee favorable academic performance. The study recommended intensification of efforts by school authority towards monitoring of students in doing class work, assignment, punctuality in school and re-visitation of the classroom instructional practice by the teachers among others.

#### **2.4 Summary of the Literature Reviewed**

The literature reviewed revealed the concept of nature and scope of Biology, the Biology curriculum in Nigeria, effect of class size on academic achievement, effect of gender on academic achievement. These concepts were discussed in detail to build up the conceptual

framework of the study. Four (4) theories were found to be relevant to the study, these were the Cognitive Development Theory, Behavioral Theory, Constructivism Theory and the Experiential Learning Theory. These theories built up the theoretical framework of the study. The empirical studies revealed the effect of class size on teaching and learning, it revealed the effect of class size on academic achievement with researchers revealing that class size has a significant effect on achievement and performance of students. The empirical studies also revealed that gender is not the only necessary condition in determining academic performance among students but also work hand-in-hand with other factors in order to guarantee favorable academic performance.

## CHAPTER THREE

### 3.0

### METHODOLOGY

#### 3.1 Research Design

The design of this study was quasi- experimental. Quasi research design is an experiment where random assignment of subjects to experimental and control groups is not possible; hence, the intact or pre-existing groups are used.

#### 3.3 Population of the Study

The total population of the study consisted of 4,215 secondary school students in Bosso Local Government Area of Niger state (Ministry of Education, 2012). The target population for this study is Biology students in secondary schools in Bosso Local Government Area, Niger State.

#### 3.4 Sample and Sampling Technique

A sample of one hundred and two (102) students from SSII was selected for the study as the researcher made use of intact classes; the students from each school were sampled as they were in the class. The simple random sampling was used to assign the schools into experimental and control. The Federal University of Technology Model secondary served as the experimental group while Bosso secondary school served as the control group. The sample distribution is shown in table 3.1

**Table 3.1 Sample Distribution of Students**

S/N	SCHOOLS	Male	Female	POPULATION
1	FUT Model Secondary School, Bosso.	14	13	27
2	Bosso Secondary School, Bosso	44	31	75
	<b>Total</b>	<b>58</b>	<b>44</b>	<b>102</b>

### **3.5 Research Instrument**

The instrument designed for data collection was a test item titled Biology Achievement Test (BAT) made of two sections. Section 'A' provided Bio-data information of the students while section 'B' was consisting of twenty (20) multiple choice questions with options lettered A-D on the digestive system. The researcher administered the BAT at the pretest before teaching commenced and the posttest was administered after instruction.

### **3.6 Validity of the Instrument**

The test items were given to two experts in the Department of Science Education, School of Science and Technology Education, Federal University of Technology Minna, Niger State. For face and content validation. The comments of these experts helped the researcher to modify the test instrument before production.

### **3.7 Reliability of the instrument**

To ascertain the reliability of the instrument, the researcher used test-retest method by administering the Biology Achievement Test (BAT) to twenty students from Ahmadu Bahago secondary school which was not part of the sample population. The result of this method was analysed using Pearson Production Moment Correlation Co-efficient (PPMC) to determine reliability co-efficient of 0.71.

### **3.8 Method of data collection**

The researcher obtained permission from the selected schools by a letter issued from the HOD Science Education, Federal University of Technology Minna and then visited the schools by introducing himself to the principal(s) of the selected schools, stating the purpose of his visit. The pre-test was first administered to both the experimental and control groups before teaching commenced and after one week, the post-test was administered.

### **3.9 Method of Data Analysis**

Mean and standard deviation was the statistical instrument the researcher used to analyse the data and the hypothesis was tested using t-test statistics and computed using Statistical Package for Social Sciences (SPSS) version 25.00.

## CHAPTER FOUR

### 4.0

### RESULTS AND DISCUSSION

#### 4.1 Result

In this chapter, data for the study were analyzed and presented based on the research questions and hypotheses that guided the study. The research questions were answered using mean and standard deviation while independent statistics was used to test the research hypotheses. All the hypotheses were tested at  $P < 0.05$  level of significance.

**Research Question One:** What is the mean difference between the achievement of student taught Biology in large class setting and those taught Biology in the small class setting?

**Table 4.1 Mean and Standard Deviation of posttest scores of students in the experimental and control group**

Group	N	Pretest		Posttest	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental	27	4.00	1.34	17.73	2.61
Control	75	3.48	1.18	9.62	1.11

Table 4.1 indicates that students taught Biology in small class had a mean achievement score of 17.73 with a standard deviation of 2.61 at the posttest while those taught using in large classes had a mean achievement score of 9.62 and a standard deviation of 1.11. From the posttest mean scores, it is revealed that the students that were taught in small classes scored higher than those taught in large classes.

**Research Question 2:** To what extent does class size affect the mean achievement scores of male and female students in Biology?

**Table 4.2 Mean and Standard Deviation of male and female achievement scores of students in the experimental group**

Group	N	Pretest		Posttest	
		$\bar{x}$	SD	$\bar{x}$	SD
Male	14	4.15	1.57	16.46	3.97
Female	13	3.75	1.13	17.66	2.90

Table 4.2 reveals the influence of gender on the mean achievement scores of students taught Biology in small class size. The male students had a mean achievement score of 16.46 and a standard deviation of 3.97 at the posttest, the female students had a mean achievement score of 17.66 and a standard deviation of 2.90. This indicates that females achieved higher than their male counterparts, although the difference in the mean achievement score is shown in table 4.5.

#### 4.2 Hypothesis Testing

**HO<sub>1</sub>:** There is no significant difference in the mean achievement scores of students taught Biology in the large class setting and those taught Biology in the small class setting in Niger State.

**Table 4.4 T-test for the posttest achievement scores of the experimental and control groups**

Group	N	Df	$\bar{x}$	SD	t-value	p-value
Experimental group	27		17.73	2.61		
		100			14.64	0.00
Control group	75		9.62	1.11		

Significant at  $p < 0.05$

Table 4.4 shows the mean achievement scores of students taught Biology in small class size and those taught in large class size. There was a significant difference between the mean

achievement scores of students taught Biology small class size and those taught in large class size as determined by the t-test analysis with a t-value at 14.64 and a p-value of  $0.00 < 0.05$ . Students taught using class size (M=17.73, S. D=2.61) scoring higher than students taught using the conventional method (M=9.62, SD=1.11). Therefore, the null hypothesis was rejected.

**Hypothesis 2:** There is no significant difference in the mean achievement scores of male and female students in Biology

**Table 4.5 t-test statistics of male and female student’s achievement scores**

Gender	N	Df	$\bar{x}$	SD	t-value	p-value	Decision
Male	13		16.46	3.97			
		21			-0.86	0.39	NS
Female	10		17.66	2.90			

NS= Not Significant at  $p > 0.05$  level

Table 4.5 shows the mean achievement scores of male and female students taught Biology in small class size. There was no significant difference between the mean achievement scores of male and female students taught Biology in small class size as determined by the t-test analysis with a t-value at -0.86 and a p-value of  $0.39 > 0.05$ . Male students (M=16.46, S.D=3.97) while the female students (M=17.66, SD=2.90). Therefore, the null hypothesis was accepted.

### 4.3 Discussion of Findings

The data analyzed in this chapter were interpreted and discussed on the results derived from four research questions and hypotheses. The main objective of the research is to determine the effect of class size on teaching and learning of Biology among senior secondary schools in Bosso Local Government Area of Niger State. The posttest scores in table 4.1 shows that the experimental group (M=17.73, S.D=2.61) had a higher achievement scores than the control group (M=9.62,

S.D=1.11). Similarly, the p-value associated with the calculated value of t.val (14.64) in table 4.4 is 0.00 which is less than the level of significance; the null hypothesis was therefore rejected. Hence, there is significant difference in the mean achievement scores of students taught Biology in small class size. Small class size therefore has a significant effect on student's achievement in Biology as compared to large class size. This was in line with the findings of Ruffina et al. (2018), Ayeni and Olowe (2016), Obiakor and Oguejiorfor (2020) who revealed that large class size had negative impact on students' academic achievement.

The female Biology students (M=17.66, S.D=2.90) achieved higher than the male students at posttest level (M=16.46, S.D=3.97). Although, the p-value revealed there was no significant difference (p=0.39), in table 4.5 the p-value was greater than the 0.05 level of significance hence, the null hypothesis was accepted. This indicated that there is no significant difference in the mean achievement scores of male and female Biology students. This was in line with the findings of Olayemi (2017) who revealed that there was no influence of gender on the academic achievement of students taught in small classes.

## CHAPTER FIVE

### 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter is aimed at summing up the findings of this study as well as to draw the conclusion from the research study. And finally, the researcher gives recommendations based on the findings of the study.

##### 5.1.1 Summary

From this research, it has been observed that class size affect teaching and learning of Biology among senior secondary.

The findings revealed that class size has an impact on the academic achievement of students as the experimental group taught in a small class outperformed those taught in large classes.

The findings revealed that there was no significant difference in the mean achievement scores of male and female students in Biology, hence the null hypothesis was accepted which implies that there is no significant difference in the mean achievement scores of male and female students in Biology

#### 5.2 Conclusion

Based on the following findings above the researcher conclude that class size has an effect on teaching and learning of Biology among senior secondary schools in Bosso local government area of Niger State.

#### 5.3 Recommendations

Having discovered the aforementioned from the study, the following recommendations are therefore postulated:

1. Workshops and seminars should be organized for teachers of Biology periodically to enhance and improve their classroom efficiencies.

2. Government should make provision for more instructional materials such as laboratories, conducive and serene learning environment for the purpose of optimizing the teachers' and students' output in Biology.
3. There is need to effect the teacher-students ratio policy stated in the National Policy on Education so as to reduce the congestion in our classes.
4. Each school administrator should also see to it that classes exceeding forty students should be broken into arms and liaise with appropriate authority to make provision for infrastructural and other necessary facilities.
5. In cases where large classes could not be broken down as a result of factors beyond the administrators and teachers control, the Biology teachers should embark on grouping the students. This will give room for efficiency, monitoring the student's participation in the class, identifying the deviant students, identifying students' individual differences and also make the available instructional materials to circulate.

#### **5.4 Suggestions for further studies**

1. Impact of class size on the academic achievement and retention of Biology among senior secondary schools in Bosso Local Government Area of Niger State.
2. Perception of class size on secondary school student's motivation and interest in Minna Metropolis.

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## APPENDIX A

### BIOLOGY ACHIEVEMENT TEST (BAT) PRETEST

1. The alimentary canal is a long tube stretching from the \_\_\_\_\_ to the \_\_\_\_\_  
A) Mouth and anus (B) Anus and eyes  
(C) Mouth and nose (D) Nose and ear
2. Mechanical digestion is carried out using the \_\_\_\_\_ while chemical digestion is carried out by the help of \_\_\_\_\_ respectively?  
A) Teeth, enzymes (B) enzymes, saliva  
C) Saliva, teeth (D) teeth, tongue
3. The name of the enzyme contained in saliva which acts on cooked starch is called  
A) oesophagus (B) glands (C) ptyalin (D) chemical saliva
4. Saliva can be defined as a watery, slightly alkaline substance secreted by the \_\_\_\_\_  
(A) Chemical gland (B) Salivary gland (C) Mechanical gland (D) Saliva and tongue gland
5. Another name for the trachea and oesophagus are \_\_\_\_\_ and \_\_\_\_\_ respectively  
(A) Windpipe and gullet (B) saliva and pharynx (C) Alkaline and ptyalin (D) glands and tongue
6. The \_\_\_ flaps down to cover the trachea during swallowing  
(A) Oesophagus (B) Windpipe (C) Trachea (D) Epiglottis
7. The process where bands of muscles contract and relax alternately to push each bolus of food downwards slowly is referred to as \_\_\_\_\_  
(A) Peristalsis (B) Gullet (C) Digestion (D) Muscle process
8. Anti-peristalsis are food that moves backward  
(A) True (B) False (C) partially true (D) None of the above
9. When does food enter into the stomach?

(A) At the point the ring of sphincter at the entrance of the stomach relaxes (B) At the point the muscles at the entrance of the stomach contracts (C) At the point the sphincter at the entrance of the stomach contracts and relaxes (D) None of the above

10. Gastric juice contains two (2) important enzymes, name them

(A) Alkaline and sphincter (B) Pepsin and renin (C) Option A and B (D) All of the above

11. Pepsin works in an \_\_\_\_\_ medium

(A) alkaline (B) polypeptides (C) Acidic (D) Protease

12. The coagulation of milk into thick curds is caused by\_\_\_\_\_

(A) Sphincter (B) Pepsin (C) Renin (D) Bacteria

13. The process whereby food is retained in the stomach for 3-4 hours becoming a thick, creamy fluid is called

(A) Chyme (B) Food retainer (C) Caseinogen (D) Nutrition

14. The\_\_\_\_\_ is the first part of the small intestine

(A) Duodenum (B) Sphincter (C) Renin (D) Caseinogen

15. A watery alkaline liquid containing several digestive enzymes is called\_\_\_\_\_

(A) Jejunum (B) Pancreatic juice (C) Ileum (D) Gastric juice

16. When \_\_\_\_ enters the duodenum, certain hormones stimulate the pancreas and gall bladder to send their digestive juices to the duodenum

(A) Pancreatic juice (B) ileum (C) Chyme (D) Polypeptides

17. Pancreatic juice contains three (3) important enzymes namely

(A) Amylopsin, pepsin and renin (B) Pepsin, renin and chyme (C) Amylopsin, trypsin and lipase (D) Trypsin, chyme and lipase

18. The “gall bladder” is where the \_\_\_\_\_ is stored which is produced by the liver

(A) Pancreas (B) Duodenum (C) Gastric juice (D) Bile

19. Maltose is changed to glucose by\_\_\_\_\_, lactose is changed to glucose and galactose by\_\_\_\_\_ and sucrose is changed to glucose and fructose by\_\_\_\_\_ respectively

(A) Maltase, lactase and galactase (B) Lactase, galactase and fructose (C) Galactase, fructose and sucrose (D) Maltase, lactase and sucrose

20. Erepsin changes all polypeptides to amino acids which are the end products of \_\_\_\_\_ digestion

(A) Protein (B) Carbohydrate (C) Fats (D) Glycerol

## APPENDIX B

### ANSWERS

1. A
2. A
3. C
4. B
5. A
6. D
7. A
8. A
9. A
10. B
11. C
12. C
13. A
14. A
15. B
16. C
17. C
18. D
19. D
20. A

## APPENDIX C

### BIOLOGY ACHIEVEMENT TEST (BAT) POSTTEST

1. The alimentary canal is a long tube stretching from the \_\_\_\_\_ to the \_\_\_\_\_  
A) Mouth and anus (B) Anus and eyes  
(C) Mouth and nose (D) Nose and ear
2. Mechanical digestion is carried out using the \_\_\_\_\_ while chemical digestion is carried out by the help of \_\_\_\_\_ respectively?  
A) Teeth, enzymes (B) enzymes, saliva  
C) saliva, teeth (D) teeth, tongue
3. The name of the enzyme contained in saliva which acts on cooked starch is called  
A) oesophagus (B) glands (C) ptyalin (D) chemical saliva
4. Saliva can be defined as a watery, slightly alkaline substance secreted by the \_\_\_\_\_  
(A) Chemical gland (B) Salivary gland (C) Mechanical gland (D) Saliva and tongue gland
5. Another name for the trachea and oesophagus are \_\_\_\_\_ and \_\_\_\_\_ respectively  
(A) Windpipe and gullet (B) saliva and pharynx (C) Alkaline and ptyalin (D) glands and tongue
6. The \_\_\_ flaps down to cover the trachea during swallowing  
(A) Oesophagus (B) Windpipe (C) Trachea (D) Epiglottis
7. The process where bands of muscles contract and relax alternately to push each bolus of food downwards slowly is referred to as \_\_\_\_\_  
(A) Peristalsis (B) Gullet (C) Digestion (D) Muscle process
8. Anti-peristalsis are food that moves backward  
(A) True (B) False (C) partially true (D) None of the above
9. When does food enter into the stomach?

(A) At the point the ring of sphincter at the entrance of the stomach relaxes (B) At the point the muscles at the entrance of the stomach contracts (C) At the point the sphincter at the entrance of the stomach contracts and relaxes (D) None of the above

10. Gastric juice contains two (2) important enzymes, name them

(A) Alkaline and sphincter (B) Pepsin and renin (C) Option A and B (D) All of the above

11. Pepsin works in a \_\_\_\_\_ medium

(A) Alkaline (B) polypeptides (C) Acidic (D) Protease

12. The coagulation of milk into thick curds is caused by\_\_\_\_\_

(A) Sphincter (B) Pepsin (C) Renin (D) Bacteria

13. The process whereby food is retained in the stomach for 3-4 hours becoming a thick, creamy fluid is called

(A) Chyme (B) Food retainer (C) Caseinogen (D) Nutrition

14. The\_\_\_\_\_ is the first part of the small intestine

(A) Duodenum (B) Sphincter (C) Renin (D) Caseinogen

15. A watery alkaline liquid containing several digestive enzymes is called\_\_\_\_\_

(A) Jejunum (B) Pancreatic juice (C) Ileum (D) Gastric juice

16. When \_\_\_\_ enters the duodenum, certain hormones stimulate the pancreas and gall bladder to send their digestive juices to the duodenum

(A) Pancreatic juice (B) ileum (C) Chyme (D) Polypeptides

17. Pancreatic juice contains three (3) important enzymes namely

(A) Amylopsin, pepsin and renin (B) Pepsin, renin and chyme (C) Amylopsin, trypsin and lipase (D) Trypsin, chyme and lipase

18. The “gall bladder” is where the \_\_\_\_\_ is stored which is produced by the liver

(A) Pancreas (B) Duodenum (C) Gastric juice (D) Bile

19. Maltose is changed to glucose by\_\_\_\_\_, lactose is changed to glucose and galactose by\_\_\_\_\_ and sucrose is changed to glucose and fructose by\_\_\_\_\_ respectively

(A) Maltase, lactase and galactase (B) Lactase, galactase and fructose (C) Galactase, fructose and sucrose (D) Maltase, lactase and sucrose

20. Erepsin changes all polypeptides to amino acids which are the end products of \_\_\_\_\_ digestion

(A) Protein (B) Carbohydrate (C) Fats (D) Glycerol

## APPENDIX D

### ANSWERS

1. A
2. A
3. C
4. B
5. A
6. D
7. A
8. A
9. A
10. B
11. C
12. C
13. A
14. A
15. B
16. C
17. C
18. D
19. D
20. A

## APPENDIX E

### LESSON PLAN FOR THE CONTROL GROUP

School	FUT Model secondary school
Date	20th May, 2021
Number in Class	27
Sex	Mixed class
Average age	14-17
Subject	Biology
Topic	Digestive System
Subtopic	Alimentary canal and digestion of food in humans
Time	10:00 - 10:40
Duration	40mins
Period	1 <sup>st</sup>
Method of Teaching	Discussion, Demonstration
Teaching Techniques	Set induction, Questioning
Instructional materials	Whiteboard, Diagrams
Specific Objective	At the end of the lesson students should be able to; a. Define alimentary canal b. Explain at least four processes of digestion in the mouth and stomach c. Mention three (3) digestion process in the small intestine
Introduction	Teacher introduce the lesson by asking the students the following questions: a. What is Digestion b. Mention two (2) process through which digestion can take place
PRESENTATION	Teacher presents the lesson by the following steps
Step I	Teacher explains that the alimentary canal is adapted for breaking up food into smaller pieces; producing digestive secretions and absorbing digested food and water
Step II	Teacher explains the digestion in the mouth 1. Mechanical digestion: here, the teeth cut and grind food into smaller pieces 2. Chemical digestion begins with saliva, saliva contains an enzyme calle ptyalin which acts on cooked starch, converting it into complex sugars Digestion in the stomach 1. The muscular walls of the stomach contracts and relax forcefully thus churning the food 2. Gastric juice is mixed into the food, it contains two important enzymes; renin and pepsin Pepsin is a protease, digesting proteins to polypeptides which

are intermediate products of protein digestion

Renin causes the coagulation of milk into thick curds, it does this by acting on soluble milk protein, caseinogen and converting it into insoluble caseinogen and converting into insoluble casein

Step III

Digestion process in the small intestine

1. The duodenum is the first part of the small intestine. Several substances are secreted into the duodenum. The pancreas secretes pancreatic juice, a watery alkaline liquid containing several digestive enzymes
2. The liver: produces bile which is stored in the gall bladder. Bile is greenish alkaline liquid which does not contain digestive enzymes
3. The ileum: intestinal juice is produced by special cells of the small intestine. This liquid contains a number of enzymes which work in an alkaline medium and complete the process of digestion.

EVALUATION

Teacher evaluates the lesson by asking the students the following questions.

- i. Define alimentary canal?
- ii. Explain at least four processes of digestion in the mouth and stomach?
- iii. Mention three digestion process in the small intestine?

SUMMARY

The teacher repeats the salient points of the lesson on the chalkboard, ask the students to copy the notes

Conclusion

The teacher concludes the lesson by summarizing the main point of the lesson

Assignment

State three processes of absorption of digested food

Reference material

Essential Biology for Secondary schools.

## APPENDIX F

### LESSON PLAN FOR THE CONTROL GROUP

School	Bosso secondary school, Minna
Date	25th May, 2021
Number in Class	75
Sex	Mixed class
Average age	14-17
Subject	Biology
Topic	Digestive System
Subtopic	Alimentary can and digestion of food in humans
Time	10:00 - 10:40
Duration	40mins
Period	2 <sup>nd</sup>
Method of Teaching	Discussion, Demonstration
Teaching Techniques	Set induction, Questioning
Instructional materials	Whiteboard, Diagrams
Specific Objective	At the end of the lesson students should be able to; a. Define alimentary canal b. Explain at least four processes of digestion in the mouth and stomach c. Mention three (3) digestion process in the small intestine
Introduction	Teacher introduce the lesson by asking the students the following questions: c. What is Digestion d. Mention two (2) process through which digestion can take place
PRESENTATION	Teacher presents the lesson by the following steps
Step I	Teacher explains that the alimentary canal is adapted for breaking up food into smaller pieces; producing digestive secretions and absorbing digested food and water
Step II	Teacher explains the digestion in the mouth 3. Mechanical digestion: here, the teeth cut and grind food into smaller pieces 4. Chemical digestion begins with saliva, saliva contains an enzyme called ptyalin which acts on cooked starch, converting it into complex sugars Digestion in the stomach 3. The muscular walls of the stomach contracts and relax forcefully thus churning the food 4. Gastric juice is mixed into the food, it contains two important enzymes; rennin and pepsin Pepsin is a protease, digesting proteins to polypeptides which

are intermediate products of protein digestion

Renin causes the coagulation of milk into thick curds, it does this by acting on soluble milk protein, caseinogen and converting it into insoluble caseinogen and converting into insoluble casein

Step III

Digestion process in the small intestine

4. The duodenum is the first part of the small intestine. Several substances are secreted into the duodenum. The pancreas secretes pancreatic juice, a watery alkaline liquid containing several digestive enzymes
5. The liver: produces bile which is stored in the gall bladder. Bile is greenish alkaline liquid which does not contain digestive enzymes
6. The ileum: intestinal juice is produced by special cells of the small intestine. This liquid contains a number of enzymes which work in an alkaline medium and complete the process of digestion.

EVALUATION

Teacher evaluates the lesson by asking the students the following questions.

- iv. Define alimentary canal?
- v. Explain at least four processes of digestion in the mouth and stomach?
- vi. Mention three digestion processes in the small intestine?

SUMMARY

The teacher repeats the salient points of the lesson on the chalkboard, ask the students to copy the notes

Conclusion

The teacher concludes the lesson by summarizing the main point of the lesson

Assignment

State three processes of absorption of digested food

Reference material

Essential Biology for Secondary schools.