RELATIVE EFFECTIVENESS OF FLIPPED CLASSROOM AND POWERPOINT INSTRUCTIONAL APPROACHES ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN BIOLOGY

BY

ADONU, JULIET CHIOMA
PG/M.ED/16/80682

DEPARTMENT OF SCIENCE EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF NIGERIA, NSUKKA.

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TITLE PAGE

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A THESIS PRESENTED TO THE DEPARTMENT OF SCIENCE EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA IN PARTIAL FULFILMENT OF THE REQUIRMENT FOR THE AWARD OF MASTERS IN EDUCATION DEGREE (M.Ed) IN SCIENCE EDUCATION (BIOLOGY EDUCATION)

SUPERVISOR: PROF. C. R. NWAGBO

JANUARY, 2020.

CERTIFICATION

Adonu Juliet Chioma, a post graduate student of the Department of Science Education, Faculty of Education, University of Nigeria, Nsukka, with registration number PG/M.ED/16/80682 has satisfactorily completed the requirements for the award of the degree of Masters in Science Education (Biology).This work embodied in this thesis is original and has not be submitted in part or full for any other diploma or degree of the University or any other University.

_____	_____
Adonu Juliet Chioma	**Prof C. R. Nwagbo**
Student	Supervisor

APPROVAL PAGE

This thesis has been approved by the Department of Science Education, University of Nigeria, Nsukka.

By

Prof. C. R. Nwagbo
Supervisor

Prof. J. C. Adigwe
Head of Department

Internal Examiner

External Examiner

Prof. D. Ngwuoke
Dean, Faculty of Education

DEDICATION

This research work is dedicated to God Almighty.

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Abstract

The study investigated the relative effectiveness of Flipped classroom and PowerPoint instructional approaches on students' achievement and retention in biology in Enugu State, Nigeria. The study was guided by six research questions and six hypotheses. Quasi-experimental design of 2x2 factorial design was adopted for the study. Population of the study comprised of 4,828 Senior Secondary School two (SS2) students from 48 senior secondary schools in Obollo Afor Education Zone. The study employed multistage sampling procedure; comprising purposive and simple random sampling. One instrument was used for data collection in this study, Biology Achievement Test (BAT). The instrument was validated by experts. The internal consistency reliability coefficient of BAT was determined using Kudder- Richardson 20 (K-R 20) formula and yielded a reliability index of 0.89. The estimate of temporal stability of reshuffled form of BAT was determined using test-retest method and was subjected to Pearson correlation coefficient that yielded a correlation coefficient of 0.85. The study lasted for 7 weeks. Data for the study were obtained through pretest, posttest, and retention test. The research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significant. The results of the study revealed that both Flipped classroom and powerpoint instructional approaches enhanced students' achievement and retention in Biology. However, flipped classroom instructional approach was more efficacious than PowerPoint in promoting biology students achievement and retention. The study revealed that gender had no effect on biology students' achievement and retention and that there was no significant interaction effect of instructional approaches and gender on biology students' achievement and retention. In line with the findings of the study, the educational implications of the findings were highlighted and the recommendations were equally proffered among others that science teachers, science educators and authors and textbook writers should adopt flipped classroom instructional approach for teaching Biology and curriculum planners should promote its usage to enhance students' achievement and retention in Biology. The limitations of the study and suggestions for further studies are contained in the study.

CHAPTER ONE
INTRODUCTION

Background of the Study

Biology is a branch of natural science that focuses on the study of life and living organisms of all types. Biology occupies a unique position in the secondary school education curriculum because of its importance as science of life. In Nigeria, the secondary school Biology curriculum is designed to continue students' investigation into natural phenomena, deepen students' understanding and interest in biological sciences and to encourage students' ability to apply scientific knowledge to everyday life (Federal Ministry of Education, 2014). Biology is an important science subject and stands as the bedrock to the learning of other science courses like Medicine, Pharmacy, Nursing, Biochemistry, Genetics and Agriculture that are of great economic importance to the nation. Every branch of biology helps human race to live healthier and more productive lives. Biology is one of the science subjects offered at the senior secondary school levels in Nigerian schools (Federal Republic of Nigeria (FRN), 2014).In addition, the objectives of studying biology in Nigeria as stipulated by the Nigerian Educational Research and Development Council (NERDC) (2008) are to prepare students to acquire adequate laboratory and field skills in biology, make them to have meaningful and relevant knowledge in biology, have the ability to apply scientific knowledge to everyday life in matters of personal and community; health and agriculture as well as make them possess reasonable and functional scientific attitude. Biology which is one of the most important science subjects is meant to equip students with foundational knowledge that may help in solving many social problems relating to health, poverty, food shortage, crop production, environmental pollution and conservation.

However, the issue remains that in most secondary schools in Nigeria, there is students' poor achievement in Biology in external examinations (Jibrin & Zayum, 2012; Arayo, 2013; Nwagbo & Okoro,2014; WAEC chief examiners reports, 2018)

Academic achievement deals with the extent students have gained from a particular course of instruction. Achievement according to Ezeudu, Gbendu and Umeifekwem (2014) means doing something successfully typically by effort, courage and skills. Achievement means an act of accomplishing or finishing, especially by means of assertion, skills, practice or perseverance. According to Onyilo and Onyilo (2010), achievement is a term for noteworthy act. From the foregoing, achievement is a very strong word which is often used in so many areas. For

instance, the achievement in biology, which is the focus of this study, is viewed as a very important factor in teaching and learning biology, which focuses students' cognitive achievement. Students' attainment of high achievement in biology is necessary because of relevance of biology in national development. However, in spite of students' preference of biology to physical science subjects like chemistry and physics, students underachieved in biology external examinations (Araoye, 2013; Nwagbo & Okoro, 2014; Ogundiwin, Osaaju, Adegoke & Ojo, 2015). This is further substantiated by the WAEC chief examiner's report of 2015 and 2018. In line with this, WAEC biology chief examiners' report (2011-2018) showed an average pass of 41.49 (35.74%, 33.61%, 33.57%, 33.94%, 33.87%, 50.0%, 59.22%, 49.98%) respectively. This shows that averagely less than 50% of biology students pass at credit level. Also, in Enugu state for instance where this study was carried out, there is poor achievement in external examinations (The tide news online, 2016). In addition, WAEC chief examiner's report of 2016 and 2017 observed improvement in students' achievement in biology. Although students' achievement improved in 2016 and 2017, WAEC chief examiner's report of 2018 observed poor achievement of students in biology in external examinations. This fluctuation in students' achievement in biology, and not able to attain high achievement in the subject create gap that necessitated more studies in students' achievement in biology. Also, achievement is an important academic factor that has been identified to be influenced by instructional approach. Studies have also shown that instructional approaches influence students' achievement in biology (Nwagbo 2006; Ugwu & Nzewi, 2015). This poor achievement of students in biology at the senior school certificate examination leaves one in doubt about the effectiveness of instructional approaches employed by the biology teachers for the teaching and learning of biology. In fact, studies carried out by different science educators such as Abimbola (2013); Njoku (2007); Olorundare (2014); have shown that students performed poorly in science subjects.

However, there are several factors responsible for students' poor achievement in biology. These factors as revealed in literature include; poor usage of instructional resources for biology teaching and learning, poor state of infrastructural facilities, large class size, ineffective instructional approach, use of faulty assessment practice and inadequacy of quality teachers (Ibitoye & Fape, 2007), poor state of laboratory facilities and inadequate use of instructional materials (Okebukola, 2004), use of ineffective method of teaching(Ezenwosu & Nworgu,2013;

Okoyefi, 2014), over loaded biology syllabus (Osuafor& Okigbo, 2013). Buttressing the above assertion on the causes of decline in students' achievement in biology examinations, poor instructional approaches used by teachers at senior secondary school level in Nigeria have been identified amongst the major factors contributing to poor achievement of students in biology (Gambari, Yaki, Gana & Ughovwa, 2014). In line with this, Freedman (2002) and Omoniyi (2006) revealed that poor instructional approaches lead to poor achievement and retention in science. Students' retention of biology contents is facilitated by instructional approach as this will enable them link the present learning with previous learning.

In line with the above, retention is the ability to remember effectively when experiences are passed across to the learners through appropriate instructional approaches, thus, for the content and concepts of biology to be retained and recalled therefore, there is need to make the biology teaching meaningful to the students, by presenting it in a meaningful way by using appropriate instructional approaches. Retention is the act of retaining or the ability to recall or recognize what has been learnt or experienced over a long period of time. Probably, if what has been learnt is retained over a long period of time, it may lead to higher achievement because retention is measured in collaboration with achievement (Iji, 2010). Retention is also the ability to store facts and remember things easily (Aninweze, 2014). This implies that if there is no proper storage structures developed in the learners, information recalling may be stained and consequently resulting to poor achievement. Many researchers such as Ogbonna (2007); Okereke (2006), have carried out studies in the past on retention in various fields, and all viewed retention as an important sustenance of achievement. In other words if a student performs well in a post test, it is expected that the student performs very well in a retention test but if the reverse happens, it is an indication that concepts and ideas did not register in the long term memory(Aninweze, 2014). It can equally be said that retention is influenced by instructional approach. This is supported by the assertion of Osemwinyen (2009) and Tolu (2009) that poor achievement and retention in biology is as a result of poor instructional approach. These poor instructional approaches stress more on the transmission of knowledge in a manner that emphasizes memorization (Ibe, 2004).The shortcomings of these traditional instructional approaches resulted to the persistent search by researchers for innovative ways to stimulate effective teaching/learning of Biology.

Innovative instructional approach is a proactive approach to integrate new teaching methods into classroom. It encourages the teachers and students to explore and use all tools to uncover something new. Innovative instructional approaches help the students to develop creativity and problem solving skills thereby fostering achievement and retention. It is student centered and views the teacher as a facilitator, mentor, a coach or consultant as the students construct their meaning (Guisti, 2008). Examples of innovative instructional approaches are computer aided instruction, computer animation, cooperative learning, simulation, jigsaws, inquiry- based learning, powerpoint, flipped classroom and so on

Furthermore, researches have been conducted on some of the innovative instructional approaches in the area of biology and the researchers advocated for their use in biology teaching since they are activity-based as well as ensure interactive, collaborative and tension- free classroom among learners (Nzewi & Ibeneme, 2011).The innovative instructional approaches are considered as effective approaches that can improve on students' achievement and retention in Biology approach. In order to enhance students' achievement and active participation in the learning process in Biology, much attention should be placed on instructional approaches. Kochhar (2007) opined that the best of the curriculum and the most perfect syllabus of any programme or course of study remain dead unless quickened into life by appropriate instructional approaches and effective, dedicated and competent hands (teachers). Therefore, there is need to focus research on innovative instructional approach that is technology based which could enhance effective teaching and learning.

Technology has become a fast growing delivery tool in all educational institutions at all levels with the increased availability of the internet, computers, smart phones, Television, videotapes and other educational application. A considerable number of researches have been conducted on several of these technological media devices in identifying the kinds of educational contributions they can make to improve the teaching and learning of science in schools. The secondary school students today live in a world of instant gratification with technology integrated into every aspect of their daily lives. For example, secondary school students no longer need to pull dictionary out to look up an unknown word or look through an encyclopedia to find an answer to a puzzling question; they simply use their phone to find answers to questions. With students like this, teachers are faced with the challenges of developing lessons that are motivating that incorporate the skills and tools that students are confident with and

proficient in using. It is the drive to meet students' need increase, 21st century skills and incorporate technology into daily instruction that has led to evolution of the flipped classroom (Bishop & Verleger, 2013; Lage, Platt & Treglia, 2000; Roeh, Reddy & Shannoh, 2013). According to the Horizon report which focused on exploring and reporting emerging technology in education, the flipped classroom has been highlighted as an emerging technology which is very important to use at college level (Johnson, Adams, Estrada, & Freeman, 2014).

The flipped classroom has become one of emerging technologies in education to foster students' active learning. The flipped classroom is an approach to teaching and learning activities where students watch a video lesson or recorded lectures outside the class and have hands on activities in the class (Bergmann & Sams, 2012). Flipped classroom or reverse classroom is an element of blended learning, integrating both face-to-face learning in the class through group discussion and learning outside the class by watching video lessons and online collaboration. Flipped classroom is one of the student-centered approaches to learning where the students are more active than the instructors in the classroom activity. In this case, the instructor acts as a facilitator to motivate, guide, and give feedback on students' performance (Bergmann& Sams, 2012). Hence by applying the flipped classroom approach to teaching and learning activities the instructor can move the traditional lecturer's talk to videos and students can listen to the lectures anywhere outside of class. The flipped classroom allows students to watch the video according to their preferred time and need, and they can study at their own pace, this type of activity also increases student's collaborative learning in distance education outside the class. Thus, by flipping the class, the students will not spend so much time listening to long lectures in the classroom, but will have more time to solve problems individually or collaboratively through distance learning with peers. Flipping the classroom (a.k.a "flipped classroom," "flipped learning," or "inverted learning") reverses the role of the classroom instruction and out-of class homework. Students are provided instructional materials before class, which commonly involves a video lecture the teacher prepared in advance (Overmeyer, 2012). The students are required to watch the videos outside the class and take notes just as they would be expected to do during a classroom lecture. The students then come to class with a basic understanding of the content knowledge given from the video and complete what is traditionally known as "homework" in class in collaboration with the teacher. However, teachers are encouraged to not simply have students do rote paper work in class to fill the classroom time but to work on higher order

learning from knowledge to evaluation. Flipped classroom can help solve the problem of students being stuck on homework.

The two reasons why the flipped classroom can help solve the problem of students getting stuck on homework is that it:

- Opens more time in class for the teacher to go deeper into a topic which allows students to develop a better understanding of the content, and
- The students are doing their homework in class where the teacher is available to help if they get stuck (Bergmann& Sams, 2012).

The teacher is available to review the material as a group or help students one-on-one or in small groups with specific questions they have about the in-class work. The teacher can use any variety of strategies that a traditional classroom teacher might use. In this way, the flipped classroom is not simply a new technique to instruction that would replace other common classroom strategies, but rather it is a way to maximize the amount of time teachers has with students doing higher level learning, rather than trying to get students to memorize a set of facts. In the traditional lecture method, students often try to capture what is being said at the instant the speaker says it. They cannot stop to reflect upon what is being said and they may miss significant point. By contrasts, the use of video and other pre-recorded media put lecture under the control of students. They can watch, re-wind, and fast forward as needed. This enhances students' learning. Apart from learning through flipped classroom, students could also learn through the use of powerpoint instructional approach.

Powerpoint is a program that allows teacher to present their lessons in a more dynamic way than simply teaching and writing on the chalkboard. Teachers can focus on the class and interact with the students instead of writing on the chalkboard, because the text and the entire presentations are already there in the form of point file. Lengthy materials can readily be summarized and presented. Power point is a software tool that is used in over 30 million presentations a day and its software is on 250 million computers world-wide (Alley & Neeley, 2005). Powerpoint was developed to improve learning by providing the means to develop presentations that are more structured and interesting to audiences (Amare, 2006). Power point presentations (PPPs) can be as simple as consisting only of text on a coloured screen. Presentations can also be complex and include tables, pictures, graphs, sound effects, visual effects, clips etc. Infact, several researchers have demonstrated that material, such as interesting

but extraneous text, irrelevant sounds (Moreno & Mayer, 2000) and irrelevant pictures (Mayer, 2001), can reduce comprehension. Students who were exposed to teaching method with PPPs emphasized that their interest and achievements were improved (Ugwuanyi, Nwankwo & Ugwuoke, 2016). One related factor that is confronting the use of instructional approach lies in ability to have equal impact on both the male and female students. This raises the issue of gender in relation to achievement and retention with flipped classroom and power point instructional approaches.

Gender is a variable that plays important role in learning. Existing literature reveals that gender issue is an important factor in educational setting and could be a hindrance to high achievement of learners in sciences (Igwe, 2003). Gender refers to a social attribute and opportunity associated with being male and female. Nzewi (2010) noted that the females are usually associated with attributes such as being fearful, weak, submissive, tactless and talkative among others. These characters are never genetically acquired but are ascribed by the society over the years in the course of socializing the young ones into what characteristic behavior and roles the society expects of them as males and females. The societal misconceptions on abilities and expectations of male and female learners may influence achievement and retention. Gender role differentiations are encouraged in pictorial illustration in text books which usually portray males as doctors, engineers, lawyers and architectures while the females are seen as nurses, cooks, typists and so on (Ezeudu, 2013).The stereotyping bias that science is a male enterprise is of great concern to science educators. Studies by Okwara, Anyagh and Ikyaan(2017) showed that science achievement depends on gender. But, Ogunleye and Babajide(2011); Okeyefi(2014); Okeye(2016) lend credence to non-significant gender effect in science achievement. Similarly, Yaki and Babagana(2016) reported that Technology Instructional Package employed for teaching Biology was gender friendly. Moreso, influence of gender on students' conceptual change has been equally investigated. Baser (2006) shows that fostering conceptual change does not depend on gender. But, Agommouh (2010) found that gender significantly influence students' conceptual shift, in favour of male. It is therefore hoped that this study will contribute in respect of gender by investigating if Flipped classroom and Powerpoint instructional approaches will enhance students' learning in biology irrespective of gender thereby ensuring gender equity in Biology classroom.

The interaction effect between gender and treatment has received research attention in recent time in science education. In line with this, Baser (2006) found that gender significantly interacts with instructional treatment. The interaction could come from the gender difference in group who utilized the flipped classroom and power point presentation. However, Okeyefi(2014) and Agommouh (2010) found no interaction effect of gender and instructional treatment. In view of these research inconsistencies, further studies on interaction effect of gender and instructional approach becomes imperative.

In this study, the researcher is interested in investigating the efficacies of flipped classroom and powerpoint instructional approaches on students' achievements and retention in Biology and also to contribute to the academic debate on the influence of gender on students' achievement and retention in Biology.

Statement of the Problem

Biology is a practical oriented subject that exposes students to adequate knowledge, requisite scientific skills and desirable attitudes needed for individual and societal development. Despite its importance, students' achievement in Biology is still poor. The students' poor achievement in biology could be attributed to so many factors such as poor usage of instructional resources for biology teaching and learning, poor state of infrastructural facilities, large class size, ineffective instructional approach, use of faulty assessment practice and inadequacy of quality teachers. Researchers have pointed out that the use of inappropriate instructional approach is the major cause of students' poor achievement in biology. In order to improve students' achievement in biology, studies have been carried out by scholars in pedagogy in science education and they advocate for more use of the innovative instructional approaches than conventional instructional approaches. This is because findings have shown that innovative instructional approaches are students' centered and can enhance students' achievement and better retention. The researcher wishes to investigate the efficacy of the instructional approaches (Flipped classroom and power point) on secondary school students' achievement and retention in biology. There is also need to ascertain the efficacy of these two instructional approaches (Flipped classroom and power point) on male and female students' achievement and retention in biology. The problem of this study is; what is the relative efficacy of the two instructional

approaches (Flipped classroom and power point) on male and female students' achievement and retention in biology?

Purpose of the Study

The main purpose of the study is to investigate the relative effectiveness of flipped classroom and power point presentation as instructional approaches on senior secondary school students' achievement and retention in Biology in Obollo Afor Education Zone.

Specifically the study is to determine the:

1. relative effects of flipped classroom and power point presentation on students' achievement in biology
2. relative effects of flipped classroom and power point presentation on students' retention in biology
3. influence of gender on students' achievement in biology
4. influence of gender on students' retention in biology
5. interaction effect of mode of instruction and gender on students' achievement in biology
6. interaction effect of mode of instruction and gender on students' retention in biology

Significance of the Study

The findings of this study have both theoretical and practical significance. Theoretically, this study is based on Vygotsky social constructivism theory and Bandura's social learning theory. Vygotsky proposes that students obtain a new knowledge through social interaction with others. This is relevant in Flipped classroom and Powerpoint in the sense that the students interact with each other, the teacher and with the technology. This scaffolding learning is showed clearly with power point presentation and flipped classroom students, by using the class time to improve the students thinking skills.

Bandura's social learning theory provided another theoretical framework for the use of flipped classroom and powerpoint presentation in teaching. This social learning theory shows that people learn new information and behaviors by observing others. Students can learn from each other, by modeling and observing others. Student in flipped classroom and powerpoint presentation acquire knowledge after seeing lesson through videos, observing powerpoint slides, are expected to learn complex new skills quickly, with a minimum of verbal instruction. The findings of this study will help to strengthen the basic tenets and implications of the theory of Vygotsky and Bandura's social learning theory by validating the theory.

Practically, the findings of this study could be of benefit to students, teachers, parents, administrators and curriculum planners.

The Findings of this study when published would guide the learning of the students if their teachers use the suggestions that would be made to focus their attention to what is being imparted to them in schools. It is expected that when students are focused, they work towards achieving objectives of the lesson which enhances transfer of what has been learnt in the classroom to out-of-school experience.

Findings of this study when published and presented at conferences would enable the biology teachers to see the need to use flipped classroom and power point biology as alternative modes of instruction. The study could also motivate teachers that are computer illiterates to strive and equip themselves with knowledge of computer usage. Hence, teachers could be motivated to prepare biology lectures to be watched by the students or download good biology lectures from you tube to be given to the students before and/or in the class. The exposure of the teachers to this flipped classroom and power point presentation will motivate them to develop other educational media used in teaching biology.

The joy of parents is to see their children excel in academics. This wish has eluded most parents. It is assumed that with the result of this study, their dreams could become a reality, as the appropriate use of flipped classroom or power point presentation may enhance the achievement of their children.

The findings of this study when published could also provide empirical evidence which could serve as a guide in organizing conference and seminars and workshops for professional science teachers, educational administrators, curriculum planners and textbook writers in their effort to help improve instructional strategies. The findings of this study when published could help textbook writers to be aware of the merits of flipped classroom and power point presentation, and update their texts to reflect the need to incorporate technology in education. The findings could also sensitize textbook writers to avoid gender stereotyping in use of the pictures and illustrations activities in science textbooks.

School administrators through the results of this study when published would be aware of the advantages of flipped classroom and see the need to make the schools incorporate technology in teaching through flipped classroom and power point approach, and consequently help to produce students who can thrive in the modern world.

Findings of the study when published will also create awareness for curriculum planners to review the curriculum from time to time, and involve the teachers on the field in order to develop curriculum that will incorporate new teaching/learning innovations like flipped classroom and power point presentation that will facilitate training of science students to acquire a good knowledge of science for successful and meaningful life.

Scope of the Study

The study was restricted to determining the relative effectiveness of flipped classroom and PowerPoint approaches on senior secondary school students' achievement and retention in biology in Obollo Afor Education Zone where there is report of poor students' achievement in external examination (The tide news online, 2016). Students' low retention in biology is also of concern. Obollo-Afor Education Zone has three local government areas namely: Udenu, Igboeze-South and Igboeze – North local government areas having a total forty- eight public secondary schools.

The study was carried out using the SS 2 biology students in the zone. The SS2 biology students will be used because they have been exposed to the subject for at least one year. In other words, they have background knowledge in biology which serves as anchor for future learning of the subject. The units that will be selected for the study, as contained in the senior secondary two (SS II), is supporting tissues in animals. The content scope includes supporting tissue in animals, axial skeleton and appendicular skeleton and joints. The choice of the topic was also based on the fact from literature that students perform poorly in biology concepts like internally situated organs and systems which ordinarily could not be easily accessed (Gambari, Bello, Agboola& Adeoye, 2016). The topic was also among the area of weakness of biology students from WAEC chief examiners report.

Research Questions

The following research questions guided the study:

1. What is the relative effect of flipped classroom and power point presentation on students' achievement in biology?
2. What is the relative effect of flipped classroom and power point presentation on students' retention in biology?
3. What is the influence of gender on students' achievement when taught biology using flipped classroom and power point?

4. What is the influence of gender on students' retention when taught biology using flipped classroom and power point?

Hypotheses

The following hypotheses were tested at 0.05 level of significance

1. There is no significant difference in the mean achievement score of students taught biology using flipped classroom and those taught with power point presentation.
2. There is no significant difference in the mean retention score of students taught biology using flipped classroom and those taught with power point presentation approach.
3. There is no significant difference in the mean achievement scores of male and female students in biology.
4. There is no significant difference in the mean retention score of male and female students taught biology with flipped classroom and power point presentation mode.
5. There is no significant interaction effect of mode of instruction and gender on students' mean achievement scores in biology.
6. There is no significant interaction effect of mode of instruction and gender on students' mean retention scores in biology.

CHAPTER TWO

LITERATURE REVIEW

Literature related to the study was reviewed under the following subheadings: Conceptual framework, Theoretical framework, Empirical Studies and Summary of Review of Literature

Conceptual Framework

Related Sub-themes

Biology

Instructional Approaches

Flipped Classroom in Teaching and Learning

PowerPoint Presentation in Teaching and Learning

Achievement in Biology

Gender and Science Teaching and Learning

Retention in Biology

Theoretical Framework

Vygotsky's Social Constructivism Theory (Vygotsky, 1978)

Bandura's Social Learning Theory (Bandura, 1977)

Empirical Studies

Flipped Classroom

PowerPoint

Gender and Students' Achievement and Retention in Science

Summary of Literature Review

Conceptual Framework

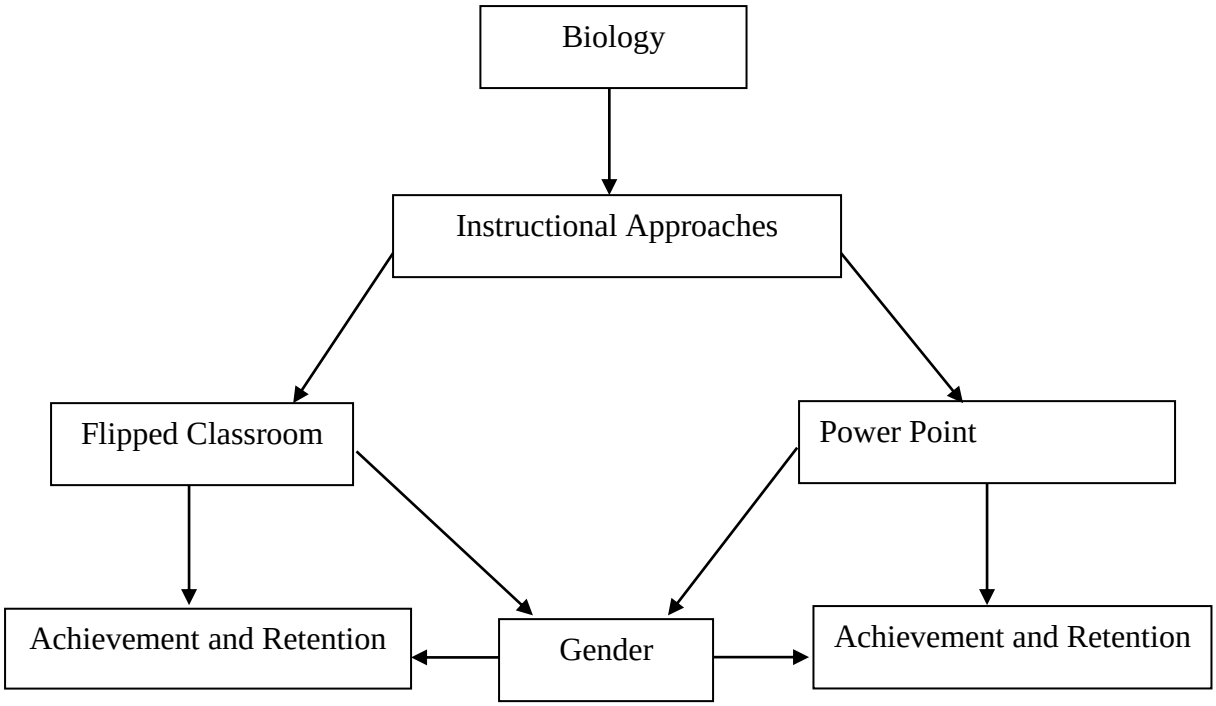

Fig. 1: A Schematic diagram showing relationship among the study variables

The schematic diagram above shows the relationship among the study variables. These variables are the dependent variable and independent variables. However, other variable known as moderator variable also occur in the study. The major independent variables of the study are the two instructional approaches which are Flipped classroom and Power point. Flipped classroom and power point are used to teach biology students. Gender, a moderator variable may also have influence in addition to instructional approaches on students' achievement and retention which are the two dependent variables of the study. It is assumed that when students retain information, they will have high achievement. This statement shows the relationship between retention and achievement.

Related Sub-themes

Biology

Biology is a branch of natural science that deals with the study of living organisms, their structures, functions, evolution, distribution and interrelationships. It has been defined by different authors. For instance, biology is the study of living things (Nweze, 2004).Ramalingam

(2005) defined biology as the branch of science that involves living things. This definition sees biology as science that is interested in studying living things just like Nweze.

Biology has many branches. The branches can be summarized majorly into botany, zoology, microbiology and biochemistry. Botany is the scientific study of plants. Zoology systemically studied animals. Microbiology focuses on the study of microscopic organisms and how they interact with other living organisms. Biochemistry, on the other hand, studies the chemical reactions needed for life to exist and function properly. In modern times, the branches of biology have been extended to include biotechnology among others (Branches of biology, 2010; Biology online.org, 2011). Biotechnology is the scientific use of organisms or living systems to synthesize products commercially. These make biology have wide application.

Biology has helped in controlling pests in agriculture whereby biological pesticides are used rather than the chemical ones that affect the environment negatively. It is applied in crime dectection, genetic screening, organ transplant, and pharmaceutical drug production (Ramalingam, 2005;Ermak, 2013). It is used in marriage counseling as pertains to determining sickle cell genotype. It helps in pollution control as it facilitates protection of the environment. These help in achieving a sustainable environment for the present and future generations.

The relevance of biology in preparing scientifically literate citizens who will contribute maximally towards national development made the subject to be among the science subjects that could be chosen by students as an elective subject at the senior secondary school level as contained in section 4 , subsection 6A and 6B of the National Policy on Education(FRN,2014) In order to ensure that student as acquire adequate knowledge and skills in biology as well as acquire a functional scientific attitude needed national development, there is need for biology teachers to adopt instructional approach that fosters active learning teaching/ learning process.

Instructional Approaches

The key to the success of our curriculum content depends on the instructional approaches. Instruction is the process of passing on knowledge to pupils/students by a teacher. Instructional approach is a process in which a teacher uses variety of teaching strategies to communicate and interact with students around academic content. The teacher effectively engages students in learning by using a variety of instructional approaches in order to meet individual learning needs. As education is concerned with the process of transmitting knowledge, skills, attributes and values needed by the people to survive and live comfortably in their environments, the educators

should seek for effective procedures for transmitting them. What students learn is greatly affected by how they are taught. This is because the method by which a teacher teaches a subject itself conveys important information to students about the subject matter. Instructional approach is an educational approach for turning knowledge into learning. It is also a way in which information is presented to students (Bannon, 2012). It is also an educational approach for turning knowledge into learning. Teacher should use a variety of instructional approach to encourage students' development of critical thinking, problem solving and performance skills (Berlongieri, 2013). This is because, students learn on different levels. Therefore, the way in which the instruction is given can help the students use various types of skills to think and solve problems on their own. The use of traditional instructional approach to teach biology makes students understand subject at knowledge level and they usually memorize the science concepts without understanding the real meanings (Cepni, Tas &Kose, 2006). As a result, they do not conceptualize the science well as intended. It is therefore obvious that alternative instructional approach is needed to teach some difficult concepts in biology. To support this assertion, the Educational Encyclopaedia (2013) submitted that improvement of instruction has been a goal of educators as far back as the teachings of the Greek Philosophers Socrates. Although there are a wide variety of approaches, in most cases instruction can be characterized by the following tasks; Setting objectives, teaching content based on these objectives, and evaluating performance.

Appropriate instructional approach portrays good teaching technique and successful learning. The selection of proper instructional approach ensures the achievement of the stated instructional objectives effectively (Nafees, Farouq & Tahirkheli, 2012). Appropriate instructional approach portrays good teaching technique and successful learning. A great deal of researches has been conducted regarding the effective instructional approach for teaching of biology. The instructional approaches are not specifically designed for the teaching of a particular topic/concept in biology. Each method is applied to a particular topic/concept as the need arises. So, the issue is when to adopt them. Various teaching methods are used by teachers in the teaching of biology which is aimed at bringing about meaningful learning. These methods are categorized into traditional/convectional method and innovative method. The traditional method includes lecture method/expository, explanation, demonstration and so on. Innovative approaches include Discovery, laboratory, computer aided instruction, field trip, flipped classroom, power point presentation etc. In line with this, Obiekwe (2008) categorized the

teaching methods into two approaches: teacher centered approaches and student centered approaches.

Teacher centered approaches to instruction are often referred to as the traditional method of teaching, didactic or direct instruction, and that it include all the methods grounded in behaviorism, such teaching methods like the lecture/expository methods, demonstration and recitation(Guisti, 2008; Campbell, 2006). The term teacher-centered comes from the role that the teacher assumes in traditional classroom context, as the possessor of knowledge which is transferred to students, the decision taken on how the knowledge transfer takes place depend solely on the teacher. Teachers in a teacher centered environment focus on making relationships with students that are anchored in intellectual exploration of selected materials. They focus more on content than on student. It is difficult to believe in children's capacity, since the teacher centered approach places control for learning in the hands of the teacher (Mc Donald, 2002). The teacher uses the expertise in content knowledge to help learner make connections. The effort to get to know the learner and how he processes information is secondary.

Teacher centered approaches stress transmission of knowledge in a manner that emphasizes training or memorization (Ibe, 2004).From the foregoing it indicates that teacher-centered approach includes teaching methods that involves only unidirectional flow of information from the teacher to students and does not permit exchange of ideas that makes teaching and learning process active. In view of these shortcomings Isiugo – Abanihe and Tandi (2010) characterized the traditional instructional approaches as poor approaches of teaching sciences, because it limits science skill acquisition and hands on activities that characterize science teaching and learning especially biology. The persistent uses of traditional/conventional instructional approaches have been reported to account for poor student performance in Biology. Example of teacher centered approach includes;

Lecture Method: Lecture method is the oldest traditional form of teaching. It requires the teacher to go into the classroom, tell the content development line by line, allow the students to pay attention and to copy. The teacher assumes that position of knowing it all in the teaching-learning situation and provides information which she feels that pupils/students do not have. Lecture method is that method where the teacher prepares lectures and comes to class exposes the knowledge to the students who passively take down without regards whether the students understand or not. This is a teacher dominated method as it focuses the teaching activity on the

teacher instead of the pupils/students. This method of teaching is what pervades schools and universities all over the world.

The following are the merits of lecture method.

- It is time saving. The teacher pours out all the knowledge and the students copy. This makes the teachers to cover their syllabuses faster.
- It is good in teaching large classes. In a class of about 200 students, lecture method is the only way out in transmitting knowledge to the students. This is one of the reasons it is widely used in tertiary institutions.
- It trains the students in paying attention as the lecture is going on and forces them to be up and doing, since they are to take notes.

The demerits of Lecture Method are:

- Places students in a passive rather than an active role, which hinders learning.
- Encourages one-way communication; therefore, the teacher must make a conscious effort to become aware of student problems and student understanding of content without verbal feedback.
- Requires a considerable amount of unguided student time outside of the classroom to enable understanding and long-term retention of content. In contrast, interactive methods (discussion, problem-solving sessions) allow the instructor to influence students when they are actively working with the material.
- Requires the instructor to have or to learn effective writing and speaking skills (Mandore (2002).
- Lectures are not well suited for teaching complex abstract material.

Guideline for Effective use of Lecture Method in Science Education

- The teacher must make all effort to communicate to the class effectively. The language use must be appropriate to the level of the audience;
- Endeavour to involve the students as much as possible by asking questions which provoke critical thinking;
- Maintain a continuous interaction or dialogue between you and the learners so as minimize boredom on the part of the learners maintain the notion that science is Inquiry; inquiry involves questioning and critical thinking.

- The lecture method by itself should not be used in isolation in any one lesson, if you use the lecture method to introduce a lesson strive to use another or technique to develop the lesson like discussion.
- Use a place or position where all the students can see your face as you present your lesson. Do not bury your face to your lecture notes and do not talk to the blackboard or to the ceiling

The student centered approach is grounded on constructivism and includes all the instructional methods that view the teacher as a facilitator (guide). Instructional approaches that are often referred to as student centered approaches include discovery, constructivist, inquiry, problem solving, cooperative learning, role play, simulation, flipped classroom and power point presentations e t c. Student-centered approaches are characterized by students sharing some degree of the responsibility for making decision in the classroom (Campell, 2006; Guisti, 2008). In student-Centered Classroom, the role of the teacher is less defined than with the traditional teacher-centered approaches. The teacher in the student-centered approach is seen as a facilitator, a mentor, a coach or a consultant as the student constructs their learning (Kirshner, Sweller & Clark, 2006; Guisti, 2008). The principles of student-centered approaches are rooted in the philosophy of Rousseau's work 'Emile' which particularly stressed the instinctual (intuitive) nature of children to investigate and naturally learn from experience from the environment (Exline, 2004; Guisti, 2008). Today, the learning theory advocating for student-centered idea is the constructivism, while its application to educational settings has obvious link to Dewey, its epistemological under mining, are closely tied to the work of Jean piaget (Exline, 2004).

The student-centered approach however, emphasizes a variety of different types of methods that shifts the role of the instructors from givers of information to facilitating student's learning. Many researchers such as Campell (2006); Kirshnerl et al (2006) are of the view that learning in a student centered environment makes learning more meaningful and durable as student are more active participants in the learning process. Today, many educators and researchers promote a shift from teacher-centered approaches of instruction to student centered approaches of instruction, especially in sciences (Exline, 2004; Kirshner et al.,2006). Practice that supports student centered approach includes less structured activities such as open-ended projects that focus on problem solving and analytical skills rather than mastering facts. Student-centered learning allows student to actively participate in discovery learning process from an

autonomous view point. Student consume the entire class time constructing a new understanding of the material being learned without being passive, but rather pro active (McDonald, 2002).Some types of student centered approaches include;

Discovery approach: This is a method where the students are guided to build biological concepts, develop thought patterns, and discover relationship (Nwabueze, 2009). The teacher explains exactly what the students must do, gives them a free hand to carry out the activities after giving them suitable guides to prevent student from going astray. In doing this, the teacher gives them hint to the discovery so as to ensure success of the activity. This method provides an avenue for students to use existing and already established rules or principles to discover things for themselves as a result of their own observation. It is student centered and the activities provided permits students self direction, exploration and satisfaction of their curiosity. The type of discovery method just explained is called guided discovery. There is another one called open discovery. In this type, the teacher allows the students free hand to play with the materials and come up with whatever discoveries that come their way. The discoveries made by the students may be new to the teacher. The use of open discovery is minimal in our education system. The discovery method has some advantages as well as disadvantages.

Some of the advantages are:

- It develops biology skills in the students in their independent search or discovery
- It fosters students' participation in biology and gives room for students' interaction in the class.
- No student is passive in a discovery class as they would want to put in their best.
- It encourages acquisition of patience, students' cooperation, generation of ideas and decision making in biology class.
- It generates critical and logical thinking about biology ideas, issues, problems and questions.
- Most students are likely to retain knowledge learned by discovery more than any other method because they found it out by themselves.

Some of the disadvantages are:

- It is time consuming. Biology teachers do not have the whole time in the world to use discovery always.
- A lot of instructional materials may not be readily available due to lack of fund.

- It may cause students loss of interest and frustration if the problem is too difficult.
- A discovery lesson is always noisy.

Laboratory Approach: This is an approach which is based on “learning by doing”. It involves students manipulating concrete objects in structural situation. It proceeds from concrete to abstract. This method of teaching biology proposes that experimental origin of biology be fully recognized, that the students be led to the need of the biology tool through some material experiments he has carried out. This helps to build readiness for the development of more abstract concepts. Biology is a subject which has to be learnt by doing rather than by listening or seeing. It is very practical. Some advantages abound in the application of laboratory approach in teaching biology. They include;

- Every student participates and is able to proceed at his/her own rate. It arouses students’ interest and investigation capacities are developed.
- It helps the students to acquire psychomotor skills such as the use of fingers in drawing, sawing, cutting etc.
- It is especially useful for slow learners.

The disadvantages of using laboratory approach are:-

- It makes the lesson noisy
- It is expensive – the equipments/materials may be costly and it requires good supply of materials and suitably designed classroom
- Accident may occur in laboratory lessons.
- It is time consuming for both the teachers and the students. In case of the teacher, it demands a fair amount of his/her preparation and creativeness.

Computer assisted instruction: Is a teaching approach that has consisted of self learning principles. Hence computer is used as platform of learning to occur, to strengthen the process of teaching and students motivation. So, students can benefit from considering speeding up their learning by using computer technology to assist their learning.

Computer assisted instruction can be defined as activities during which students are interacting with the courses that are conducted in the computer. In using computer assisted method in teaching biology, the teacher assumes the role of the guide and the computer assumes the role of the platform (Sunbul, Gunduz & Yilmaz, 2002). The computer adapts instruction to individuals of different abilities and interest.

Advantages of computer assisted method are:

- It takes care of all students, both fast and slow learners
- It is interactive as students responds to instruction presented to them by the computer
- It can present many exercises to the students
- It keeps voluminous records which can be retrieved if students want to review or practice skill previously taught

The disadvantages of computer assisted method include

- It is costly to procure as computers are expensive machines
- It is also costly to maintain
- It can only be used in places where source of electricity or power is guaranteed

Summarily, all the instructional approaches enumerated so far will guide the teachers and biology educators who may want to apply any of them on how they can be utilized, their advantages and disadvantages. This will help the teachers and other users in deciding appropriate method to be used in teaching and this is the essence of the review. However, the methodologies of instruction enumerated so far are by no way exclusive, and any given system of biology education will probably combine several or different methods in teaching any topic at any time and for whatever objective. Moreover the issue is not only knowing the methods, but also knowing when to use and adopt them at different times and different cultures. For this study, the instructional approaches in view are innovative (student centered) as stated earlier; the flipped classroom and power point presentation in teaching of biology. As a result of the advancement in communication and network technologies, more innovative instructional approaches have emerged in order to provide meaningful learning experiences for learners in academic settings (Lim & Moris, 2009). According to Nafees *et al* (2012), instructional approaches are used in the presentation of lesson to help the students learn by ensuring the smooth delivery of the instruction. Therefore, the classroom teacher must determine the most effective instructional approach for his/her students which could be flipped classroom and power point presentation.

The Flipped Classroom in Teaching and Learning

The flipped classroom has become one of emerging technologies in education to foster students' active learning. The flipped classroom is an approach to teaching and learning activities where students watch a video lesson or recorded lectures outside the class and have hands on activities in the class. Flipped classroom or reverse classroom is an element of blended learning,

integrating both face-to-face learning in the class through group discussion and learning outside the class by watching video lessons and online collaboration. Blended learning is simply defined as teaching and learning approach which combines face-to-face classroom methods with computer mediated activities to deliver instruction. Flipped classroom is one of the student-centered approaches to learning where the students are more active than the instructors in the classroom activity. In this case, the instructor acts as a facilitator to motivate, guide, and give feedback on students' performance (Bergmann& Sams, 2012). Hence by applying the flipped classroom approach to teaching and learning activities the instructor can move the traditional lecturer's talk to videos and students can listen to the lectures anywhere outside of class. The flipped classroom allows students to watch the video according to their preferred time and need, and they can study at their own pace, this type of activity also increases student's collaborative learning in distance education outside the class. Thus, by flipping the class, the students will not spend so much time listening to long lectures in the classroom, but will have more time to solve problems individually or collaboratively through distance learning with peers. Flipping the classroom (a.k.a "flipped classroom," "flipped learning," or "inverted learning") reverses the role of the classroom instruction and out-of class homework. Students are provided instructional materials before class, which commonly involves a video lecture the teacher prepared in advance (Overmeyer, 2012). The students are required to watch the videos outside the class and take notes just as they would be expected to do during a classroom lecture. The students then come to class with a basic understanding of the content knowledge given from the video and complete what is traditionally known as "homework" in class in collaboration with the teacher. However, teachers are encouraged to not simply have students do rote paper work in class to fill the classroom time but to work on higher order learning from knowledge to evaluation. Flipped classroom can help solve the problem of students being stuck on homework.

The two reasons why the flipped classroom can help solve the problem of students getting stuck on homework is that it:

- Opens more time in class for the teacher to go deeper into a topic which allows students to develop a better understanding of the content, and
- The students are doing their homework in class where the teacher is available to help if they get stuck (Bergmann& Sams, 2012).

The teacher is available to review the material as a group or help students one-on-one or in small groups with specific questions they have about the in-class work. The teacher can use any variety of strategies that a traditional classroom teacher might use. In this way, the flipped classroom is not simply a new technique to instruction that would replace other common classroom strategies, but rather it is a way to maximize the amount of time teachers has with students doing higher level learning, rather than trying to get students to memorize a set of facts. In the traditional lecture method, students often try to capture what is being said at the instant the speaker says it. They cannot stop to reflect upon what is being said and they may miss significant point. By contrasts, the use of video and other pre-recorded media put lecture under the control of students. They can watch, re-wind, and fast forward as needed. This enhances students' learning.

The study of flipped classrooms was based on the theory of bloom's revised taxonomy of cognitive domain. This taxonomy provides six levels of learning. The explanation is arranged from the lowest level to the highest level:

1. Remembering**:** In this stage, the students try to recognize and recall the information they receive; they also try to understand the basic concepts and principles of the content they have learned.
2. Understanding**:** The students try to demonstrate their understanding, interpret the information and summarize what they have learned.
3. Applying**:** The students practice what they have learned or apply knowledge to the actual situation.
4. Analyzing**:** The students use their critical thinking in solving the problem, debate with friends, compare the answer with peers, and produce a summary. The students obtain new knowledge and ideas after implementing critical thinking or a debate in group activities. In this level of learning, the students also produce creative thinking.
5. Evaluating**:** Assessment or established peer-review knowledge, judge in relational terms; in this stage, students are evaluating the whole learning concepts and they could evaluate or make judgment on how far they successfully learned.
6. Creating**:** The students are able to design, construct and produce something new from what they have learned (Bloom, 1969).

In implementing flipped classroom, remembering and understanding as the lowest levels of cognitive domain are practiced outside the class hour (Anderson & Krathwohl, 2001). While

in the classroom, the learners focused on higher forms of cognitive work, including applying, analyzing, evaluating, and creating. The following figure 2 illustrates the level of students' learning in the flipped learning according to Bloom's revised taxonomy.

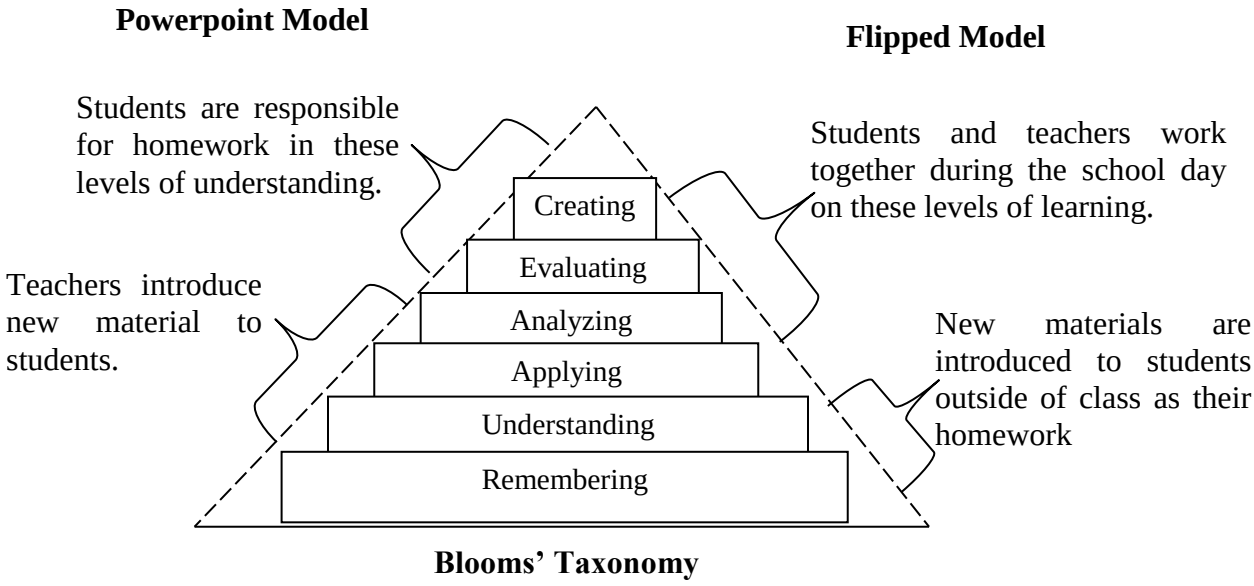

Figure 2: Bloom's revised taxonomy in the flipped classroom, (Researcher, 2019)

With the flipped model, the lower levels are presented before class through recorded lectures and video. Readings, simulations, and other materials also provide this foundational support for learning so that in-class time can be spent working on higher levels of learning from applying to creating. In flipped classrooms, students go from the lowest level (remembering) to achieve the highest level (creating). Williams (2013) mentioned that the flipped classroom focuses on how to support the learners in achieving a higher level of the taxonomy domain. Flipped learning allows the students to spend more time supporting higher-level learning tasks such as a group discussion, while lower-level tasks such as remembering and understanding are completed independently outside the class.

Bergmann and Sams (2012) identified many benefits in flipping one's classroom. Today's students grow up with the always-on digital world. They feel that they need to dumb down when they are in school because school bans smart devices. We need to embrace the digital culture instead of fighting against it. Teachers need to understand the pedagogy and use it to drive the technology. FC helps busy students (e.g. Competitive athletes) catch up or get

ahead. The approach allows teachers to reach all students, not just for the bright students who dominate the conversation in in-class activity.

Students have more control over their learning. Therefore flipped classroom is a method to personalize contents for all students. The speed is appropriate for all. Flipping allow teachers to leverage technology to increase the interaction between teacher to students, students to students and allow teachers to get to know their students better. Teachers have time to influence students and being a positive adult role model in their lives. Small groups working on inquiry based projects allow students to help and learn from one another.

Flipping allows differentiated instructions to reach students in broad range of abilities. If students can work at their own pace and demonstrate mastery of learning, teachers can modify appropriate tasks that are best fitted for them.

Parents also love to watch the videos along with their children. The conversation with the parents also change from the questioning the child's behaviour in class to focusing on the child's learning and to become better learners. Flipping allow parents to access the content and therefore make teaching transparent. This eliminates incorrect perspective of parents to the school. Once there are enough videos to cover the content of a course, teachers can develop a flipped class mastery program where students can demonstrate competency by mastering the course materials at their own pace (Bergmann & Sams, 2012).

Characteristics of a good flipped class and a good flipped lesson

Bergmann and Sams (2012) recommend the following characteristics in a flipped lesson:

- Video lectures deliver direct instruction. Teachers can make their own videos or use others' videos downloaded from youtube.
- The video should be between 10 to 15 minutes. Smaller segmented videos help students learn better.
- Students take notes from the video. To check for understanding of content of the video, teachers can use pre-quiz or start a class discussion by having students to ask their teacher an interesting question about the video.

Bennett, Jason, Gudenrath and Mclntosh (2012) recommend the following characteristics in a flipped class:

- Student led discussions on content brought in from outside of class. The discussions reflect higher order critical thinking.

- Students make decisions to collaborate on the various simultaneous discussions that interest them.
- Students learn content within the real-world context scenarios.
- Active learning students take ownership on the learning material. Self-directed students lead themselves and others. Students do not need prompt from the teacher to form spontaneous collaborative learning.
- Students have the freedom to go beyond the traditional scope of the course.

Powerpoint in Teaching and Learning

Powerpoint is a program that allows teacher to present their lessons in a more dynamic way than simply teaching and writing on the chalkboard. Teachers can focus on the class and interact with the students instead of writing on the chalkboard, because the text and the entire presentations are already there in the form of point file. Lengthy materials can readily be summarize and presented. Power point is a software tool that is used in over 30 million presentations a day and its software is on 250 million computers world-wide (Alley & Neeley, 2005). Powerpoint was developed to improve learning by providing the means to develop presentations that are more structured and interesting to audiences (Amare, 2006). Power point presentations can be as simple as consisting only of text on a coloured screen. Presentations can also be complex and include tables, pictures, graphs, sound effects, visual effects, clips etc. Infact, several researchers have demonstrated that material, such as interesting but extraneous text, irrelevant sounds (Moreno & Mayer, 2000) and irrelevant pictures (Mayer, 2001), can reduce comprehension. Students who were exposed to teaching method with PPPs emphasized that their interest and achievements were improved (Ugwuanyi, Nwankwo & Ugwuoke, 2016).

Powerpoint forms part of the Microsoft office suite and is also called Microsoft power point. It is a presentation package that allows you to produce on-screen computer presentations, overhead projection, transparencies, posters and web pages. (Information Technology Service, 2006). PowerPoint is defined by Asogwa and Echemazu (2011), as a commercial presentation program developed by Microsoft. Powerpoint Presentation (PPP) consists of individual pages or slides. Slides may contain text, graphics, sound, movies, animation and other objects which may be arranged freely. The presentation can be printed, displayed on a computer or navigated through at the command of the presenter. For larger audiences, the computer display is often

projected using a video projector and only the essential details are meant to be projected point by point to those viewing .

Powerpoint is a powerful representation which enables viewers to understand better the meaning of words or concepts used (Aninweze, 2014). It conveys meanings and influence attitude when colour is added to it. The colours chosen and the way it is used have a strong impact on viewers, thus ensuring the success and quality of one's presentation. Essentially, powerpoint(PP) enables users to create a series of slides on a computer which may then be projected in the lecture theatre using a data projector or overhead projector. According to Frank (2008), PP comes with preformed templates to help you prepare professional looking and visually stimulating slides. Judicial use of colour can help to stimulate interest and emphasis key points. It saves the presenter from talking too much, except perhaps, in some cases that may require the teacher or presenter to give certain clarifications or explanations to the students or audience on points that are not clear. PP slide can be made in advance, thereby increasing the time available to teach. Also, PP makes it possible to provide a much richer quality of visual including multicoloured complicated diagrams.

There are certain benefits derived from using PP in classrooms which include:

- PP provides an effective approach to both student's work and classroom instruction. When you teach students to use this programs and allow them to turn in work completed with it, you effectively prepare students for the world in which they will work as adults.
- PP holds students attention through the use of graphics. Therefore, increase students' involvement and interaction.

Achievement in Biology

Students' achievement has become the key factor for personal progress. The desire to climb the ladder of achievement to as high a level as possible put a lot of pressure on students, teachers, school and in general, the educational system. It appears as if the whole system of education revolves round students' academic achievement. In Nigeria, greater emphasis has been placed on education because it is believed to be the only avenue for national development. However, this can only be achieved if students are actively involved in the academic activities which will enhance their academic achievement.

In this era of scientific knowledge and development, much demand is placed and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole

process of learning science. Achievement according to Ezeudu, Gbendu and Umeifekwem (2014) means doing something successfully typically by effort, courage and skills. Achievement means an act of accomplishing or finishing, especially by means of assertion, skills, practice or perseverance. According to Lewis, as cited by Ashu and Ayadema (2011), behavior or experience is an interactive function (F) of the person and the environment. Their Mathematical formula B=F (P, E) indicates that behavior (B) reflects the environment (E) and the person within the environment (P). This formula stressed the need for new research strategies in which behavior is considered to be a function of the person and the environment. Modern science learning stressed the importance of students' participation in the process through exposure to diverse learning experiences (Baikie, 2000). According to Onyilo and Onyilo (2010), achievement is a term for noteworthy act. From the foregoing, achievement is a very strong word which is often used on so many areas. For instance, the achievement in biology, which is the focus of this study, is viewed as a very important factor in teaching and learning biology, which is referred to as students' cognitive achievement. Academic achievement of students is defined as the level of performance in a particular field of study. Higher scores indicate better academic achievement. In the educational system, a poor or an under achiever is someone whose performance is constantly below average

Unfortunately, research reports show that students achieve poorly in biology. Poor achievement in biology however has been attributed to a number of factors by several researchers. Nwagbo (2006) blamed the poor achievement on the state of science education enterprises in Nigerian Schools. Objectives as indicated by their failure to implement them. Inamulla (2005) reported that interaction between the teacher and student is an essential part of all the teaching and learning processes. This point was further stressed by Oloruntegbe (2010) that interaction in the science classroom has always been a triple dynamics between the teacher, the learner and the instructional materials. These three variables are expected to interact harmoniously in a way to produce the intended learning outcomes.

According to Opara (2011), there is a high rate of failure in biology as revealed by the analysis of May/June SSCE result of 2006-2008. In order to address this issue of low achievement in biology, teachers need to be exposed to appropriate teaching and learning approaches which requires the use of instructional materials. This will promote imaginative,

critical and creative skills in the learners resulting to better achievement of instructional objectives (Federal Ministry of Education, Science and Technology, 2001).

Explaining the factors affecting students' achievement in various subjects has become a subject that interests a great number of researchers. Studies of this kind are carried out intensively in the field of science. The reason for this is that students' achievement in the field of science is low (Martin, Mullis, Foy, Olson, 2008). Recently, studies have been carried out to investigate the possible cause of low achievement and how to increase students' learning of the subject. Many variables like inadequate time, improper teaching methods, teachers' competency, inadequate instructional materials, considered to contribute to low achievement have been discussed (Dajal & Rinmark, 2002; Danjuma, 2009). Yucel (2007) considers the variables under discussion to be variables of both cognitive and sensory quality.

Academic achievement is an important parameter in measuring students' learning outcome in various school disciplines. It is commonly measured by assigning scores to the outcome of continuous assessments and examinations. Research reports have shown clearly that no two individuals are exactly the same in overall personality. This means that no individuals have equal potentials as far as learning is concerned because people do not have the same level of interest. What is likely to be of interest to learner "A" may not be of interest to learner "B" which could eventually create a disparity in their achievement levels. The most dominant factor of value in any educational system, according to Ndioho (2007) is achievement. That is why the teacher applies different forms of achievement tests to students in order to classify them into different levels of achievement based on their potentialities.

Ndioho classified students into two categories;-

- High –achievers; these are those whose academic potentials are above class average and their performance is described as good.
- Under-achievers; these are students whose academic potentials are below the class average. Their performance is described as poor.

Presently in Nigeria, it is the West African Examination council (WAEC) and National Examination Council (NECO) that perform the role of grading students at the end of their secondary school education. WAEC and NECO conduct achievement examinations to show how much the students have achieved after completion of the secondary school program. Studies over

the years have shown that there is a disparity in the achievement of males and females in the sciences.

Gender and Science Teaching and Learning

Gender has remained an issue in the front burner of academic discourse. Scholars have become enthusiastic on addressing issues that have continued to create differences among people on the basis of gender which has continued to have adverse consequences on sustainable economic development of the nation (Imam & Dada, 2011). Imam defined gender as the social roles, responsibilities, and behavior created in our families, societies and culture. It also includes the expectations held about the characteristics, aptitudes and likely behaviors of both men and women. These roles are passed on from generation to generation (United States Aid for Individual Development (USAID), 2005). Miller and King (2004) view gender as a social, historical and cultural construct and conditioning, indicating acceptable and preferable forms of behavior and attitudes for both men and women in the society.

Gender can also be viewed as a socially ascribed attribute which differentiates feminine from masculine. For Ekeh (2000), gender is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex. Ekeh maintains further that gender implies the character of being male or female, man or woman, boy or girl. Oraifo (2000) opined that sex is based on biological and physical differences between male and female while gender refers to cultural understanding about what constitutes masculinity and feminity in a society. Thus, while sex is biologically defined, gender is socially defined. On another note, Onyebuenyi (2009) stated that "being male or female is a matter of sex but to be masculine or feminine is a matter of gender". Gender roles are therefore not only different but unequal. Gender difference in science is a global phenomenon that is confined to countries with high numbers of out of school girls. Besong (2002) noted that one factor that militates against science literacy is gender discriminatory barriers in African societies that operate against equitable participation of boys and girls in science education. Benson observed that one out of four girls of school age is actually in school. Curricular pedagogic practices and classroom organization, according to the author, further hinder the access and retention of girls in science education.

According to UNESCO (2003), females constitute more than fifty percent (50%) of the world's active population and though they make immense contribution to national development,

they still face a number of inequitable difficulties that limit their potentials in prompting personal and collective development. A key area of concern in this is that of their participation in science. Gender should not be allowed to restrict total development of the potentials of anybody because whatever reason that makes science attractive to males, does the same for females. Ezeliora (2002) submits that women and girls need science education for some reasons. One is that growing population is bringing and increasing pressure on natural resources and the environment. We need to find ways to use the same resources in more different ways. Another is that in this era of technological development, every profession uses the result of science and technology so the women/girls should also be prepared for it. Also, growing demoralization increasingly involves the population in decision-making and to be able to decide, women need to be able to choose.

Women in science came into limelight during the United Nations Decade for Women (1976-1985) which addressed women in science and the challenges confronting women in choosing and performing well in science related occupations (Otuka,2004). The association between gender and the response to Science, Technology and Mathematics (STM) education has been widely studied (Anegbe & Adeoye, 2006). The main focus of their findings is lack of girls opting to study the physical sciences. Studies on gender differences in science achievement retention and participation are enormous in science education.

In the last four decades, there has been concern about low participation rate of women in science. Women and science research has focused on practical and pedagogical barriers to girls performing well in science. Issues identified, according to Otuka (2004) included teachers giving more attention to boys than girls, lack of female role models and pursuits in text books and so on. In these practical and empirical matters, there has been also developed feminist argument about bias in the very nature of science and its practice. This bias is held by some feminists to be responsible for girls shunning science or underachieving in it. Achieving equity in science is important because of its relationship to economic development.

In more recent international comparative studies by the International Association for the Evaluation of Educational Achievement (I.E.A) and the Organization for Economic Cooperation and Development (OECD), it was observed that the differences between girls and boys in the areas of achievement and that of retention are now only very small (Martinet al. 2008). Overall, the effects and strengths are low even when significant differences are observed. Similarly, no

indications were found that boys systematically differ in their expectations of having a future career which is related to science and technology.

However, while the benefits of science education for women in sustainable, social and economic development are numerous in some major parts of the world, Africa still lags behind among other continents in terms of provision of an effective science education for girls. Since the driving force for success in life is interest, there is the need for the girl child to be guided by the teacher into developing the appropriate learning strategy that could probably lead her to participate actively in biology learning activities for better achievement and retention

In conclusion, differences in sex were found to affect biology teaching and learning .With this, in mind, this study sought to find out how FC or PPP would influence students' achievement and retention in biology.

Retention in Biology

Retention is an individual's ability to remember and recall information, materials and experiences learned over time. This acquired materials in the mind need to be preserved in form of images for knowledge to develop. When a stimulating situation occurs, retained images are revived or reproduced to make memorization possible (Morris, 2004). Biology concepts therefore, need to be presented to the learners in a way or method that touches their sub consciousness, which can trigger quick recalling of the concept being taught or learnt. Retention is defined by Kundu and Tutoo (2002) as a preservative factor of the mind. The mind acquires the materials of knowledge through sensation and perception. These acquired materials in the mind need to be preserved in form of images for knowledge to develop. When a stimulating situation occurs, retained images are revived or reproduced to make memorization possible. Hence, biology concepts need to be presented to the learners in a way or method that touches their sub consciousness which can trigger quick recalling of the concept being taught or learnt. In line with this, Fakayode (2009) viewed retention as individual ability to hold information or store learned material for future use. Retention is an act of retaining or the ability to recall or recognize what has been learnt or experienced over a long period of time. Probably, if what has been learnt is retained over a long period of time, it may lead to higher achievement because retention is measured in collaboration with achievement (Iji, 2010). This implies that if there is no proper storage structures developed in the learners, information recalling may be stained and

consequently resulting to poor achievement. It can equally be said that retention determines the level of achievement of the learners.

Unfortunately, research reports show that students retain poorly in biology. The prevalent problem in secondary schools is poor retention among secondary school students offering science subjects including Biology. Concepts learned tend to fade with time when not put to use, or not properly retained, hence, lead to forgetting and loss of knowledge. Retention in biology can be enhanced through appropriate instructional approaches, thus, for the content and concepts of biology to be retained and recalled therefore, there is need to make the biology teaching meaningful to the students, by presenting it in a meaningful way by using appropriate teaching approaches. Okoye (2003) refers to retention as the process of maintaining the availability of new meanings or some part of them. It may be suggested that the amount of the original meaning that will be retained at any given point in time is a variable quantity. Therefore, forgetting represents a decrement in the availability of an acquired meaning. That is, it describes the loss in availability that occurs between the original establishment of the meaning and its later reproduction. Considering the two terms, retention is seen as referring to the positive aspects of memory while forgetting refers to the negative aspects.

Frequent reviews and tests, elaborated feedback and active involvement of students in learning projects have all been associated with longer retention. Cope (2011), stated that active participation during instruction increases learning and retention. Lecturing is still a common way for instructors to communicate information. However, it does not allow for much interaction between learners and teacher and as a result, the instructor may falsely assume that the students fully understood the concepts that he presented. In order words, students learn more efficiently by participating in instruction. To further support this idea, (Iji, 2002; Chianson, 2008) stated that retention in biology is not acquired by mere rote learning but through appropriate instructional approach. Therefore, using a variety of instructional approaches can significantly improve learning and retention in students of all ages.

However the ability to retain information depends on many variables such as time interval between when learning occurred and retrieval, intervening experiences, environment, instructional strategies/material used etc. These variables in one way or the other affect retention adversely. The techniques that can aid retention should be sought by science (Biology) teachers

and educators so as to improve the retentive ability of the pupils/students. These may include the following among others.

1. Meaningfulness of materials: Retention can be improved through the organization of materials in some meaningful way. Good teaching helps retention while poor teaching aids forgetting, so we teachers should take note. When materials learned are meaningful to students, it is not easily forgotten. Learning can be made meaningful by giving students examples which occurs daily.
2. Over-learning: This is a repetition of learned tasks several times. It is a term used to describe practice that continues after a perfect recall has been made. Teachers can encourage over-learning by giving students exercises and assignments regularly.
3. Use of mnemonics: This is in form of abbreviations which are very useful in recalling major points in a topic. For instance in simplification of biological concepts, mnemonics like MR NIGER + D, IPMAT have been very popular and very helpful to students in learning some biological concepts.

Theoretical Framework

Vygotsky's Social Constructivism Theory (Vygotsky, 1978)

Vygotsky suggested that students acquired knowledge through social interactions and through their culture to experience meaningful learning. When Vygotsky's social constructivism theory was implemented in the biology classroom (via facilitation, collaboration, multiple representation, technology, etc.), students retained biology information longer and grasped the concepts regardless of the level of difficulty; in turn, and students' biology achievement was maximized (Jones, Jones, & Vermette, 2010). The major theme of the social constructivism framework is that social exchanges or interactions play an essential role in cognitive development. "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)" (Vygotsky, 1978). In order for biology instruction to effectively take place, students' interests and attitudes about biology must be considered. Instruction must be designed so that students effectively interact within the classroom and construct their own understanding (Berrett, 2012).

Vygotsky's theory suggested that the facilitator incorporate effective scaffolding in lessons to assist learners in obtaining and retaining information (Vygotsky, 1978). The flipped

classroom and power point have provided alternative ways of scaffolding to support learners' reasoning and problem solving skills. The educator provides the appropriate strategies to ensure precision of knowledge for content development. The flipped classroom educators support learners' content development by providing suitable activities at the correct level of difficulty and complexity. The educator provides the learning constructions necessary so that the student can complete the task with the proper amount of assistance, which will help the learner through the Zone of Proximal Development (Lewis, Perry, Friedkin, & Roth, 2011).

In the 1930s, Vygotsky introduced the Zone of Proximal Development as scaffolding. The Zone of Proximal Development is defined as the distance between what learners comprehend within a task and the next level of learning that they can complete by themselves with a higher conceptual level of comprehension. Vygotsky suggested that scaffolding was the role of the facilitator who provides support structures to move the learner to the next level. The scaffolding learning strategy is evident in the flipped classroom and power point since these modes of teaching require the facilitator to provide students with meta-cognitive support and ensure exactness of student learning so that the students can become self-regulated and independent (Bergmann & Sams, 2012b; Johnson & Renner, 2012). Thus, Vygotsky's social constructivism theory provided a framework for this alternative curriculum since components that frame the theory were evident in the flipped classroom. Effectively providing scaffolding for the learner, the educator as the facilitator, and the Zone of Proximal Development are all major components of Vygotsky's social constructivism theory that are presented in the flipped classroom and powerpoint presentation.

Bandura's Social Learning Theory (Bandura, 1977)

Bandura's Social Learning Theory provided another theoretical framework for the flipped classroom and power point presentation and also explained how learning occurs and is retained. Bandura's theory suggested that a student, the student's behavior, and the situation the student was in all exerted an influence on what the student's next action would be (Bandura, 1977). According to this theory, learning occurs socially; students learn from their interactions with other students and adults. Abbott (2007) said: Social learning theory talks about how both environmental and cognitive factors interact to influence human learning and behavior. It focuses on the learning that occurs within a social context. It considers that people learn from one another, including such concepts as observational learning, imitation, and modeling.

The premise of the Social Learning Theory is that people learn new information and new behaviors by observing others. Bandura believed that a learner's behavior was the result of watching others, forming ideas of how new behaviors were supposed to be performed, and then mimicking that coded information into action. Observational learning (also called modeling) can be used to describe a wide variety of learners. Bandura's Social Learning Theory explained the cognitive, environmental, and behavioral influences on human behavior (Bandura, 1977).

In order for observational learning to be effective, the learner must exhibit four conditions. These conditions include attention, retention, reproduction, and motivation (Abbott, 2007). Once the first condition is met, the other conditions follow sequentially. The first condition, attention, sets the tone of the outcome. Since the other conditions rely heavily on attention, this stage will determine how effective the modeling can be. In terms of attention, the learner must give the appropriate focus to what is being modeled. Once the appropriate amount of attention is shown, the retention condition can be met and the learner can reproduce the actions and behaviors of the modeler. If the learner can successfully reproduce the modeled actions, the learner will likely become motivated about the experience and in turn, want to continually model appropriate actions to receive verbal praise, recognition, or for intrinsic reasons (Abbott, 2007).

In the flipped classroom and power point, the Social Learning Theory is displayed continuously. The learner is presented with media in which a presenter models appropriate behavior. When the learner is attentive to instruction, retention, reproduction, and motivation will likely occur (Alvarez, 2012; Fulton, 2012a; Miller, 2011). Bandura's Social Learning Theory provided a theoretical framework for the flipped classroom and power point presentation since effective modeling of concepts is presented. The attentive student then retains and reproduces the concepts learned through solving practice problems and extends those concepts to real life application. Student engagement, timely student feedback, and student collaborations are all addressed during flipped instruction, which could result in students retaining concepts longer and connecting those concepts to real life application.

According to Miller (2011), "Older children, by observing a model, are expected to learn complex new skills quickly, with a minimum of verbal instruction". Social Learning Theory supported the need for multiple representations and peer collaboration in curricula. In the flipped classroom and power point presentation, multiple representations are delivered through

technology. Students' interactions with technology and peer-to-peer or peer-to-teacher collaborations can take place daily or as often as new material is introduced in the classroom (Fulton, 2012a). According to Bandura (1987), adults also learn socially. Since adults learn socially, they should consider implementing social interactions within the classroom. These interactions between students can enrich learning experiences and present platforms for numerous rich discussions. However social interactions are just one way to foster learning. Educators must value the diversity of learning and implement various instructional formats and assessments to ensure that students' needs are met (Stanford & Reeves, 2009).

Empirical Studies

Flipped Classroom

Gladys, Carmina, and Catherine (2018), investigated Flipped Classroom Approach in Teaching Biology: Assessing Students' Academic Achievement and Attitude towards Biology. Quasi-experimental design was adopted for the study, specifically the non equivalent control group design. The sample comprised of 80 SS1 students from a non sectarian private school in Metro manila drawn using multistage sampling procedure. Two groups of students were used for this study; they are experimental and control groups. The experimental group was taught using Flipped classroom and the control group was taught using the conventional lecture method. Two instruments were used for data collection in this study namely: Biology Achievement Test (BAT) and Biology Attitude scale (BAS). The same test (BAT) was used as pretest, posttest. At each stage after the pretest, the items were reshuffled. The research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significant. The result of the study revealed a significant improvement in both achievement and attitude towards Biology in favour of the flipped classroom group (FCG). The exposure to flipped classroom instruction developed a more positive attitude in students, which also resulted in a greater improvement of understanding of concepts as reflected in their performances. The reviewed study is related to the present study as the present study investigated flipped classroom in teaching biology and also related in the design used and sampling technique. However this study differs from the present study, which seeks to determine the effect of flipped classroom and powerpoint on the students' achievement and retention in biology.

Makinde and Yusuf (2018) studied the effect of flipped classroom on senior secondary school students' performance and retention in mathematics. This study examined post-test performance (pp) and retention performance of students in mathematics when taught with flipped classroom and traditional lecture method. The study adopted quasi - experimental design. Sample was drawn from two secondary schools in Lagos State Nigeria. Respondents were 268 students (145 for experimental taught with offline video and 123 for group taught with lesson note drawn using purposive sampling technique. The instrument used for data collection was the performance test and its reliability yielded 0.88 using Cronbach Alpha and two null hypotheses were tested using ANCOVA). The findings revealed that students in flipped classroom performed better than their counterparts in conventional method. The findings also revealed that the students' retention in mathematics improved. This study is similar to the present study in terms of dependent variable flipped classroom, independent variable students' retention and also in design but differs in terms of area of study, subject, and in other independent variable such as achievement.

Baki and Khaled (2016) studied the effect of using flipped classroom instruction on students' achievement in the new 2016 scholastic assessment test mathematics skills in the United Arab Emirates. The quasi – experiment design was adopted for the study. The population of the study was eight hundred and eighty- seven female students and a sample of seventy nine eleventh–grade female students from two secondary schools. The instrument for data collection was new scholastic assessment test (SAT) with reliability coefficient of 0.71. The ANCOVA was employed to determine the main effects of flipped classroom instructional approach on group achievement. The findings revealed that the students taught mathematics using flipped classroom instructional approach out-performed their counterpart taught the same concept using convectional lecture method in achievement. This study is related to the study at hand in the aspect of instructional approach used flipped classroom and also students' achievement and in biology. However, the present study investigated not only the effect of flipped classroom on student' achievement but also retention an influence of gender was also investigated.

Muhammad and Falalu (2016) worked on the impact of flipped class room model in the teaching of integrated science among 200 level students at Ahmadu Bellow University, Zaria. The research design for the study was non equivalent control group quasi - experimental control group design. The population of the study was 230 students; out of which 82 students were

selected to participate in the study. They were grouped in two: the experimental group (EG) which comprises of 42 students and the control group (CG) which also comprises of 40 students. The data was collected using a research instrument tagged Properties of Matter Achievement Test (POMAT) with reliability coefficient of 0.78. The sampled students were exposed to the treatment for the period of six weeks those in the experimental group were taught using the flipped classroom model while those in control group were taught using lecture method of instruction. The data obtained were subjected to t-test statistical analysis at 0.05 level of significant. The findings of the study revealed that flipped classroom model enhances students' academic achievement in understanding the properties of matter concept in integrated science. This study is similar to the present study in terms of independent variable flipped classroom, but differs in terms of area of study, subject, class level, and in other independent variables such as retention.

Literature review presented in this section shows that only a few studies have being carried out on the effectiveness of flipped classroom on students' achievement and retention in biology. Therefore, this study intends to investigate the effectiveness of flipped classroom as an instructional approach on students' achievement and retention in biology.

Power Point (PP)

Aninweze (2014) investigated the effects of two instructional delivery approaches on secondary school students' achievement and retention in biology (Video Taped Instruction and Power Point Presentation). The design of the study is the pretest-posttest non-equivalent group design. The sample of the study was Seventy – Nine (79) Biology students in Senior Secondary Two (SSII) were drawn from two intact classes. The instruments for data collection were Biology Achievement Test (BAT) and Biology Retention Test (BRT). Six research questions and six hypotheses were also formulated to guide the study. The research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA). The result of the analysis showed that VTI had a significant effect on students' achievement and retention in Biology. Following the findings and implications of this study, it was recommended that Biology teachers should employ the use of VTI in teaching Biology to enhance students' achievement and retention. It was concluded that VTI was more effective in enhancing students' achievement and retention in Biology in Senior Secondary School taught using VTI. Following the findings and implications of this study, it was

recommended that Biology teachers should employ the use of VTI in teaching Biology to enhance students' achievement and retention. It was concluded that VTI was more effective in enhancing students' achievement and retention in Biology in Senior Secondary Schools. This study is similar to the present study in terms of method, independent variable power point presentation and dependent variable such as students' achievement and retention, but differs in terms of area and another independent variable flipped classroom was also investigated in the present study.

Polk (2013) studied the effect of teaching biology concepts with animations versus static cartoons via PPP on content retention. The research study adopted two activity groups: experimental and control groups. Students were pre-tested prior to the introduction of content in three units of study. Cellular transport, photosynthesis and mitosis. A sample of eighteen students was randomly arranged to the experimental and control groups. The experimental group viewed an animation on the topic using PPP and accompanied by teacher narration while the control group viewed a series of static cartoons with captions through PPP. The two groups were post-tested together immediately following the treatment and again approximately 21 days later. The data collected was analysed using a Krustal-Wallis (non-parametric ANOVA analog), along with a Dunn's Multiple Comparisons test, was run to determine if any statistically significant differences existed between the means of control and experimental group. At 0.05 level of significant, the result showed that no statistically significant differences due to animations were found in these comparisons, though student engagement and class discussion were increased by the use of animations based on teacher observations. A class survey revealed an overwhelming interest in continued use of the animations as an instructional technique to increase students' retention of biology content. This study differs from the present study, which seeks to determine the effect of flipped classroom and power point presentation on the students' achievement and retention.

Ugwuanyi, Nwankwo and Ugwuoke (2016) studied the efficacies of power point presentation mode of instruction and demonstration method of instruction on the interest and achievement of students in secondary school physics in Enugu State. Two research questions and two null hypotheses guided the study. A non-equivalent control group quasi-experimental research design was adopted for the study. Two hundred and thirty six (236) SS1 physics students from four secondary schools were sampled and used for the study. The students in two

different groups of the intact classes were exposed to power point mode of teaching and demonstration method respectively. The instruments used for data collection were Physics Interest Inventory (PII) and Physics Achievement Test (PAT). Items of PAT were adopted from the physics curriculum of senior secondary school class one students. The instruments were trial tested and reliability coefficients of 0.83 and 0.77 were obtained for the instruments respectively. All the groups were pretested before the experiment and post tested after the experiment. The data obtained from the study were analyzed using mean and Standard Deviation (SD) and Analysis of Covariance (ANCOVA) was used to test the hypotheses of 0.05 level of significant. The findings revealed that with the integration of power point as an ICT tool in teaching physics, students' interest and achievement were enhanced better than those taught using demonstration method. This study is related to the present study because both used power point presentation to determine Students' achievement and also related in design but they differ in terms of students' class level, area, and subject. Most importantly, the present study seeks to determine the effect of flipped classroom and power point presentation on students' achievement and retention in biology

Rotimi, Ajogbeje and Akeju (2011) studied the application of a New Kind of Visual-Model Instructional Strategy in physics education as a means of improving the learning achievement of physics students. The new kind of visual model instructional strategy introduced in their research was a computer intelligent-based power point visual simulation used to investigate learning achievement in physics. The research study adopted the Quasi-Experimental Research Design and two activity groups: Experimental group and control group. A sample of 168 purposively selected for the research. The instrument used in the study was NKVM and the method of statistical analysis used for the research study is the T-test. The research study revealed that the New Kind of Visual Model Instructional Strategy called computer intelligent-based power point visual simulation contributed positively to learning achievement in physics. Result also showed that there is significant effect of treatment on students' retention of learned materials. This study differs from the present study, which seeks to determine the effect of flipped classroom and power point presentation on the students' achievement and retention in biology.

From the foregoing, the reviewed studies indicated that the innovative instructional approaches such as flipped classroom and power point presentation etc have positive effects on

students' academic achievement and retention, improve the performance of low achievers in Biology and generally improve on students' understandings of Biological concepts more than the conventional teaching methods such as lecture and demonstration methods respectively. From the reviewed studies there is also a clear indication that there is limited or no significant studies on the effects of flipped classroom and power point presentation on students' achievement and retention in Biology. In view of this, the researcher considered it necessary to investigate the relative effectiveness of flipped classroom and power point presentation on students' achievement and retention in Biology.

Gender and Students' Achievement and Retention in Science

Okoyefi (2014) investigated the effect of Four Mode Application Techniques (4MAT) on achievement, retention and multiple intelligences of students with different learning styles. Quasi-experimental design was adopted for the study, specifically the nonequivalent control group design. The study was carried out in Abakaliki Local Government Area of Ebonyi State. A sample size of one hundred and thirty nine (139) SSII Biology students was used for the study. Two groups of students were used for this study; they are experimental and control groups. The experimental group was taught using four mode application techniques (4MAT) and the control group was taught using the conventional lecture method. The treatment lasted for six weeks. Three instruments were used for data collection in this study namely: Biology Achievement Test (BAT), Multiple Intelligence Inventory (MII) Students and Teacher Interview Schedule (STIS). The same test (BAT) was used as pretest, posttest, and retention test. The research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significant. The results of the study revealed that there was no significant main influence of gender on students achievement in biology, there was no significant main influence of gender on students' retention in biology, there was no statistical significant main interaction effect of method and gender on mean achievement score of students in biology, there was no statistical significant main interaction effect of methods and gender on mean retention score of students in biology. This study is related to the present study, in terms of gender, but differs in terms of area.

Ezenwosu and Nworgu (2013) investigated the "Efficacy of peer tutoring and gender on students' achievement in Biology. Guided by two research questions and three mull hypotheses, the study employed a type of quasi-experimental design called pretest-posttest non-equivalent

control group design. Conducted in Aguata Education Zone of Anambra State, the study has a population of 1,731 SSII students and sample size of 228 SSII Biology students drawn from two co-education secondary schools in the zone. Mean and standard deviation was used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results among others showed that students taught Biology using peer tutoring performed higher in BAT than those taught Biology using the conventional lecture method. The result further revealed that male students slightly performed better than female students. This study is related to the present study because gender is a moderating variable in the study, but the two studies differ in terms of the methods employed in the study and area.

Chukwu (2011) carried out a study on the "Effect of integrated model of teaching on students' retention in Biology". Guided by two research questions and three hypotheses, the study employed a type of quasi-experimental design called pretest-posttest non-equivalent control group research design. 351 SSII Biology students were drawn from a population of 1,406 SSII students of four selected schools in Enugu East L.G.A using multistage sampling technique. Instrument for data collection was a Biology Teacher Made Retention Test (BTMRT) which has a reliability index of 0.72 determined using Kudder-Richardson formula 20 (K-R20). Data were analyzed using mean and standard deviation for the research questions while multiple classification Analysis of Covariance was used to test the hypotheses at 0.05 level of significance. Results among others revealed that there was no significant difference in the mean retention test scores of male and female students in Biology. Also, there is a significant interaction effect of gender of students and teaching method in students' retention in Biology. The reviewed study is related to the present study as the present study will also determine the influence of gender on students' retention in Biology. However, the present study will determine the influence of gender on students' retention in Biology using flipped classroom and power point instructional approaches which the reviewed study did not use.

Okeye (2016) carried out a study on the 'influence of gender and cognitive styles on students' achievement in Biology. The study guided by a research question and a null hypothesis respectively adopted causal comparative research design. The study being conducted in Awka Education Zone of Anambra State has a population of 12,000 SSII Biology students and a sample size of 265 SSII Biology students (141 males and 124 females) drawn from four government owned schools comprising of two (2) boys' and two (2) girls' schools.

Disproportionate stratified random sampling technique was used. Data were collected using Group Embedded Figure Test (GEFT) and Biology Achievement Test (BAT) which contained 40 multiple choice items. GEFT which was used to access the cognitive styles of students as either field dependent or field independent has a reliability of 0.89 determined using test-retest method. The reliability of BAT was established to be 0.86 using Cronbach alpha approach. Mean and standard deviation were used to answer the research questions while one-way Analysis of Covariance (ANOVA) was used to test the null hypothesis. Results showed that the male and female cognitive styles in Biology did not differ significantly in their achievements. The reviewed study is related to the present study in that the present study will also determine the influence of gender on students' achievement in Biology. However, the present study will adopt quasi-experimental of 2x2 factorial research design and flipped classroom and power point instructional approaches which the reviewed study did not use.

Okwara, Anyagh and Ikyaan (2017) conducted a study on the "Effect of projected instructional media on senior secondary school students' achievement in Biology". Guided by two research questions and three hypotheses, the study adopted pre-test posttest non-equivalent control group research design. Carried out in Education Zone B of Benue State, the study has a population of 11,520 SSI Biology students and a sample of 165 SSI Biology Students. The instrument for data collection was Biology Achievement Test (BAT) with a reliability of 0.72 determined using split-half method of Pearson r. Descriptive statistic was used to answer the research question while ANCOVA was used to test the null hypotheses at 0.05 level of significance. Results among other things showed that gender had a significant effect on students' achievement as female students achieved higher when taught with projected instructional media. The reviewed study is related to the present study as the present study will also determine the influence of gender on students' retention using flipped classroom and power point instructional approaches which the reviewed study did not use.

Enohuean (2015) investigated effects of instructional materials on the academic achievement and retention of SS 2 biology students in Delta State. Quasi-experimental design was adopted for the study. The study sample consisted of 86 SS2 biology students randomly selected from a population of 5,626 students drawn from 18 public schools. Data was collected using Biology Achievement Test (BAT). The Reliable index was 0.65. Four null hypotheses were tested using t-test statistics. The following major findings were made: There is a significant

difference between the mean academic achievement scores of students taught using instructional materials (EG) and those taught without the use of instructional materials (CG). The result on the effects showed that there is no significant difference in the mean achievement scores of male and female students taught biology concepts using instructional materials. There is significant difference in the retention ability of male and female students exposed to the use of instructional materials. This study is related to the present study because gender is a moderating variable in the study, but the two studies differ in terms of the methods employed in the study and location.

Anaun (2014) studied the effects of constructivists' learning strategies on students' achievement and retention in Biology in selected Senior Secondary Schools in Owo Local government of Ondo State. The study adopted a quasi experimental design. A total of one hundred and sixty students from two co-educational schools participated in the study. 80 students served as experimental group while 80 served as the control group. Three research instruments were used for the study. Data was collected using Biology Achievement Test (BAT). Two research questions and two null hypotheses were tested at 0.05 levels of significance. Analyses of data were carried out using Analysis of Covariance (ANCOVA). The result obtained on the effects of gender showed that male students had higher achievement score than their female counterparts in the experimental group. This study is related to the present study because gender is a moderating variable in the study, but the two studies differ in terms of the methods employed in the study and area.

In a related study, Obiekwe (2008) investigated the effect of constructivist instructional approaches on students' achievement and interest in Basic Ecological concepts in Biology. The study adopted a quasi-experimental design of pre and post- tests non-equivalent control group. A purposive random sampling technique was used to select from (94) schools (2 boys and 2 girls' schools) in Ogidi Education Zone of Anambra State. Out of the four (4) schools, one male and female school was assigned as the experimental groups while the other one male and one female school were assigned as the control group. The experimental group was taught ecological concepts using constructivism instructional approach while the control group was taught using conventional (lecture) method. Biology Achievement Test on Ecological Concepts (BATEC) was used to collect data. The data were analyzed using means, standard deviations and ANCOVA. The findings from the study on influence of gender indicated that male students benefited more significantly than the females counterparts on achievement in basic ecological

concepts using constructivists instructional approaches. This study is related to the present study because gender is a moderating variable in the study, but the two studies differ in terms of the methods employed in the study and area.

However, in all the works reviewed, some are either in favour of male, or in favour of the female students. However, none articulated the reason for such gender differences. Therefore, the present study intends to close that gap by investigating the relative effectiveness of flipped classroom and power point presentation on student's achievement and retention in Biology. This is aimed at finding out whether flipped classroom and power point presentation favour male or female most. In view of these inconsistent findings on gender as it relates to student's achievement and retention, there is a gap, which the present study is geared towards filling by contributing to the body of knowledge on gender, achievement and retention in science.

Summary of Literature Review

The review of literature for this study described a schema that illustrates the relationship among the variables of the study. Biology, instructional approaches, flipped classroom, power point, gender, achievement and retention were reviewed. The reviewed subthemes exposed the relevance of biology especially in fostering learner's development; controlling of pest, diseases and pollution; enhancing the acquisition of knowledge, skills and attitudes they acquire from biology that they can apply the same in societal development. This calls for effective teaching/ learning of biology in Nigerian classrooms. However, studies showed that students inability to achieve maximally in biology and other learning process have been attributed to poor use of instructional approaches. The need to improve students' achievement has become necessary because when students' achievement in biology is affected irrespective of gender, it seems to make them show apathy towards learning. As such, students may not strive to commit the knowledge acquired to memory for future use which perhaps negatively affects their retention. Hence calls for this study.

Two theories namely Vygotsky's Social Constructivism Theory and Bandura's Social Learning Theories were reviewed. The former theory among other tenets maintained that students obtain a new knowledge through social interaction with others. The later theory among other principles showed that people learn new information and behaviors by observing others. Students can learn from each other, by modeling and observing others. The two reviewed theories are related to this study since the students learn through social interactions, in groups, or

in collaboration with the teacher (facilitation), they retained the self-discovered knowledge and information apprehended with teacher assistance, and actually enjoyed learning biology.

However, various related studies were reviewed under empirical studies. Reviewed studies on flipped classroom and power point were found to enhance students' achievement and retention in biology than conventional instructional approaches used in teaching/learning biology. However, no study was indentified to have investigated the efficacy of flipped classroom and powerpoint on senior secondary students' achievement and retention in biology hence; the need for the study. Also, the reviewed empirical studies on the influence of gender on students' achievement and retention showed contradictory results, further studies on gender and instructional approach becomes imperative.

In this study, the researcher is interested in investigating the efficacies of flipped classroom and powerpoint instructional approaches on students' achievements and retention in Biology and also to contribute to the academic debate on the influence of gender on students' achievement and retention in Biology.

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CHAPTER THREE
RESEARCH METHOD

This chapter was organized under the following subheadings: design of the study, area of study, population of the study, sample and sampling technique, instrument for data collection, validation of instrument for data collection, reliability of instrument, experimental procedure and method of data analysis.

Design of the Study

The study adopted a quasi-experimental of 2x2 factorial design. This is an experimental design which incorporates two or more independent variables in a single experiment and the effect of each independent variable is measured using different group of participant (Field, 2013). Factorial design will be used because it will help the researcher to determine the main effects of two treatments in one single experiment. The design equally permits various other comparisms of interest like interaction effects. The independent variables (treatment) are flipped classroom and power point. The design is represented as thus;

Group A O_1 X_1 O_2 O_3

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Group B O_1 X_2 O_2 O_3

The symbols are explained thus:

O_1 = Pretest scores of the group

X_1 = experimental treatment A using flipped classroom instructional approach

X_2 = experimental treatment Busing power point instructional approach.

O_2 = Posttest scores for the groups

O_3 = Retention test scores for the groups

--- = indicates that both groups are not composed randomly

Area of the Study

The study was conducted in Obollo Afor Education zone of Enugu State where there is report of poor students' achievement in external examinations (The tides news online, 2016). In addition to students' poor achievement, their retention is of concern. Obollo –Afor Education Zone is one of the six zones in Enugu State. It is situated between Nsukka Local Government

Area of Enugu State and Kogi State. It has three local government areas namely: Udenu, Igboeze North and Igboeze South local government areas. It has a total of forty-eight public secondary schools, sixteen of which are in Udenu local government area; twenty-two of the schools are in Igboeze North local government area and ten are in Igboeze South local government area (see Appendix H, pg.147). Among the forty-eight public secondary schools in this zone, forty–one are co-educational secondary schools while seven are single-sex secondary schools.

Population of the Study

The population of the study was all the four thousand, eight hundred and twenty-two (4828) Senior Secondary Two Biology students in Obollo-Afor Education Zone; consisting of two thousand, eight hundred and ninety-four(2, 894) female and one thousand nine hundred and thirty- four (1934) male (Planning and Research Unit Obollo Afor Education Zone). The SS2 students will be used for the study because the units from the biology curriculum which constituted students' areas of weakness in West African Senior School Certificate (WASSC) Biology; are done in SS2. The choice of the topic was also based on the fact from literature that students perform poorly in biology concepts like internally situated organs and systems which ordinarily could not be easily accessed. Such complex and internal structures include nervous system, excretory system, respiratory system, blood circulatory system, digestive system, tissue and supporting systems in animals among others (Gambari, Bello, Agboola& Adeoye,2016)); are done in SS2.In addition, theSS2 Biology students have been exposed to the subject for at least one year. In other words, they have background knowledge in biology which serves as anchor for future learning of the subject.

Sample and Sampling Techniques

The Sample size for the study was seventy nine (79) SS2 biology students from two intact classes in Obollo Afor Education zone.

The sample was drawn using multistage sampling procedure. This is because the sampling occurs in stages; involving the use of simple random sampling, and purposive sampling techniques. In the first stage, simple random sampling was used to draw one local government area out of three local government areas in Obollo Afor education zone. In the second stage, Purposive sampling technique was used to select two schools with functional computer laboratory (Computers and Generators) and coeducational because gender is a moderating

variable in this study. In the third stage, simple random sampling was used to draw one intact class from each of the two schools to make a total of two intact classes. All the students in the selected two (2) intact classes constituted the sample for the study. Finally, each intact class was randomly assigned to flipped classroom and Power point groups respectively. In flipped classroom group, there were 15 male and 25 female biology students and in power point groups, there were 13 male and 26 female biology students making the sample size for the study to be 79.

Instrument Used for Data Collection

One instrument was used to collect data for this study. The instrument was Biology Achievement Test (BAT) (see Appendix A, pg.88). The instrument was developed by the researcher. BAT had two sections; A and B. Section A elicited biographical information of the students while section B contained forty(40) multiple-choice items whose development was guided by test- blue print (see Appendix C, pg.100) in order to ensure its content validity. Forty questions were developed from the contents and the students were taught among which are: supporting tissue in animals, axial skeleton, appendicular skeleton and joints. In scoring the BAT, each correctly answered question attracted a score of one mark to get a total of 40 marks which will be converted to percentages using the formula:

$$\text{Students' final score} = \frac{students' mark}{total} x \frac{100}{1}.$$

Therefore, if a student answers all the questions correctly, 100 marks will be assigned to such student. After two weeks of administering BAT, the reshuffled form of BAT was administered to students to test their retention.

Development of flipped video and power point slides.

Flipped video was developed by the combined efforts of the researcher and a Computer Programmer using the lesson script, Microphone and editing software named Corel Video Studio Pro X3. The flipped video contains a lesson on supporting tissues in animal in which the researcher uses her voice from the background to explain supporting tissues in animals. The lesson video is a short video. It contains three lessons on supporting tissues in animals based on the three weeks lessons from the lesson note. The first video teaches meaning of skeleton, skeletal materials, functions of skeleton and types of skeleton and sections of skeleton. The second video teaches axial skeleton (skull, bones of the vertebral column, their distinguishing

features and ribs and sternum. The third video teaches appendicular skeleton, types of joint and movement at a joint. Finally, the videos were burned in DVD and CD- ROM.

The powerpoint slides were developed by the researcher using Microsoft powerpoint. It was developed using the following steps.

Step 1: Open Microsoft PowerPoint.

Step 2: Go to File at the top of the screen and click New. A box that says "New Presentation" should appear on the right side of your screen.

Step 3: In the "New Presentation" dialog box, click on "From Design Template." Then scan through design templates and choose one that you like.

Step 4: Slide Design Select a design template by clicking on the template you like. Choose a different color for template by clicking on "Color Schemes" in the "New Presentation" dialog box.1

Step 5: Slide Layout Change the Slide Layout. Change the slide layout (how information is presented in the slide) by going to the top of the screen and clicking on "Format" – "Slide Layout." A box will appear on the right side of your screen (where "New Presentation" appeared) labeled "Slide Layout." Select a design by clicking on it.

Step 6: Adding Text Enter your text by clicking and then typing in the box titled "Click to Add Text" or "Click to Add Title."

Step 7: Adding Pictures Add pictures by clicking on the box that says "Click to add content."Inside that box, there will be a smaller box with six icons. Click on the icon that looks like a photograph of a mountain. A new window will open, allowing you to browse for a picture on your computer or a CD. Once you find your picture, click on it and then click "Insert."2

Step 8: Resizing Pictures Change the size of your picture by clicking on the picture. The picture will then have black lines around it with small bubbles or boxes in the corners. Place your mouse over the bubbles or boxes and click. Holding the mouse pointer down, drag the picture to the size you want. The powerpoint slides contain the topics in supporting tissues in animal as illustrated in the lesson notes.

Validation of the Instruments

In order to ensure that the instrument was usable and measure what they were supposed to measure, the instrument BAT, Flipped Classroom (FC) and Power Point (PP) CD-ROM

containing biology instructions and lesson notes (see Appendix F, pg.103), and marking guide(see Appendix D, pg.101)were face- validated by three (3) experts in Science Education Department, University of Nigeria, Nsukka. Two of the experts are specialists in Biology Education and one in Measurement and Evaluation. They were asked to check: the appropriateness of the purposes, research questions and hypotheses as regard to the project topic. Also, to check were if the Biology Achievement Test instrument was appropriate in terms of timing, framing of questions, arrangement of question and options, and the placement of keys. Finally, they were asked to check if lesson notes and flipped classroom (FC) and power point (PP) CD-ROM containing biology instructions were appropriate as regards to the project topic. Their useful suggestions were useful in modification of the instrument. Finally, the content validation of BAT was also ensured using test-blue print.

Reliability of the Instrument

The validated instrument - BAT was trial-tested using 20 students in one intact class of SS 2 students in a school that was not in the area of study but shared common characteristics in areas such as the use of the same curriculum, and the use of the same academic calendar. The trial- tested instrument was scored and subjected to reliability measures.

The estimate of temporal stability of the reshuffled form of BAT which was given after two weeks BAT was administered was determined using test- retest method and scores obtained were subjected to Pearson Correlation Coefficient that yielded a correlation coefficient of 0.85(See Appendix J, pg.152) the estimate of internal consistency of BAT was determined using Kudder–Richardson 20 (K-R20) formula since BAT contained multiple-choice items that are dichotomously scored. A reliability coefficient of 0.89 was obtained. (See Appendix I ,pg. 150).

Training of the Research Assistants

Four research assistants who were Biology teachers of the intact science classes used for the study in sampled schools were trained by the researcher for the purposes of teaching using the prepared lesson notes and administration of instruments only. The scoring was done b the researcher using the marking guides for BAT and its reshuffled form. The training of two research assistants in Flipped Classroom group and two research assistant in Powerpoint group were done as follows:

Day1- Introduction: The researcher met research assistants (teachers) for 2 hours. After introduction, the researcher stated the general aim of the study. The researcher explained the stages of the study such as pretest, teaching of the selected topics, posttest and retention test stages. Pretest will come before the actual teaching starts. After three weeks of teaching comes the posttest. Two weeks later retention test will be administered. The BAT will last for 40 minutes. The reshuffled form of BAT on the other hand, would last also for 40 minutes. The researcher assured the teachers that lesson notes for all the selected topics had been written and the DVD and CD-ROM they will use in the teaching have been developed; their study is to adhere to the training regarding their usage as would be given to them by the researcher.

Day 2- Meeting with the Teachers in the Experimental School (Flipped classroom group): The teacher met only with the two teachers in Flipped classroom group for 2 hours. The researcher explained to the teachers how to use flipped classroom to teach using three stages involved in it.

Stage I: Pre class activities: The students would be given the DVD containing the next class lesson video to watch at home. Also, prior to class, the students would be paired and given CD-ROM containing video lesson on the topic selected to watch in the computer laboratory, without the teacher' guidance for 15 minutes. The students are required to take notes just as they would be expected to do during a class lecture. This makes the students to have the basic knowledge of the content that will be taught in the class.

Stage 2: In class activities: This provides the students opportunities to deepen their understanding of the content.

Teachers are expected to work on higher order learning from knowledge to evaluation. The students do their homework in class where the teacher is available to help if they get stuck having gained basic knowledge from the video lecture outside the class. The teacher will review the material as a group or help students one-on-one or in small groups with specific questions they have about the in-class work. The teacher can use any variety of strategies that a traditional classroom teacher might use. The teacher might display the video in class if the need arises.

Stage 3: Post class activities that extend students' learning: The teacher encourages the students to watch the video again after class for more comprehension.

Day 3- Meeting with the teachers in the Powerpoint School: The teacher met only with the two teachers in Powerpoint group. The teacher would teach the students using powerpoint powerpoint. The researcher assured the teachers that she has made the powerpoint slides that their duty is to use it to teach the students making use laptop and projector.

Day 4-Mini teaching by the teachers in flipped classroom group:

The researcher monitored them and made comments where necessary. The researcher then, told them when to commence teaching in the school.

Day 5- Mini teaching by the teachers in Powerpoint group:

The researcher monitored them and made comments where necessary.

Experimental Procedure

The experimental Procedure was as follows:

The regular biology class teachers of the sampled schools were co-ordinated to assist in the study. This was done for three days before the commencement of the study. The co-ordination exercise was based on; the general conduct of the study. The teachers were advised to; follow the lesson plan in teaching the students, observe all normal classroom procedures such as entry behaviour, set induction and so on and also to use the same length of time (three weeks) to teach the content to the groups.

This study involved two groups of subjects - the Flipped classroom group and the Powerpoint group. The flipped classroom group was the experimental group A while the power point presentation group was the experimental group B. Students in both experimental group were given the pre-test on the BAT, before the experiment by their respective regular biology teachers.

After the pre-test, both the flipped classroom (FC) and power point (PP) groups were taught supporting tissues in animals using the FC and PP CD-ROM played in a laptop and projector in the computer laboratory. The teachers also made use of the lesson plan prepared for flipped classroom group to instruct them and the lesson plan for power point group to instruct them for a period of three weeks. For the flipped classroom group, a day before class, the students were given DVD containing the biology topic of next class to be watched at home. Also prior to class, the flipped classroom group were paired and given CD-ROM containing video lesson on the topics selected to watch in the computer laboratory, without the teacher's guidance

for 15 minutes. This made the students to have the basic knowledge of the content that will be taught in the class. The power point group was not given CD-ROM to watch prior to class. Teachers used power point to teach them in class. Each lesson lasted for 45 minutes. One lesson was taught weekly. As a result, the selected topics were exhausted in three weeks. The forth week was used for conducting post test.

After two weeks, the reshuffled form of BAT was administered to both groups to test their retention. In all a total of seven weeks was used for the study from the training stage to the administration of the reshuffled form of BAT.

Control of extraneous variables

The researcher controlled the extraneous variables under the following headings: Experimental bias, differences in teacher's ability and teacher's qualification, teacher variability and Hawthorne effect.

Experimental bias was controlled by ensuring that students in both groups were taught the same lesson contents obtained from biology curriculum for senior secondary schools. Differences in teacher's ability and teacher's qualification were held constant by training the teachers. Teachers' variability was controlled by ensuring that the biology teachers teaching each intact class in the sampled schools were used to teach the selected topics.

To control Hawthorne effect, the students were taught in their normal classrooms, during the normal biology periods and by their regular teacher. As a result, the researcher was not directly involved in the treatment.

Method of Data Analysis

The research questions were answered using Mean and Standard Deviation. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).The analysis of covariance (ANCOVA) was chosen because of the lack of initial equivalence of the groups as a result of using intact classes.

CHAPTER FOUR

RESULTS

This chapter deals with presentation of results. The results are presented in line with research questions and hypotheses that guided the study.

Research Question 1

What is the relative effect of flipped classroom and powerpoint instructional approaches on students' achievement in Biology?

Table 1: **Mean and Standard deviation of achievement scores of students taught biology using flipped classroom and powerpoint.**

VARIABLE		PRE –TEST		POST-TEST		MEAN GAIN
Group	N	$\overline{X}$	SD	$\overline{X}$	SD	
Flipped classroom	40	33.03	9.15	73.85	11.30	40.83
Powerpoint	39	30.38	9.37	60.79	8.88	30.41

Table 1 shows the mean and standard deviation of achievement scores of students taught biology using flipped classroom(group A) and powerpoint(group B) instructional approaches. From Table 1, the students in group A had pre-test mean achievement score of 33.03 with a standard deviation score of 9.15 and a post-test mean achievement score of 73.85 with a standard deviation of 11.30. The difference between the pre-test and post-test mean achievement scores of students taught biology using flipped classroom was 40.83. Also, from Table 1 the students in group B had pre-test mean achievement score of 30.38 with a standard deviation score of 9.37, and a post-test mean achievement score of 60.79 with a standard deviation of 8.88. The difference between the pre-test and post-test mean achievement scores of students taught biology using power point was 30. 41.However, for each of the groups, the post-test means were greater than the pre-test means with the group taught biology using flipped classroom having a higher mean gain. This is an indication that flipped classroom enhanced students' achievement in biology better than power point.

Hypothesis 1

There is no significant difference in the mean achievement score of students taught biology using flipped classroom and those taught with powerpoint

Table 2: Analysis of covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught biology using flipped classroom and those taught with powerpoint instructional approaches.

Source	Type 111 Sum of Squares	Df	Mean Square	F	Sig.	Remark
Corrected Model	3643.926[a]	4	910.981	8.758	.000	
Intercept	21378.023	1	21378.023	205.528	.000	
Pretest	276.986	1	276.986	2.663	.107	
Treatment	2721.521	1	2721.521	26.165	.000	S
Gender	.834	1	.834	.008	.929	NS
Treatment *gender	1.464	1	1.464	.014	.906	NS
Error	7697.112	74	104.015			
Total	370273.000	79				
Corrected Total	11341.038	78				

a. R Squared = .321 (Adjusted R Squared = .285)

The result in Table 2 shows that with respect to the group A and group B an F-value of 26.17 was obtained with associated probability value of 0.00. Since the associated probability value of 0.00 was less than 0.05 set as level of significance, the null hypothesis($H0_1$), which stated that there is no significant difference in the mean achievement scores of students taught biology using flipped classroom and powerpoint instructional approaches was rejected. Thus, inference drawn therefore is that there is a significant difference in the mean achievement scores of students taught biology using flipped classroom and power point instructional approaches, with those taught using flipped classroom having a higher mean achievement gain. This shows that these instructional approaches enhanced students' achievement in biology, with flipped classroom enhancing achievement better than power point.

Research Question 2

What is the relative effect of flipped classroom and powerpoint instructional approaches on students' retention in Biology?

Table 3: **Mean and Standard deviation of post-test scores and retention scores of students taught biology using flipped classroom and those taught with powerpoint.**

VARIABLE		**POST TEST**		**RETENTION TEST**		**MEAN GAIN**
Group	N	$\overline{X}$	SD	$\overline{X}$	SD	
Flipped Classroom	40	73.85	11.30	75.83	8.43	1.98
Powerpoint	39	60.79	8.88	62.05	9.24	1.26

Table 3 shows the mean and standard deviation of retention scores of students taught biology using flipped classroom(group A) and power point(group B) instructional approaches. From Table 3, the students in group A had post-test mean score of 73.85 with a standard deviation score of 11.30, and a retention mean achievement score of 75.83 with a standard deviation of 8.43. The difference between the post-test and retention test mean scores of students taught biology using flipped classroom was 1.98. Also, from Table 3, the students in group B had post-test mean score of 60.79 with a standard deviation score of 8.88, and a retention mean score of 62.05 with a standard deviation of 9.24. The difference between the post-test and retention test mean scores of students taught biology using powerpoint was 1. 26. However, for each of the groups the retention test mean score were greater than the post –test means with the students taught biology using flipped classroom having a higher mean gain. This shows that flipped classroom and powerpoint instructional approaches enhance students' retention in biology, with those taught with flipped classroom instructional approach having higher mean retention gain than those taught with powerpoint.

Hypothesis 2

There is no significant difference in the mean retention score of students taught biology using flipped classroom and those taught with powerpoint instructional approaches.

Table 4: Analysis of covariance (ANCOVA) of the significant difference in the mean retention scores of students taught biology using flipped classroom and those taught with powerpoint instructional approaches.

Source	Type 111 Sum of Squares	Df	Mean Square	F	Sig.	Remark
Corrected Model	4140.538[a]	4	1035.135	16.614	.000	
Intercept	2750.411	1	2750.411	44.145	.000	
Posttest	1377.130	1	1377.130	22.104	.000	
Treatment	563.351	1	563.351	9.042	.000	S
Gender	8.354	1	8.354	.134	.715	NS
Treatment *gender	14.136	1	14.136	.227	.635	NS
Error	4610.449	74	62.303			
Total	374183.000	79				
Corrected Total	8750.987	78				

a. R Squared = .473 (Adjusted R Squared = .445)

The result in Table 4 shows that with respect to the group A and group B an F-value of 9.04 was obtained with associated probability value of 0.00. Since the associated probability value of 0. 00 was less than 0.05 set as level of significance, the null hypothesis ($H0_4$), which stated that there is no significant difference in the mean achievement scores of students taught biology using flipped classroom and power point instructional approaches was rejected. Thus, inference drawn therefore is that there is a significant difference in the mean retention scores of students taught biology using flipped classroom and power point instructional approaches. This shows that these instructional approaches enhanced students' retention in biology, with flipped classroom having more positive effect on students' retention than power point.

Research Question 3

What is the influence of gender on biology students' achievement?

Table 5: Mean and Standard deviation of male and female students' achievement scores in biology.

Variable		Pre-test		Post test		Mean gain
Gender	N	$\overline{X}$	SD	$\overline{X}$	SD	
Male	28	33.36	10.04	67.96	12.76	34.60
Female	51	30.82	8.83	67.10	11.77	36.28

Result in table 5 shows that male students had a pre test mean achievement score of 33.36, with a standard deviation score of 10.04, and a post-test mean achievement score of 67.96 with a standard deviation of 12.76. The difference between the pre-test and post-test mean achievement scores of male students was 34. 60. The female students taught biology with flipped classroom and power point instructional approaches had a pre-test mean achievement score of 30.82 with a standard deviation score of 8.83, and a post-test mean achievement score of 67.10 with a standard deviation of 11.77 . The difference between the pre-test and post-test mean achievement scores of female students was 36. 28. The mean post-test scores of male and female students were greater than their respective mean pre-test achievement scores, with female students having a slightly higher mean gain.

Hypothesis 3

There is no significant difference in the mean achievement scores of male and female students in biology.

The result in Table 2 shows that with respect to the group A and group B an F-value of 0.01 was obtained with associated probability value of 0.93. Since the associated probability value of 0.93 was greater than 0.05 set as level of significance. The null hypothesis ($H0_3$), which stated that there is no significant difference in the mean achievement scores of male and female students in biology, was not rejected. Thus, the inference drawn was that, there is no significant difference in the mean achievement scores of male and female students in biology. The indication of this was that gender has no significant influence on students' mean achievement

score in biology. This showed that, students irrespective of gender achieved better when exposed to flipped classroom and power point instructional approaches.

Research Question 4

What is the influence of gender on students' retention in biology?

Table 6: Mean and Standard deviation of post-test and retention test scores of male and female in biology.

		Post-test		Retention		Mean gain
Gender	N	$\overline{X}$	SD	$\overline{X}$	SD	
Male	28	67.96	12.76	68.89	10.74	0.93
Female	51	67.10	11.77	68.13	10.59	1.03

Result in table 6 shows that male students had a post test mean score of 67.96, with a standard deviation score of 12.76, and mean retention score of 68.89 with a standard deviation of 10.74. The difference between the mean post-test and mean retention scores of male students was 0.93. The female students taught biology with flipped classroom and power point instructional approaches had a post-test mean score of 67.10 with a standard deviation score of 11.77, and a mean retention score of 68.13 with a standard deviation of 10.59. The difference between the mean post-test and retention scores of female students was 1.03. For each group the mean retention scores were greater than post-test mean scores with female students having a slightly higher mean gain. This showed that flipped classroom and power point instructional approaches enhanced students' retention in biology irrespective gender.

Hypothesis 4

There is no significant difference in the mean retention scores of male and students in biology.

The result in Table 4 shows that with respect to students' retention, an F-value of 0.13 was obtained with associated probability value of 0.72, which was greater than 0.05 set as level of significance. The null hypothesis ($H0_4$), which stated that there is no significant difference in the mean retention scores of male and female students in biology, was not rejected. Thus, the inference drawn was that, there is no significant difference in the mean retention scores of male and female students in biology. The indication of this was that gender has no significant influence on students' mean achievement score in biology. This implies that gender has no

significant influence on students' mean retention score in biology and that students irrespective of gender retained what they learnt in biology as a result of exposure to flipped classroom and power point instructional approaches.

Research Question 5

What is the interaction effect of mode of instruction and gender on students' achievement in biology?

Table 7: Mean and Standard deviation of students' overall pre -test and post -test scores in biology.

Variable			**Pre-test**		**Post-test**		**Mean gain**
Treatment	Gender	N	$\overline{X}$	SD	$\overline{X}$	SD	
Flipped classroom	Male	15	35.27	11.11	74.00	12.64	38.73
	Female	25	31.68	7.67	73.76	10.68	42.08
Power point	Male	13	31.15	8.54	61.00	9.05	29.85
	Female	26	30.00	9.90	60.69	8.98	30.69

Result in table 7 showed that male students under flipped classroom instructional approach had a pre test mean achievement score of 35.27, with a standard deviation score of 11.11, and a post-test mean achievement score of 74.00 with a standard deviation of 12.64. The difference between the pre-test and post-test mean achievement scores of male students was 38.73. The female students taught biology with flipped classroom instructional approach had a pre-test mean achievement score of 31.68 with a standard deviation score of 7.67, and a post-test mean achievement score of 73.76 with a standard deviation of 10.68. The difference between the pre-test and post-test mean achievement scores of female students under flipped classroom was 42.08. Result in table 7 also shows that the male students taught biology using power point had a pre-test mean score of 31.15 with a standard deviation of 8.54 , and a post-test mean achievement score of 61.00 with a standard deviation of 9.05. The difference between the pre-test and post-test mean achievement scores of male students under power point was 29.85. The female students under power point instructional approach had a pre-test mean score of 30.00 with a standard deviation of 9.90 and a post test mean score of 60.69 with a standard deviation of 8.98.The difference between the pre-test mean scores and post-test mean scores was 30.69 However, for each of the group, the post mean scores were greater than the pre-test mean scores. In each groups, the mean and standard deviation of male and female students are almost the

same. In each of the groups, the female students had a slightly higher mean gain than their male counterpart. This might mean that the female students have better concentration than the male students. Male and female students in flipped classroom group slightly outperformed their counterpart in powerpoint group. This indicates that the students in flipped classroom group achieved better than the students in power point group.

Hypothesis 5

There is no significant interaction effect of mode of instruction and gender on students' achievement in biology.

The result in table 2 shows that with respect to the interaction between mode of instruction and gender on achievement an F-value of 0.01 was obtained with associated probability value was 0.91 which was greater than 0.05 set as level of significance. The null hypothesis (Ho_5) which stated that there is no significant interaction effect of mode of instruction and gender on students' achievement in biology was not rejected. Thus, inference drawn was that, there is no significant interaction effect of mode of instruction and gender on students' achievement in biology. This implies that gender has no significant influence on students' achievement in biology and that students irrespective of gender had improved achievement in biology as a result of exposure to flipped classroom and power point. Hence it could be said t hat male and female students did not respond differently to the treatment.

Research Question 6

What is the interaction effect of mode of instruction and gender on students' retention in biology?

Table 8: Means and standard deviations of students overall post-test and retention test scores in biology by flipped classroom and powerpoint instructional approaches and gender.

Variables			**Post-test**		**Retention**		
Treatment	Gender	N	$\overline{X}$	SD	$\overline{X}$	SD	Mean gain
Flipped classroom	Male	15	74.00	12.64	75.87	8.70	1.87
	Female	25	73.76	10.68	75.74	8.43	1.98
Powerpoint	Male	13	61.00	9.05	62.00	8.66	1.00
	Female	26	60.69	8.98	62.08	9.68	1.39

Results in table 8 showed that the male students under flipped classroom instructional approach had a post-test mean score 74.00 with a standard deviation of 12.64 and a retention mean of 75.87 with standard deviation of 8.70. The difference between the post-test and retention mean scores of male students in flipped classroom group was 1.87. The female students under flipped classroom had a post-test mean of 73.76 with standard deviation of 10.68 and a retention mean score of 74.78 with a standard deviation of 8.43. The difference between the post-test and retention mean scores of female students in flipped classroom group 1.98. Result in table 8 also showed that the male students taught biology using power point had a post-test mean of 61.00 with a standard deviation of 9.05 and a retention mean score of 62.00 with standard deviation of 8.66. The difference between the post-test and retention mean scores of male students in power point group was 1.00. Also the female students under power point instructional approach had a post-test mean score of 60.69 with a standard deviation of 8.98 and retention means score of 62.08 with a standard deviation of 9.68. The difference between the post-test and retention means scores of female students in power point group was 1.39. However for each of the groups, the retention mean scores were greater than the post-test mean scores. Male and female students in flipped classroom group slightly outperformed their counterpart in power point group. This indicates that male and female students in flipped classroom retained what was learnt in biology better than their counterpart in power point. Also in each of the groups the female students had a slightly higher mean gain than their male counterpart. This indicates that female students retained what they learnt better than their male counterparts when exposed to flipped classroom and power point instructional approaches. This might mean that female students have better concentration than the male students.

Hypothesis 6

There is no significant interaction effect of mode of instruction and gender on students' retention in biology.

The result in table 4 shows that with respect to the interaction between mode of instruction and gender on mean retention scores, an F-value of 0.23 was obtained with associated probability value was 0.64 which was greater than 0.05 set as level of significance. The null hypothesis (Ho_6) which stated that there is no significant interaction effect of mode of instruction and gender on mean retention scores of students in biology was not rejected. Thus, inference drawn was that, there is no significant interaction effect of mode instruction and gender on mean

retention scores of male and female students in biology. The slight differences in the mean retention scores of male and female student in the groups were not significant. This implies that gender has no significant influence on students' retention in biology and that students irrespective of gender had improved retention in biology as a result of exposure to flipped classroom and power point instructional approaches. This interaction effect suggests that male and female students did not respond differently to the treatment. Hence, flipped classroom and power point enhanced students' retention.

Summary of Findings

This section of chapter is a summary of findings of the study according to each of the tested hypothesis. From the data analysis and interpretation of the results the following findings emerged.

1. There was a significant difference in the mean achievement scores of students taught biology using flipped classroom instructional approach and those taught using powerpoint instructional approach.
2. There was a significant difference in the mean retention scores of students taught biology using flipped classroom instructional approach and those taught using powerpoint instructional approach.
3. Gender has no significant influence on students' mean achievement score in biology.
4. There was no significant influence of gender on students' mean retention in biology
5. There was no significant interaction effect of mode of instruction and gender on mean achievement score of students in biology.
6. There was no significant interaction effect of mode of instruction and gender on mean retention score of students in biology.

5.

CHAPTER FIVE

DISCUSSIONS, CONCLUSION AND SUMMARY

In this chapter, the findings of the study based on the six research questions and six null hypotheses that guided the study are discussed. The conclusion, educational implications, recommendations, limitations of the study, suggestions for further research and summary of the whole study are also presented.

Discussion of the Findings of the Study

Results obtained from this study are discussed based on the following subheadings:

- The relative effect of flipped classroom and Powerpoint on students' achievement in biology.
- The relative effect of flipped classroom and powerpoint on students' retention in biology
- The influence of gender on students' achievement and in biology.
- The influence of gender on students' retention in biology.
- The interaction effect of mode of instruction and gender on students' achievement in biology.
- The interaction effect of mode of instruction and gender on students' retention in biology.

The Relative Effect of Flipped Classroom and PowerPoint on Students' Achievement in Biology.

The result in table 1 indicated that flipped classroom and power point greatly improved students' achievement in biology. With the test of hypothesis one, as shown in Table 2, it indicated a significant difference in the mean achievement scores of the two groups in favour of flipped classroom group. This shows that flipped classroom instructional approach enhanced students' achievement in Biology more than powerpoint instructional approach. This result is in line with the findings of Nwagbo (2006); Ugwu and Nzewi(2015) which pointed out that instructional approach affects the quality of output of instruction in science. The improvement in students' achievement by being exposed to flipped classroom and powerpoint instructional approaches recorded in this study confirms Vygotsky's view in learning which states that students obtain a new knowledge through social interaction with others, by supporting learners to scaffold their learning and providing them with suitable activities. This makes learners to be

active in learning process. From the result of this study, it is obvious that learning is an active process that ensures active participation of students in the learning process. The high achievement recorded in this study also confirms Bandura(1977) social learning theory which shows that people learn new information and behaviours by observing others. Students in flipped classroom and power point acquire knowledge after seeing lesson through videos, observing a model, are expected to learn complex new skills quickly, with a minimum of verbal instruction. From the result of this study, it is obvious that students learn when they are provided with the opportunity to work in groups with their friends, interact with the teacher and with technology. Teaching and learning were made interactive process that engaged the learner in obtaining knowledge.

Results from Table 1 also showed that the mean achievement scores of the students in experimental group A(Flipped classroom) is higher than that of the mean achievement scores of students in experimental group B (Power point). Hence, students who were taught biology using flipped classroom instructional approach performed better than those taught biology using (powerpoint) instructional approach in their mean post test scores..

This result which showed that flipped classroom enhanced students' achievement better than power point might be because flipped classroom instructional approach provides the students the opportunity to watch the learning video before class, that is, it provides the students the opportunity to gain first exposure prior to class and increases interaction of the students with the teacher in class. This finding is in agreement with the finding of Baki and Khaled (2016) who reported that students taught mathematics using flipped classroom performed significantly better than those taught that using conventional lecture method. It also agrees with the findings of Muhammad and Falalu(2016) who revealed that flipped classroom model enhances achievement of students in understanding the properties of matter concept in integrated science.

The Relative Effect of Flipped Classroom and PowerPoint on Students' Retention in Biology.

The result in table 3 indicated that flipped classroom and power point greatly improved students' retention in biology. With the test of hypothesis two, as shown in Table 4, it was found that the observed difference in the mean retention scores of both groups was significant. This implies that flipped classroom and power point significantly enhanced students' retention in the biology contents studied. This finding agrees with Okeyefi (2014), which emphasized that

biology teachers need to use innovative approach for students to retain learned concepts. The result of this study makes it certain that flipped classroom and power point improved students' achievement and retention.

Results from table 3 also showed that the retention scores of the student in experimental group A (flipped classroom) is slightly higher than that of the mean retention scores of students in experimental group B (power point). Hence, students who were taught biology using flipped classroom instructional approach had an improved retention better than those taught biology using (power point) instructional approach. This finding is supported by Mankinde and Yusuf (2018) whose findings revealed that that students taught physics using flipped classroom significantly retained higher than those taught with conventional lecture method.

The Influence of Gender on Students' Achievement in Biology

The result from table 5 showed that male and female students had almost the same mean achievement score in group A and group B . Also the standard deviation score of both male and female are almost the same. Although there was a slight difference in the mean gain of male and female the difference was not significant as confirmed in table 2. This showed that male and female students did not respond differently to the treatments. The result of this study supported the findings of Okeyefi (2014) and Okeye (2016) which indicated that there was no significant difference between the mean achievement scores of male and female students in biology. The result of this study has revealed that flipped classroom and power point had been found effective in the teaching biology, irrespective of gender. This result of no significant difference in the mean achievement scores of male and female students in biology could be as a result of innovative instructional approaches. With these and the findings of this study, it could be said that flipped classroom and power point instructional approaches provide equal learning experience to learners. And this supported the tenets of the theories of Vygotsky(1978) and Bandura(1977) that learning as an interactive process, makes students to be active participant in collaborative social learning environment.

However this finding was contrary to some findings, which revealed significant difference in the mean achievement scores of male and female students in biology in favour of male students (Ezenwosu & Nworgu 2013; Enohuean, 2015; Anaun, 2014; Obiekwe, 2008). Some researchers also found significant difference in favour of girls (Okwara, Anyagh & Ikyaan, 2017).

The Influence of Gender on Students' Retention in Biology

Evidence from the present study on the influence of gender on students' retention in biology shows that there was no significant difference in the mean retention scores of male and female students taught biology using flipped classroom and power point instructional approach. Male and female students from both group had slightly different mean retention scores, but the result in table 4 confirmed that the difference in the retention test scores was not significant. So according to the result of this study, gender is not a factor in determining the retention of learned concept in secondary school students. The result of this study is in agreement with the findings of Chukwu (2011) and Okeyefi (2014) which indicated that there was no significant difference between the mean retention scores of male and female students in biology. This result is contrary to the finding of Enohuean (2015) who reported significant difference in the mean retention scores of male and female students in biology in favour of male students. According to the result of this study gender had no influence in g biology retention scores of male and female students. This might be because of the fact that the flipped classroom and power point instructional approaches provided equal learning opportunity to both male and female students by giving them a direct learning embedded in real world practical workshop, in which the students demonstrated their knowledge through collaboration. The result of this study in fostering retention in all the students irrespective of gender might be as result of the interaction provided to students in biology classroom (via facilitation, collaboration, multiple representation, technology etc.), students retained biology information longer and grasped the concepts regardless of the level of difficulty.

The Interaction Effect of Instructional Approach and Gender on Students' Achievement in Biology

The interaction effect of instructional approach and gender on mean achievement scores of male and female students in biology was not significant as shown in table 2. The result in table 2, indicated minimal difference in the mean achievement of male and female students in both group A and B, but it was shown that the difference was not significant in table 3. Again within group analysis in table 7 showed no significant difference in the mean achievement scores of male and female students in the two groups. The mean achievement scores of male and female students in the within group analysis in table 7 are almost equal in the two groups. This interaction result showed that the achievement of male and female students improve equally

when taught biology using flipped classroom and power point instructional approaches. This showed that both male and female students did not respond differently to the treatment. And this is an indication that flipped classroom and power point minimize gender differences in achievement. This result agrees with the finding of (Okeyefi, 2014) who found no significant interaction effect of instructional approach and gender on students' achievement in biology when taught using four modes application technique.

Since two instructional approaches were explored in this study and it was found out that male and female students did not respond differently to them, it could be said, based on the result of this study that flipped classroom and power point present equal learning opportunities to students irrespective of gender.

Interaction Effect of Instructional Approaches and Gender on Students' Retention in Biology

The interaction effect of mode of instruction and gender on students' retention in biology was also not significant as exposed in table 4. In table 6, it could be noticed that there was a slight difference in the mean retention scores of male and female students in the two groups. The analysis in table 4 showed that this difference was not significant. Again within group analysis in table 8 showed no significant difference in the mean retention scores of male and female students in the two groups. The mean retention scores of male and female students in the within group analysis in table 8 are almost equal in the two groups. This showed that all the students regardless of gender recalled what they were taught in different degree, when exposed to flipped classroom and power point instructional approaches. The result confirmed Bandura(1977) who pointed out that when students are engaged in more meaningful learning, there is retention of learned concept and it can easily be recalled, because learning is permanent. The result also supported the work of Okeyefi (2014) who found out that the ability to remember cannot be tied to gender, but takes place when experiences are passed across to learners through an appropriate instructional approach, which is capable of arousing students' interest and foster their retention. The result of no significant difference in the mean retention scores of male and female students in this study might be because, the use of flipped classroom and power point helped the teacher to present biology in various forms which gave the students equal opportunity to use the information that enhanced learning and enabled its storage in the memory. In essence, based on the result of this study, one could say that the effect of the flipped classroom and power point

instructional approaches which were found to foster retention in student did not depend on gender. This is in line with the findings of Okeyefi (2014) who reported no significant main interaction effect of method and gender on mean achievement score of students taught biology using Four Mode Application Techniques (4MAT).

This result disagrees with the findings of Chukwu (2011) who found out that boys have better retention ability than girls. However, that girls achieved and retained equally with boys in this study may be because of the interactive nature of flipped classroom and power point instructional approaches. Also, the fact that education of the girl child is now given better attention by the government, the society, parents and teachers generally helped the girls equally to measure up with boys in terms retention of learned concept. The opportunity of the interactive nature of the flipped classroom and power point instructional approaches gave room for girls to use their untapped intellectual potentials effectively and erase the old stereotype that placed boys above girls on academic issues.

From the findings of this study, one can say that the consistent unsatisfactory achievement of students in biology which is traced among others to students' inability to understand internal structures such as supporting tissues in animals (Gambari et al., 2016 ; Chief Examiners' Report, 2018) could be attributed to teachers' consistent use of ineffective instructional approach in teaching biology. It is hoped that a wide adoption of flipped classroom instructional approach will bring about improvement in biology teaching and learning in Nigeria. However it must be noted that change of type and mode of instruction is not easy to accomplish, it requires carefully designed professional development programs at both the pre-service and the in-service level. This implies that changing how we teach will start from pre-service teacher in the universities, faculties and colleges of education. It is a fact, that changing how teachers teach, is hard to do; but when it is done, knowledgeable confident students will be the end products. Though the cause of change might be high but the investment is essential, because our students are the future of our country, Nigeria.

Conclusion

In conclusion, based on the findings of this study, flipped classroom was more superior to power point instructional approach in enhancing achievement of students in biology. Thus, students taught biology with flipped classroom achieved better than their counterpart taught using power point. Flipped classroom also proved superior to power point in promoting students'

retention in biology. Gender had no significant influence on students' achievement and retention in biology. Hence, there was no interaction effect of mode of instruction and gender on biology students' achievement and retention. Based on the result of this study, it is concluded that the tenets of Vygotsky Social Constructivism Theory states that students obtain new knowledge through social interaction to experience meaningful learning is a fact in learning process and should be imbibed with. It was also concluded that the tenets of Bandura's Social learning theory which states that learner's behavior was the result of watching others, forming ideas of how new behaviours were supposed to be performed, and then mimicking that coded information into action is a fact in learning process.

Implications of the Findings of the Study

The findings of this study have obvious educational implications for biology students, teachers, science educators and curriculum planners.

Generally the findings of the study revealed the efficacy of flipped classroom over power point in promoting students' achievement and retention irrespective of gender.

To teachers is that, teachers should be encouraged to integrate activity oriented approaches such as flipped classroom and powerpoint into teaching/ learning process to achieve instructional objectives. Teachers should prepare in advance video lesson or download good biology lesson from youtube which should be given to the students before class. This provides an opportunity for the students to gain first exposure prior to class and this opens more time in class for the teacher to go deeper into a topic which allows students to develop a better understanding of the content. Promoting students' achievement in biology could help to produce appreciable number of students that may undertake careers in biology related disciplines and promote national development.

To biology students, it implies that complimenting biology teaching with flipped classroom approach will actively involve them in teaching and learning process and could help to enhance achievement and retention in both internal and external examinations. Students should be encouraged to learn biology on their own, and at their own pace/time. With this a student could study a particular concept over and over as needed. This enhances mastering of the subject matter. Promoting students' achievement in biology could help to help to produce appreciable number of students that may undertake careers in biology related disciplines and promote national development Flipped classroom serves as a guide.

The implication of this is to biology educators and curriculum planners is for them to structure teaching and learning in such a way that classroom activities do not only motivate the students to learn and solve problem but also to foster their retention.

From the findings of this study, it has been revealed that flipped classroom was more efficacious in enhancing achievement and retention better than power point. The implication is that if teachers should use flipped classroom instructional approach in teaching biology the students achieve more and retain greatly.

The implication of this study to the society is that gender equity has been achieved according to the result of this study. The use of flipped classroom and power point in teaching biology has eliminated gender inequality in learning biology in secondary schools.

Effective professional development is critical to improving whatever happens in biology classroom. The implication of this study to curriculum planners is to start a process of review in instruction for the use of flipped classroom and power point instructional approach in biology education.

The implication of the findings of the study to school administrators, professional bodies and other stake holders in education is to train teachers and students on the benefits of flipped classroom and power point in the classroom. This will be achieved through seminars and workshops.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Biology teachers should adopt the use of flipped classroom instructional approach in their lessons in order to enhance students' achievement and retention in biology.
2. Teacher training institutions should structure and restructure the special methodology course to include flipped classroom. This will enable biology teachers to be adequately trained on the use of flipped classroom.
3. Government in conjunction with other professional associations should organize workshops; seminars conferences and in-service training on a regular basis to train teachers on the use of flipped classroom since the approach has been found effective in enhancing students 'achievement and retention.

4. Curriculum planners should include flipped classroom instructional approach as one of the necessary instructional approach for teaching of biology in senior secondary schools in Nigeria.
5. Government should endeavour to supply computers to schools at all levels of education to enable students and teachers to have access to computers during teaching and learning.

Limitations of the Study

The conclusions made with respect to this study are however subject to the following limitations.

- Since different teachers were used for the different groups in this study, it could be assumed that they might not have been of equal attributes in terms of cognition, personality and affective functioning. This might have introduced error in the study.
- Lack of computers at home for the students to watch the videos before class.

Suggestions for Further Research

- An investigation into the effect of instructional approaches using different subject in different geographical areas.
- Researchers should make effort to carry out similar research on other level of educational institutions such as lower, middle and upper basic and even tertiary institutions like colleges of education, polytechnics, monotechnics and universities.
- A study may be carried out to investigate the effect of flipped classroom on students' acquisition of science process skills and interest in biology.

Summary of the Study

This study investigated the Effectiveness of two instructional approaches (flipped classroom and power point) on Students' Achievement and Retention in biology. Six research questions and six hypotheses guided the study. The study was restricted to the content area of supporting tissues in animals in the SS 2 biology curriculum. The study was carried out in Obollo Afor Education zone of Enugu State.

The related literature to this study was reviewed. However, no study was indentified to have investigated the efficacy of flipped classroom and power point on senior secondary students' achievement and retention in biology hence; the need for the study. Also, the

reviewed empirical studies on the influence of gender on students' achievement and retention showed contradictory results. Quasi experimental of 2x 2 factorial research design was adopted for the investigation. Seventy-nine (79), twenty eight (28) of which are males and fifty one (51) were females from two co-educational secondary schools in Obollo Afor Education zone were used for the study. One intact class of SS2 students in each of the secondary schools was used. Each of the intact class was given the opportunity of being randomly assigned to either experimental group A (flipped classroom) or group B (power point). One class for experimental group A and one class for experimental group B on the whole.

Students in the experimental A were taught biology using the flipped instructional approach, while the students in experimental group B were taught biology using power point instructional approach. All the groups were given Pre-test, Post-test and Retention test. Data was collected using Biology Achievement Test.

Lesson plans were developed by the researcher, the biology topics covered in the study were; Supporting tissues in animals types, functions and sections of skeleton; axial skeleton(skull bones of the vertebral column their distinguishing features and ribs and sternum); appendicular skeleton, joint, types of joint and movement at joint.

The data generated from the study was analysed using analysis of Covariance (ANCOVA). The result of the study showed that the use of flipped classroom and power point instructional approaches in teaching biology to senior secondary school students enhanced their achievement and improved their retention in biology. Specifically the result showed that flipped classroom enhanced students' achievement and retention better than power point. Gender had no significant influence on students' achievement and retention in biology. All the students exposed to flipped classroom instructional approach irrespective of gender outperformed their counterparts that were exposed to power point instructional approach in achievement and retention. Hence, there was no interaction effect of mode of instruction and gender on biology students' achievement and retention.

The implications of this result were discussed and it was recommended that flipped classroom instructional approach should be adopted in the teaching of biology in the primary, secondary and tertiary levels of education system. Seminars, workshops and conferences were advocated, to be organized by professional bodies, Federal and State Ministries of Education on the use of flipped classroom instructional approach in teaching.

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APPENDIX A

BIOLOGY ACHIEVEMENT TEST

Section A: Personal Data of Student

Fill and mark (_) where applicable in the box provided

Student's Serial Number _____

Name of School _____

Class _____

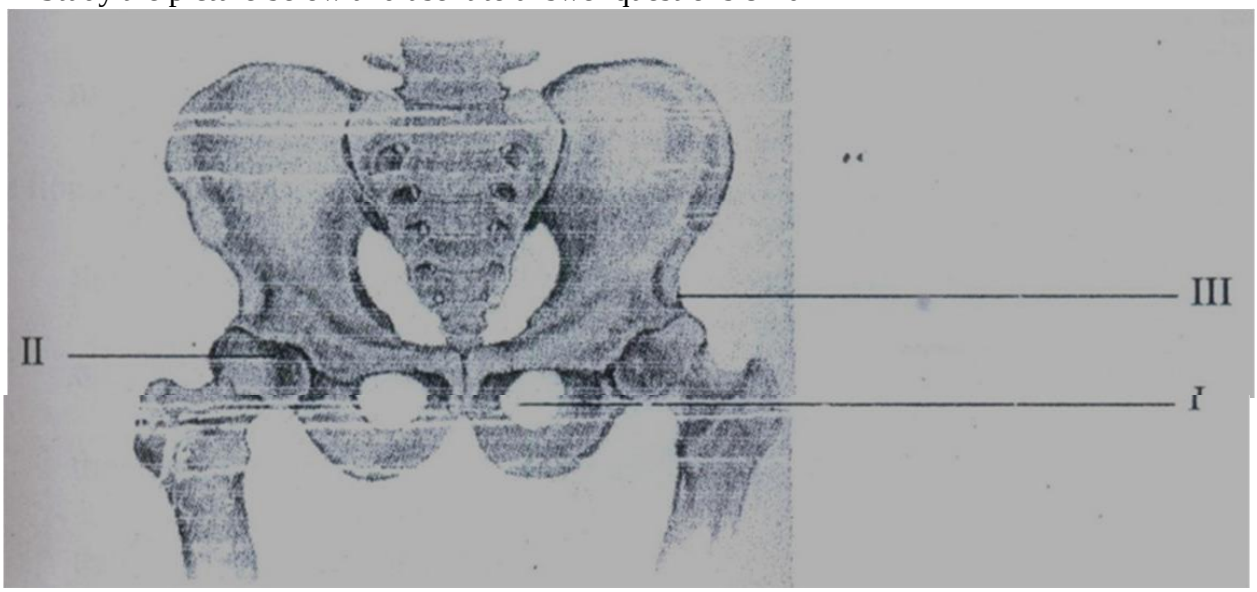
Gender: Male ☐ Female ☐

Time: 40 Minutes

Instruction: Answer all the questions, circle the correct option only

1. The frame work on which animals are built is known as: _____
   (a) Block (b) Skeleton (c) Bone (d) Muscle
2. The damage of the ribcage will affect the following organs EXCEPT
   (a) heart (b) lung (c) Skull (d) thoracic blood vessels
3. One of the following is a type of supporting tissue in animals
   (a) Tendon (b) bone (c) neural carnal (d) muscle
4. The Hollow cavity in the bone is known as: _____
   (a) Long bone (b) Blood in the bone (c). Periosteum (d) Bone Marrow
5. The type of skeleton found in man is called ___
   (a) exoskeleton (b) chitin (c) endoskeleton (d) cartilage
6. All the following organisms posses the exoskeleton, EXCEPT
   (a) cockroach (b) housefly (c) earthworm (d) spider
7. At birth your skeleton was made of
   (a) a greater number of bones (b) the same number of bones (c) a smaller number of bones
   (d) no bones

Study the picture below and use it to answer questions 8-10



8. The picture shown above is the _____

(a) pectoral girdle (b) ilium (c) ischium (d) pelvic girdle

9. The obturator foramen is labelled _____

(a) I (b) II (c) III (d) none of the above.

10. The part labelled II is a hollow that allows

(a) respiratory movement (b) no movement(c) movement in one direction (d) movement in all directions

11. The two sections of the mammalian skeleton are _____ and _____

(a) brain and spinal cord (b) axial and appendicular skeleton (c) endoskeleton and exoskeleton (d) limbs and limb girdles

12. The axial Skeleton is made up of: _____

(a) the ribs and the humerus (b)the skull, vertebral column and the ribs

(c) the Sacrum and the limbs E. the fore limbs and hid limbs

13. When were our bones mostly cartilage?

(a) at birth (b) never (c) now (d) at the age of 4

14. Which of the following statement is NOT correct about the functions of each group of mammalian vertebra?

(a). Cervical vertebra supports the neck (b) Thoracic vertebra articulates with the ribs

(c) Lumber vertebra provides attachment for abdominal muscles
(d) Sacral vertebra supports the skull and allows nodding and rotating movements

15. One of the following is the order in which the vertebral bones are arranged from the neck region

(a) cervical, thoracic, lumbar, sacral, caudal (b) caudal, sacral, lumbar, thoracic, cervical

(c) sacral, lumbar, thoracic, cervical, thoracic (d) thoracic, lumbar, sacral, caudal, cervical

16. Which of the following is found immediately after the skull?

(a). Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

17. Which of the following articulates with the ribs?

(a) Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

18. Which of the following articulates with the pelvic girdle?

(a) Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

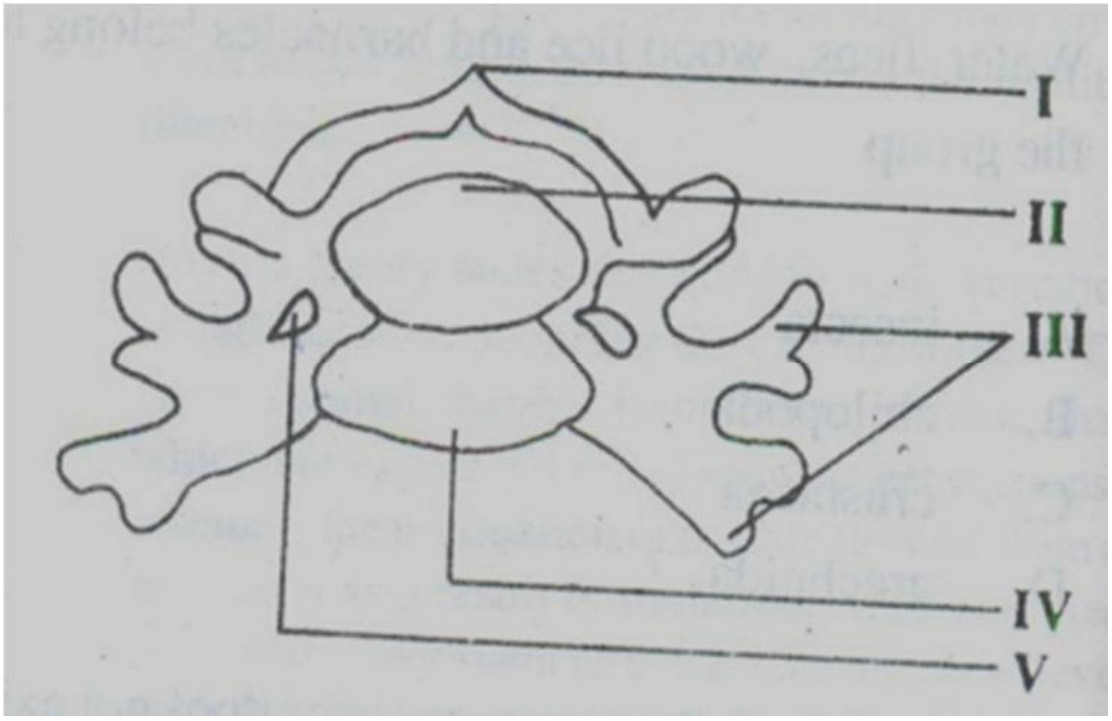
19. Atlas and Axis are types of the _____

(a) lumbar vertebra (b) caudal vertebra (c) thoracic vertebra (d) cervical vertebra

20. Which of the following bones make up the pectoral girdle?

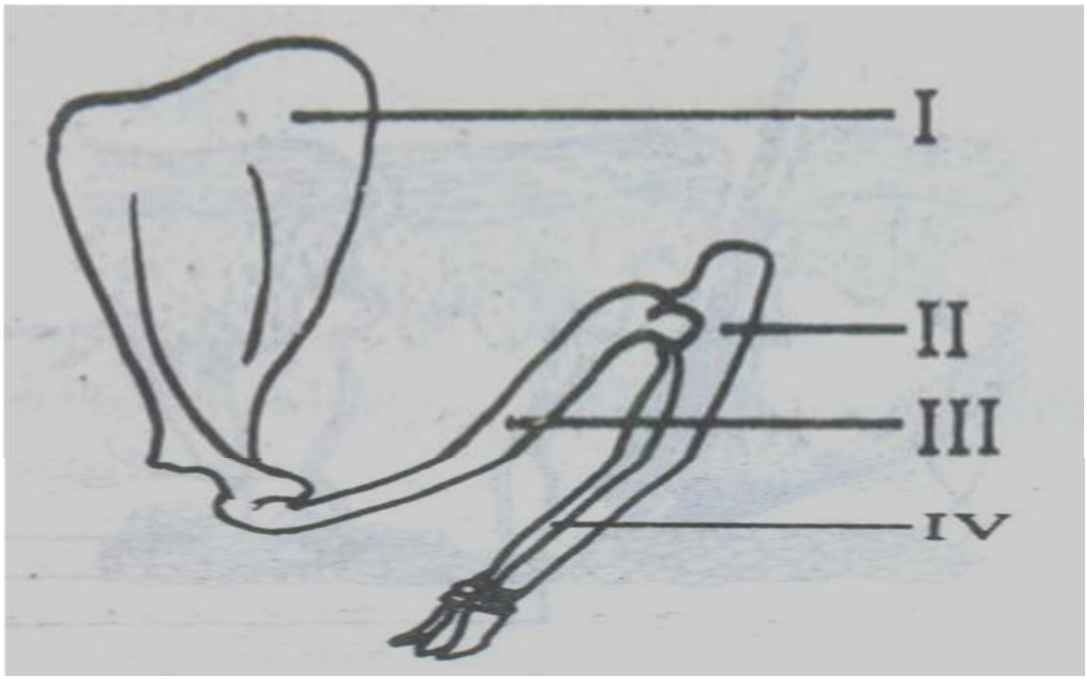
(a) caudal and clavicle (b) sacrum and scapula (c) scapula and clavicle (d) ischium and sacrum

Study the picture below and use it to answer questions 21 - 23



21. Blood vessels usually pass through the structure labeled (a) I (b) II (c) III (d) V
22. The structure above represents a (a) thoracic vertebra (b) cervical vertebra(c) caudal vertebra (d) lumbar vertebra
23. The part labeled II is the _____ (a) spinal cord (b) neural spine(c) neural canal (d) neural arch
24. The chitin in the exoskeleton of many arthropods is strengthened by (a) calcium compounds (b) organic salts(c) lipids (d) proteins
25. One of the following vertebrae is fused (a) cervical (b) caudal (c)thoracic, (d) atlas
26. This joint has a back and forth movement like a door (a) ball and socket joint (b) hinge joint (c) gliding joint (d) pivot joint.
27. Which of the following types of joints allow movement in all directions? (a) ball and socket joint(b) hinge joint (c) gliding joint(d) pivot joint
28. A movable joint? (a) allows movement in all direction (b) allows the movement of bones (c) does not allow bones to move(d) allows back and forth movement
29. An immovable joint is located in one of the following parts of the body?(a) shoulder (b) knee (c) skull (d) the vertebral column
30. During the bending of the arm, the biceps muscles? (a) contract and the triceps muscle relaxes (b) relax and the triceps muscle contracts (c) and the triceps muscle relax (d) and the triceps muscle contract
31. Which of these is NOT part of the appendicular Skeleton? (a) Clavicle (b) Ribs(c) Scapula (d) Humerus
32. The floating ribs are also called false ribs because ____ (a) they are fastened to the backbone and breastbone, (b) they are fastened only to the backbone (c) they are fastened only to the breastbone(d) they are not fastened to any bones
33. The following bones make up the rib cage EXCEPT? (a) the backbone (b) the sternum (c) the ribs (d) the humerus
34. The ears and nostril are flexible because? (a) they are made up of bones (b) they are made up of ossicles (c) they are made up of cartilage (d) they are located on the head
35. The point where two or more bones meet is known as a _____ (a) Tenden (b) Joint (c) Muscles (d) Ligament

Use the diagram below to answer questions 36-37

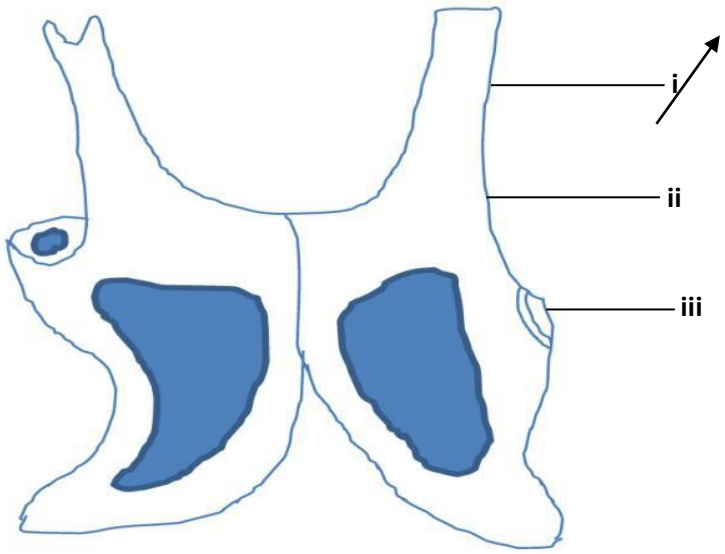


36. The structure labelled II articulates with III to form a? (a) sliding joint (b) hinge joint (c) pivot joint (d) ball and socket joint

37. Which of the bones is the radius? (a) I (b) II (c) III (d) IV

Use the diagram below to answer questions 38 – 40

38. The piece of bone represented in the diagram is found in the



(a) Pelvic region (b) Pectoral girdle (c) Vertebral column (d) Skull

39. The part labeled I is the?

(a) Lumbar(b) Sacrum(c) Ilium (d) Pubis

40. The bone that articulates with the part labeled III is the?

(a) Humerus (b) Femur (head)(c) Tibia (d) Sacrum

APPENDIX B

RESHUFFLED FORM OF BIOLOGY ACHIEVEMENT TEST

Section A: Personal Data of Student

Fill and mark (_) where applicable in the box provided

Student's Serial Number _____

Name of School _____

Class _____

Gender: Male ☐ Female ☐

Time: 40 Minutes

Instruction: Answer all the questions, circle the correct option only

1. All the following organisms posses the exoskeleton, EXCEPT

   (a) housefly (b) earthworm (c) spider (d) cockroach

2. At birth your skeleton was made of

   (a) a greater number of bones (b) the same number of bones (c) no bones (d) a smaller number of bones

3. The damage of the ribcage will affect the following organs EXCEPT

   (a) heart (b) lung (c) thoracic blood vessels (d) Skull

4. One of the following is a type of supporting tissue in animals

   (a) Tendon (b) bone (c) neural carnal (d) muscle

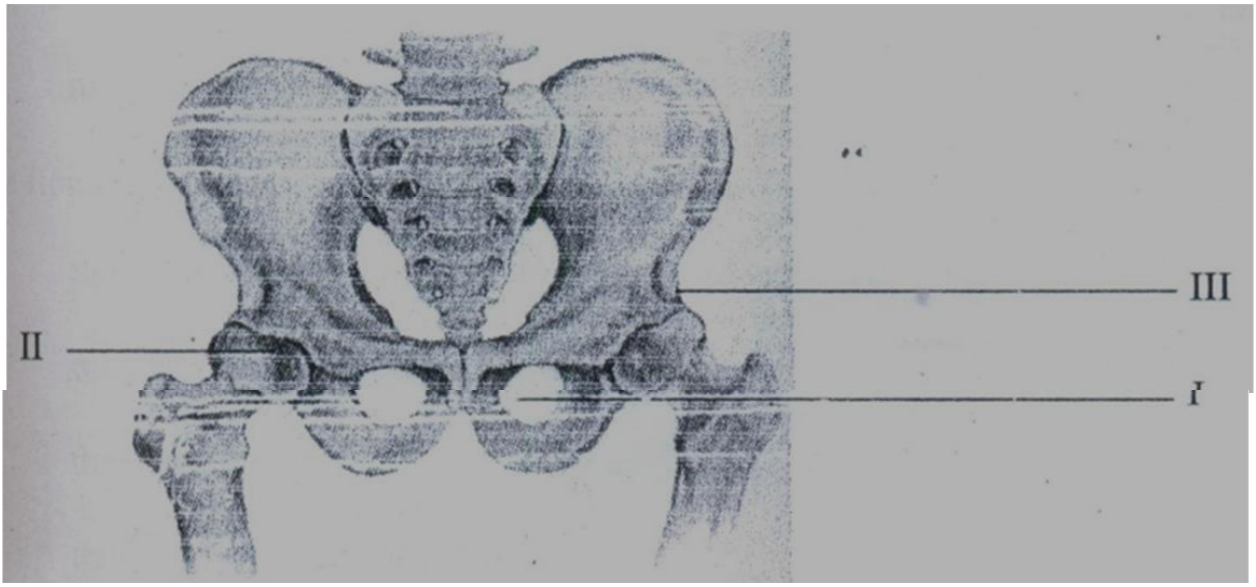
5. The Hollow cavity in the bone is known as: _____

   (a) Long bone (b) Blood in the bone (c). Periosteum (d) Bone Marrow

6. The type of skeleton found in man is called ___

   (a) exoskeleton (b) chitin (c) endoskeleton (d) cartilage

Study the picture below and use it to answer questions 7-9



7. The picture shown above is the _____

   (a) pectoral girdle (b) ilium (c) ischium (d) pelvic girdle

8. The obturator foramen is labelled _____

   (a) I (b) II (c) III (d) none of the above.

9. The part labelled II is a hollow that allows

   (a) respiratory movement (b) no movement(c) movement in one direction (d) movement in all directions

10. The axial Skeleton is made up of: _____

(a) the ribs and the humerus (b) the skull, vertebral column and the ribs

(c) the Sacrum and the limbs (d) the fore limbs and hid limbs

11. When were our bones mostly cartilage?

   (a) at birth (b) never (c) at the age of 4 (d) now

12. The chitin in the exoskeleton of many arthropods is strengthened by (a) calcium compounds (b) organic salts(c) lipids (d) proteins

13. One of the following vertebrae is fused (a) cervical (b) caudal (c) thoracic, (d) atlas

14. This joint has a back and forth movement like a door (a) ball and socket joint (b) hinge joint (c) gliding joint (d) pivot joint.

15. Which of the following statement is NOT correct about the functions of each group of mammalian vertebra?

(a). Cervical vertebra supports the neck (b) Thoracic vertebra articulates with the ribs

(c) Lumber vertebra provides attachment for abdominal muscles

(d) Sacral vertebra supports the skull and allows nodding and rotating movements

16. One of the following is the order in which the vertebral bones are arranged from the neck region

(a) cervical, thoracic, lumbar, sacral, caudal (b) caudal, sacral, lumbar, thoracic, cervical

(c) sacral, lumbar, thoracic, cervical, thoracic (d) thoracic, lumbar, sacral, caudal, cervical

17. The frame work on which animals are built is known as: _____

(a) Block (b) Skeleton (c) Muscle (d) Bone

18. Which of the following is found immediately after the skull?

(a). Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

19. Which of the following articulates with the ribs?

(a) Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

20. Which of the following articulates with the pelvic girdle?

(a) Lumber vertebra (b) Thoracic (c) Caudal vertebra (d) Cervical.

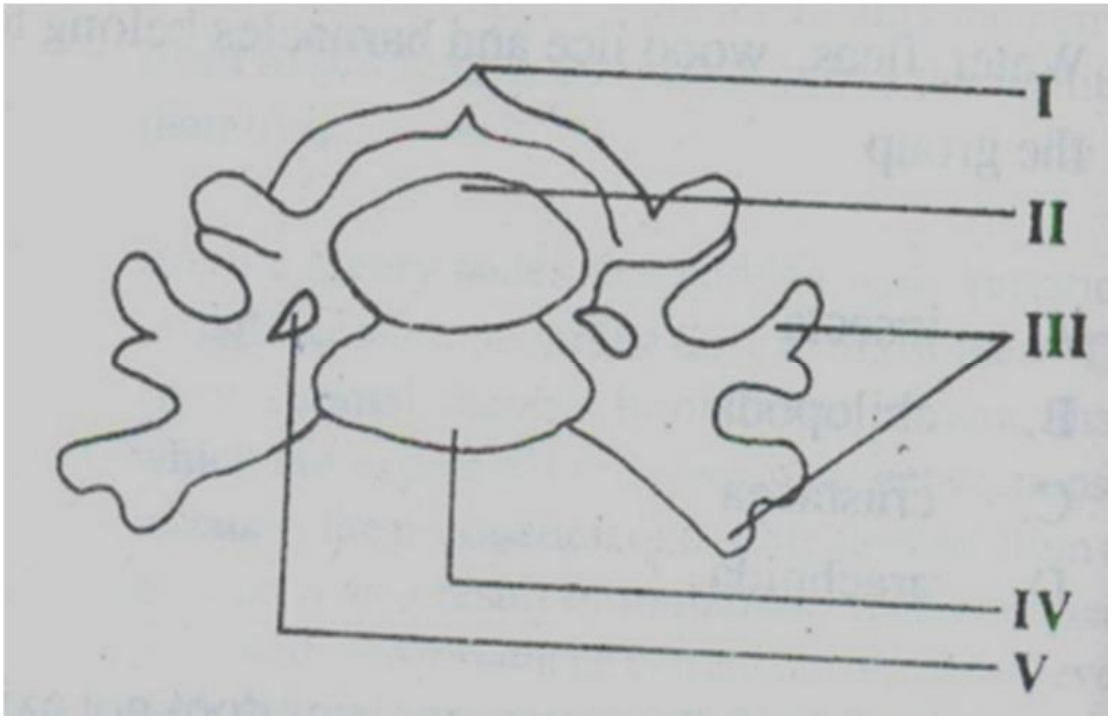
21. Atlas and Axis are types of the _____

(a) lumbar vertebra (b) caudal vertebra (c) thoracic vertebra (d) cervical vertebra

22. Which of the following bones make up the pectoral girdle?

(a) caudal and clavicle (b) sacrum and scapula (c) scapula and clavicle (d) ischium and sacrum

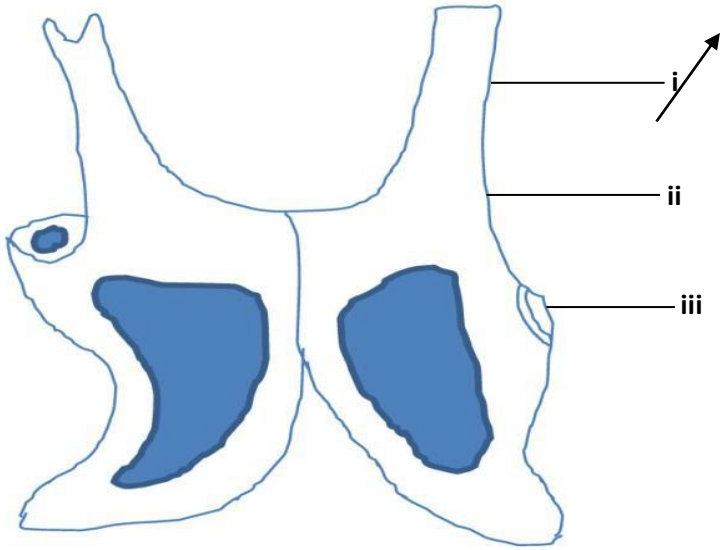
Study the picture below and use it to answer questions 23 - 24



23. Blood vessels usually pass through the structure labeled (a) I (b) II (c) III (d) V
24. The structure above represents a (a) thoracic vertebra (b) cervical vertebra(c) caudal vertebra (d) lumbar vertebra
25. The part labeled II is the _____ (a) spinal cord (b) neural spine(c) neural canal (d) neural arch

Use the diagram below to answer questions 26 – 28

26. The piece of bone represented in the diagram is found in the



(a) Pelvic region (b) Pectoral girdle (c) Vertebral column (d) Skull

27. The part labeled I is the

(a) Lumbar (b) Sacrum (c) Ilium (d) Pubis

28. The bone that articulates with the part labeled III is the

(a) Humerus (b) Femur (head) (c) Tibia (d) Sacrum

29. Which of the following types of joints allow movement in all directions?

(a) ball and socket joint(b) hinge joint (c) pivot joint (d) gliding joint

30. A movable joint

(a) allows movement in all direction (b) allows the movement of bones

(c) does not allow bones to move(d) allows back and forth movement

31. An immovable joint is located in one of the following parts of the body

(a) shoulder (b) knee (c) skull (d) the vertebral column

32. The following bones make up the rib cage EXCEPT

(a) the backbone (b) the sternum (c) the ribs (d) the humerus

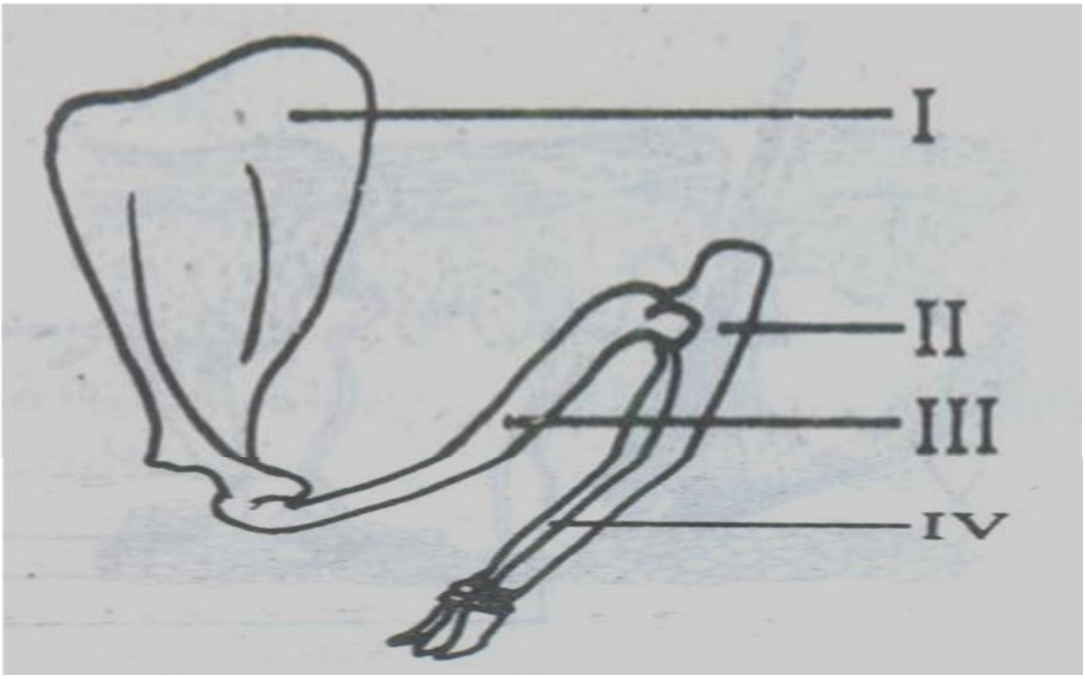
33. The ears and nostril are flexible because

(a) they are made up of bones (b) they are made up of ossicles (c) they are made up of cartilage (d) they are located on the head

34. The point where two or more bones meet is known as a _____

(a) Tenden (b) Joint (c) Muscles (d) Ligament

Use the diagram below to answer questions 35-37



35. The structure labelled II articulates with III to form a

(a) sliding joint (b) hinge joint(c) pivot joint (d) ball and socket joint

36. Which of the bones is the radius?

(a) I (b) II (c) III (d) IV

37.The two sections of the mammalian skeleton are _____ and _____

(a) brain and spinal cord (b) axial and appendicular skeleton (c) endoskeleton and exoskeleton (d) limbs and limb girdles

38. During the bending of the arm, the biceps muscles

(a) contract and the triceps muscle relaxes (b) relax and the triceps muscle contracts (c) and the triceps muscle relax (d) and the triceps muscle contract

39. Which of these is NOT part of the appendicular Skeleton?

(a) gliding joint (b) Clavicle (c) Ribs (d) Scapula

40. The floating ribs are also called false ribs because ____

(a) they are fastened to the backbone and breastbone, (b) they are fastened only to the backbone (c) they are fastened only to the breastbone(d) they are not fastened to any bones

APPENDIX C

TABLE OF SPECIFICATION FOR BIOLOGY ACHIEVEMENT TEST

	Content	**Knowledge 17.5%**	**comprehension 32.5%**	**Application 20%**	**Analysis 5%**	**Synthesis 17.5%**	**Evaluation 7.5%n**	**Total 100%**
Lesson I 25%	Supporting tissues in animals, types, functions and sections of the skeleton	(1, 11, 34)	(3, 4)	(5 , 6, 24)		(2)	(7)	10
Lesson II 35%	Axial skeleton: (skull, bones of the vertebral column, their distinguishing features and ribs and sternum)	(12,)	(19, 31, 33, 21 ,22 ,23 ,25)	(18)	(16,)	(14,15,32)	(13)	14
Lesson III 40%	Appendicular Skeleton, Joint, types of joint and movement at a joint	(8,9,35)	(10,27,39, 20)	(29,37,38, 17)	(28)	(36,30,40)	(26)	16
Total 100%		**7**	**13**	**8**	**2**	**7**	**3**	**40**

APPENDIX D
ANSWERS FOR BIOLOGY ACHIEVEMENT TEST

MARKING SCHEME (1 mark each = 40 marks)

1. B	11. B	21. D	31. B
2. C	12. B	22. B	32. B
3. B	13. A	23. C	33. D
4. D	14. D	24. A	34. C
5. C	15. A	25. B	35. B
6. C	16. D	26. B	36. B
7. A	17. B	27. A	37. D
8. D	18. A	28. B	38. A
9. A	19. D	29. C	39. C
10. D	20. C	30. A	40. B

APPENDIX E

ANSWERS FOR RESHUFFLED FORM OF BIOLOGY ACHIEVEMENT TEST

MARKING SCHEME (1 mark each = 40 marks)

1. B	11. A	21. D	31. C
2. A	12. A	22. C	32. D
3. D	13. B	23. D	33. C
4. B	14. B	24. B	34. B
5. C	15. D	25. C	35. B
6. C	16. A	26. A	36. D
7. D	17. B	27. C	37. B
8. A	18. D	28. B	38. A
9. D	19. B	29. A	39. C
10. B	20. A	30. A	40. B

APPENDIX F

LESSON NOTES ON SUPPORTING TISSUS IN ANIMALS BASED ON FLIPPED CLASSROOM INSTRUCTIONAL APPROACH

WEEK 1

Subject: Biology

Class: SSII

Topic: Supporting tissue in Animals

Duration: 45 minutes

Specific Objectives: By the end of the lesson, the students should be able to:

1) Define skeleton
2. List the skeletal materials
3) State the types of skeleton
3) State the functions of the skeleton
4) Mention the sections that make-up the skeletal system

Instructional materials: Laptop, CDs and projector

Instructional Strategies/ Techniques: Questioning, Stimulus variation, Use of examples, reinforcement and planned repetition

Entry behaviour: Students have learnt supporting tissues in plants

Test of Entry behavior: To test the student's pre-requisite knowledge, the teacher will ask the students to list supporting tissues in plants

Step I: Pre class

Teacher's activities: The teacher gives the students video lesson to watch at home before the next class. The students are given the CD- ROM containing the video lecture to watch in class in the computer laboratory prior to class. She copies to them on the board what they will learn from the video as follows:

1. Definition of skeleton
2. Examples of skeletal materials
3. Types of skeleton
4. Functions of skeleton

The teacher tells them to make a note from the video lesson.

Students' activities: The students do as instructed by the teacher.

Step II: In class activities that provide the students opportunities to deepen understanding

Teacher's activities: The teacher set induces the students by asking them questions based on the video they have watched.

1. Define skeleton
2. List skeletal materials

Students' activities: The students listen and answer the teacher's questions

Step III: (Displaying of video)

Teacher's activities: The teacher displays the video showing meaning of skeleton and skeletal materials and pause. The teacher discusses the video with the students. Skeleton is the rigid framework of the body which gives support and shape to an organism. The skeleton has materials which include chitin, cartilage and bone.

Chitinis a tough, light and flexible material that is a major component of the skeleton of arthropods. It is a dead material. Often, chitin is strengthened by deposits of hardened protein and minerals.

Cartilageis tough and flexible and is found in many parts of the body example ear, nose, ribs, throat, intervertebral disc, shoulder joint and knee joint. Cartilage is often known as "biscuit bone". It is found in the embryos of all vertebrate and throughout life in cartilaginous fish. It consists of living cells (chondroblasts), carbohydrate and protein fibres. It acts as shock absorber, cushioning the effects of bones moving against bone when we move. Cartilage does not have its own blood supply but depends on oxygen and nutrients that diffuse across from nearby tissues.

Bone: This tissue is a major component of vertebral skeleton. It consists of living cells (osteocytes), protein fibres (collagen) and minerals, mainly calcium phosphate and calcium carbonate. Bones have their own blood supply to nourish them.

In a young vertebrate embryo, the skeleton is made up of cartilage. As the embryo grows, bone cells replace cartilage cells. This causes the cartilage tissue to harden into bone through the addition of minerals. This process is known as ossification.

The teacher displays the video or pauses the lesson where students require more time to grasp the content especially where there are diagrams when necessary.

The teacher asks the students the following questions:

1. Define skeleton
2. List skeletal materials
3. Give the meaning of ossification

Students' activities: The students answer the teacher's questions.

Step IV: (Displaying of video)

Teacher's activities: The teacher continues with the video showing functions of skeleton. The teacher discusses with the students the functions of skeleton.

Having had your skeleton all through your life, what do you think are the functions of the skeleton? The functions of skeleton in animals

(1) Support

(2) Protection

(3) Movement

The skeleton also helps in respiration and production of red blood cells

Support: How does the skeleton give the body support? The vertebral column, the pectoral girdle and the pelvic girdle form a frame work which can support the bulk of the body weight. The skeleton is the framework upon which the internal organs are hung. Without the skeleton to support them, the soft internal organs would pile up on top of each other and be unable to function.

Protection: How does skeleton perform the function of protection? What parts of the skeleton helps in protection? The skull forms the strong protective box for the soft tissue of the brain. It also houses the inner ear and the eyeball. The vertebral column protects the spinal cord. The ribcage protects heart, the thoracic blood vessels and the lungs. The pelvic girdle protects the abdominal organs particularly the urinary bladder and the reproductive organs of female. In arthropods the exoskeleton protects the whole body and prevents water loss from the body surfaces by evaporation.

Movement: Movement is a general term meaning the act of changing position. Locomotion is the movement of the whole organism from one place to another. How does the skeleton make movement possible? All movement including locomotion in animals, are as a result of muscle contractions moving the bones to which they are attached.

The teacher displays the video or pauses the lessons when necessary.

She asks the students to give the functions of skeleton.

Students' activities: The students' answer the teacher's questions and ask questions where they do not understand for clarification.

Step V: (Displays video)

Teacher's activities: The teacher continues with the video showing types of skeleton. She discusses with the students the types of skeleton. Are you aware that you have skeleton? Try to find it from your arm, for instance. The skeleton forms the central core of the human body and is covered up by muscles, blood vessels nerves and skin. It is internal, and is therefore described as an exoskeleton (endo= within) In contrast, arthropods have their skeleton on the outside of their bodies. Such skeleton is called exoskeletons. In insects, the skeleton is a hard cuticle containing mainly chitin and some hardening mineral salts like phosphate and carbonates of calcium. Its outermost layer is covered with thin layer of wax which makes it water proof. It performs the same functions as the endoskeleton. Animals with exoskeleton moult periodically. They shed their old exoskeletons and grow rapidly in size, while the new exoskeletons are still soft and extensible. Moulting is also known as ecdysis. The two type of skeletons differ in their position in the body.

The teacher displays the video or pauses the lessons when necessary.

Students' Activities: The students answer the teacher's questions and ask questions where they do not understand for teacher's clarification

Step VI: (Displaying of video)

Teacher's activities: The teacher displays the video showing sections of skeleton. She discusses with the students the sections of the skeleton. The mammalian skeleton consists of two major sections axial and appendicular skeleton. The axial forms the main central axis of the body and the appendicular skeleton consists of the parts that articulates with axial skeleton. (She displays the video or pauses when necessary)

Students' Activities: The students answer the teacher's questions and ask questions where they do not understand for teacher's clarification

Step VII: (Grouping and collaborative learning)

Teacher's activities: The teacher groups the students into group of 3 and gives the students worksheet containing activities to be done in class. The sample of the worksheet is shown below.

WORKSHEET

Group No: ----------

Names of Students:

Exercises

1. The rigid framework of the body is termed _____
2. The skeletal materials are

   _____

   _____

   _____
3. The types of skeleton are

   _____

   _____
4. State the functions of skeleton

   _____

   _____

   _____
5. The sections of skeleton are

   _____

   _____
6. Pinna contains _____skeletal material
7. Define ecdysis _____

The teacher goes round the class to monitor what they are doing, guides the students.

Students' activities: The students' do the activities, ask questions in their group and also the teacher where they do not understand

Step VIII: Post class activities that extends students' learning

Teacher's activities: The teacher asks the students to play the video again after class. This will deepen their understanding.

The teacher also gives them video on the next topic to watch prior to class, telling the 108 they will learn from the video as follows;

i. The bones of axial skeleton
ii. The features of skull
iii. The number of bones that make up the vertebral column
iv. The first cervical vertebrae
v. Organs protected by ribcage

She also instructs them to make note from the video.

Students' activities: The students do as instructed by the teacher.

WEEK 2

Subject: Biology

Class: SSII

Topic: Axial skeleton

Duration: 45 Minutes

Specific objectives: By the end of the lesson, the students should be able to:

1. Name the bones that make up the axial skeleton
2. Mention the number of bones make up the vertebral column
3. Name the first two cervical vertebrae
4. Name the features of typical vertebra
5. Identify the features of all the vertebrae.
6. Name the organs protected by the ribcage.

Instructional materials: Laptop, CDs and projector

Instructional Strategies/ Techniques: Questioning, Stimulus variation, Use of examples, reinforcement and planned repetition

Entry behavior: Students have learnt the meaning of skeleton, skeletal materials, functions of skeleton and the sections of the skeletal system

Test of entry Behavior: Teacher asks students to:

1. Define skeleton
2. Mention the types of skeleton in animal
3. State the functions of skeleton

Step I: In class activities that provide the students opportunities to deepen understanding

Teacher's activities: The teacher set induces the students by asking them questions based on the video they have watched.

i. State the function of skull

ii. How many bones make up the cranium?

Students' activities: The students listen and answer the teacher's questions

Step II (Displaying the video):

Teacher's activities: The teacher continues with the video showing the skull and pause. The teacher discusses the skull with the students. Can you touch your skull? The bones of your head are called skull. The upper portion of the skull is known as cranium. How many bones make up the cranium? The cranium consists of 8 bones. The cranium bones protect the brain. The skull also has the following features

(i) Two pairs of cavities which protect the eyes and ears

(ii) The upper jaw is known as the maxilla

(iii) The lower jaw is known as mandible.

(She displays the video or pauses when necessary)

Students' Activities: The students answer the teacher's questions.

Step III: (Displaying of video)

Teacher's activities: The teacher displays the video showing vertebral column and pauses. She discusses the vertebral column with the students. What do you think is the function of the backbone? What can you learn about your backbone by feeling it? Firstly, run your fingers up and down your backbone. How does it feel? How many bones make up the backbone? There are thirty three (33) bones that make up the vertebral column and each of them is called a vertebra. By the time one becomes an adult, some of the bones of the lower end of the spinal column will have fused. Then the vertebral column will have only twenty bones. The hole inside the vertebra contains what? The spinal cord. The spinal cord is part of the nervous system, its top is connected to the brain and it is protected by the vertebrae. If you watched the video very well, you will see pads of cartilage between every two vertebrae. What function do you think they perform? The pads prevent the vertebrae from rubbing against each other. They are called the invertebral discs. There are five vertebrae in backbone. In a descending order, they are cervical vertebra, thoracic vertebra, lumbar vertebra, sacral vertebra and caudal vertebra.

She tells the students to identify the features of a typical vertebra. These include the Centrum which is a solid piece of bone below the neural canal. Can you identify the neural canal? The neural canal is for the passage of the spinal cord. It is surrounded by the neural arch. The neural spine projects upwards and dorsally. A pair of transverse processes extends sideways from the arch. Facets are used for articulation with other parts of the skeleton. Did you see holes and canals on the vertebra through which nerves and blood vessels enter and leave the spinal cord? They are the vertebrarterial canals. Now, what are the features of a typical vertebra? She tells the students to identify the features of cervical vertebra

i. It has a short neural spine

ii. Each transverse process is pierced by a hole which forms part of the vertebrarterial canal

iii. The outer parts of each transverse process is divided into two .The cervical vertebra is of two types; the atlas and axis and each of them has its own characteristic feature. The atlas is next to the skull. The features of atlas

i. It has a very large neural canal

ii. It has a broad and flat transverse process

iii. It has two large facets at the front which articulate with knobs on the base of the skull.

The features of the axis.

i. It has a prominent neural spine which projects forward

ii. Centrum which projects in front as the odontoid process.

The features of thoracic vertebra

It has the following features;

i. A long neural spine which is prominent

ii. A well developed transverse processes which articulate with the ribs

The lumber vertebra is the strongest of all the vertebrae

i. Well developed transverse process

ii. The centrum which is large and thick

iii. A number of projections from the centrum which provide attachment for muscles of the abdominal region.

The sacral vertebra:

i .They fuse to form a rigid structure known as sacrum

ii. They have narrow neural canal

iii. The transverse processes of the first two articulate with the pelvic girdle.

iv. The neural spine is reduced.

The last is the caudal vertebra and it is distinguished by the following features;

i. They are fused

ii. They resemble a solid mass of stone

iii. They lack neural canal, neural spine and transverse process. Now identify the features of caudal vertebra. (She displays the video or pauses when necessary)

Students' Activities: The students answer the teacher's and ask questions where they need clarification

Step IV: (Displaying of video)

Teacher's activity: The teacher displays the video showing the ribs and sternum and pauses. The teacher discusses with the students the ribs and sternum .The ribs and sternum which is the last part of the axial skeleton. The rib bones protect the lungs and heart. Move your hand up and down the center of your chest. What do you feel? That is the sternum. Now, feel the side of the breast bone, are there bones there? What bones are they? They are your ribs. How many ribs can you feel? You can't count them. 12 pairs of ribs and sternum form the ribcage. However, in humans only the first ten pairs are attached to the sternum. The last two pairs remain free and are known as floating ribs. They are only fastened to the back bone. (She displays the video or pauses when necessary)

Students' Activities: The students answer the teacher's questions and ask questions where they need clarification.

Step V (Grouping and collaborative learning):

Teacher's activities: The teacher groups the students (3 in each group) and gives them activity in the class (as contained in their worksheet). The sample of the worksheet is shown below.

WORKSHEET

Group No: ----------

Names of Students:

----

1. The bones that make up the axial skeleton are
   _____
   _____
2. The ribs protect _____ and _____
3. The two pairs of ribs that are only attached to the backbone are called
   _____
4. The five types of vertebral column are
   _____
   _____
   _____
   _____
   _____
5. The vertebra next to the skull is called_____
6. _____is the strongest of all the vertebrae.

   The teacher goes round to monitor what they are doing, helps them where they need clarification and displays.

Students' activities: The students work in a group and ask the teacher questions where they do not understand.

Step VI: Post class activities that extend students' learning.

Teacher's activities: The teacher encourages the students to watch video again after class for more comprehension.

The teacher also gives the students video for the next lesson to watch and tells them what they will learn from the video as follows;

i. The bones of appendicular skeleton
ii. Meaning of joint.
iii. The types of joint

The teacher tells them to make note from the video.

Students' activities: The students do as instructed by the teacher

WEEK 3

Subject: Biology

Class: SS II

Topic: The Appendicular Skeleton

Duration: 45 Minutes

Specific Objective: By the end of the lesson, the students should be able to:

1. Name the bones that make up the appendicular skeleton.
2. Draw and label a typical joint.
3. Mention the various types of joints and where they can be found in the body
4. Describe the kind(s) of movement allowed by the different joint.

Instructional materials: Laptop

Instructional Strategies/Techniques: Questioning, Stimulus variation, Use of examples, Reinforcement and Planned repetition.

Entry behaviour: Students have learnt about the axial skeleton and can answer questions on them.

Test of entry Behavior: The teacher asks the students to mention the features of the skull and mention the organs protected by the ribs

Step I: In class activities that provide the students opportunities to deepen understanding

Teacher's activities: The teacher set induces the students by asking them questions based on the video they have watched.

i. Name the bones that make up the appendicular skeleton
ii. Mention types of joint

Students' activities: The students listen and answer the teacher's questions

Step II: (Displaying of video):

Teacher's activities: The teacher displays the video showing bones of appendicular skeleton and pause. She discusses the bones of the appendicular skeleton with the students. The appendicular skeleton consists of what? The limbs and limb girdles. The fore limbs refer to the arms while the hind limbs refer to the legs. Point your legs. The girdles are the pectoral and pelvic girdles. They are the bones of the shoulder and waist respectively.

Now, feel the two long bones near the base of your neck. They are your collar bones or the clavicle. Where is each attached to at both ends? At one end, each collar bone is attached to the breast bone and at the other end is attached to the shoulder blade or scapula.

Feel the bones of your arm and hands. Your upper arm has one long thick bone called humerus; the two bones of the forearm, the radius and ulna, the multiple bones of the wrist and palm are called carpals and metacarpals respectively and the finger bones, the phalanges.

The teacher tells the students that the next bone to study is the hipbone or pelvic. Point to your hip bones, are there bones there? There are two bones, each shaped like a bowl. Do you know a bowl? B-O-W-L. Each of them attached to the lower end of the backbone. Do you remember the backbone? The pelvic girdle consists of ilium, ishium and pubis all of which are fused together on each side of the body as the innominate bone. These two halves are rigidly joined at the last lumber vertebra to the base of the spine at the back while in the front they are less rigidly joined at the pubis by the fibro cartilage of pubis symphysis. The distal ends of these bones form the cavity called acetabulum into which the head of fermur fits to form ball and socket joint.

The teacher tells the students to feel the bones of your legs. How many long, thick bones can you feel? One. This is called the femur. There are two long bones in each lower leg; the tibia and fibula. What are the functions of the bones of the legs? The bones of the legs help to support the weight of the body. The tarsals are seven small bones in the ankle while the metatarsals are five long bones in the foot which end up in the toes or phalanges. The teacher displays the video or pauses when necessary.

Students activities: The students watch, listen and answer the teacher's questions and ask questions for clarification where they do not understand.

Step III: (Displaying of video)

Teacher's activities: The teacher displays the video showing joint, types of joint and movement at joint and pause.The teacher guides the students discover joints and types of joint.

Pieces of wood or steel in the framework of a building must be fastened together. The same is true of the framework of your body. The bones must be connected if they are to give your body support, shape and protection. Have you seen how the bones in the leg of a chicken are connected? Now when you get home;

1. Obtain a whole, cooked chicken leg that has the meat removed. Clean the bones by boiling them in soapy water
2. Examine the place where the bones of the leg connect. Does the leg bend at this point?
3. Try to pull the bones apart, what holds them togeth

The place where two or more bones meet is called a joint. Joints allow movement. At a joint, the bones are held together by strong tissues ligaments which prevents dislocation during movement

Joints may either be immovable that is, tightly fixed together so that no movement is possible (for example, sutured joints of the skull, fused joint as in sacral vertebrae, bones bound tightly by ligaments as in the two halves of the pubic symphysis) or movable. Most of the joints in your body are movable joints, they are found in places where the skeleton can move. There are different kinds of movable joints and each kind allows bones to be moved in a certain way. They are

1. Ball and socket joint
2. Hinge joint
3. Gliding joint
4. Pivot joint (repeat all)

In what ways do the movable joints in your body allow your bones to move? Bend your elbows, knees and fingers. In what way do these parts move? Okay, they move in only one direction. This is called a hinge joint because it permits only up and down movement. Take a look at the diagram to see what a hinge joint looks like.

Now, stand and swing your leg in a small circle. In how many different directions can you move your leg? Look at the picture of a ball and socket joint. The place where femur fits into your hipbone is an example. At the upper end of the femur is a round part called the ball? The ball fits into a hole, or socket in the hipbone. Swing your arm. Is there a ball and socket joint in your shoulder? How do you know? The ball and socket joint allows the biggest amount of movement; in all direction.

Now, let us look at another type of movable joint. This is the gliding joints. Bend forward and backward. Can you move your backbone in the same directions that you were able to move your legs? The vertebrae of your backbone are connected by joint that allow the bones to slide over one another. Movable joint of this kind is called gliding joint.

The pivot joint allows rotation of one part of the body on another. Now, move your head in as many directions as you can; up, down, left, right. The nodding of the head is an example of a pivot joint and it found between the atlas and axis, this can be seen in the above diagram.

The teacher tells the students let us look at how movement takes place at a joint. A joint is moved by muscles attached to the skeleton. A muscle consists of a long, thread-like fibre arranged in cells and surrounded by a sheath of connective tissues. Muscles cells have a unique property. When stimulated by a nervous impulse, they contract or shorten to about two thirds to half their resting length. Can you show me your muscles? Each of the muscles which help to move a joint are attached to different bones and are attached in such a way that when the muscles contract, the bones are moved relative to each other. For example, the biceps muscles which bend the elbow are attached at one end to the scapula and at the other end to the radius. Muscles are attached to the bones by tendons. Tendons are tough elastic fibers and protect muscles from wear, because, they pass over the ends of bones. At least, two muscles are needed to bring about movement at a joint. For example, the elbow is bent by the biceps and straightened by the triceps as follows;

1. When biceps contrast, it becomes shorter and fatter and so bends the elbow
2. The triceps muscles passes across the elbow joint on the opposite side from the biceps so that when it contracts, the elbow is straightened. The biceps and triceps muscles are antagonistic in action. The muscle which causes bending in this case is called a flexor muscles while the one which causes straightening is called the extensor. Therefore, contraction or relaxation of the muscles cells bring about movement at a joint.

The teacher displays the video or pauses when necessary.

Students' Activities: The students listen and answer the teacher's questions and ask the teacher questions where they do not understand for clarification.

Step IV: (Collaborative learning)

Teacher's activities: The teacher groups the students (3 students in each group) gives them worksheet containing activities. The sample of the worksheet is shown below.

WORKSHEET

Group No: ----------

Names of Students:

Exercises

1. The bones that make up the appendicular skeleton are

   _____

   _____

2. The bones that make up the pectoral girdle are

   _____

   _____

3. A place where two or more bones meet is called _____
4. The four main types of movable joints are

   _____

   _____

   _____

   _____

5. Elbow joint is an example _____ type of joint

The teacher goes round to monitor what the students are doing, helps them where they do not understand.

Students' activities: The students do the exercises and calls for teacher's attention where they need clarification.

Step V (Post class): Post class activities that extend students' learning.

Teacher's activities: The teacher encourages the students to watch the video again. She tells them that it will help them for more comprehension.

The teacher also tells them students to watch all the videos she has given them and prepare for test

LESSON NOTES ON SUPPORTING TISSUS IN ANIMALS BASED ON POWER POINT PRESENTATION INSTRUCTIONAL APPROACH.

WEEK 1

Subject: Biology

Class: SSII

Topic: Supporting tissue in Animals

Duration: 45 minutes

Specific objectives: By the end of the lesson, the students should be able to:

1. Define skeleton
2. List the skeletal materials
3) State the types of skeleton
3) State the functions of the skeleton
4) Mention the sections that make-up the skeletal system

Instructional materials: Laptop and projector

Instructional Strategies/ Techniques: Questioning, Stimulus variation, Use of examples, Reinforcement and Planned repetition.

Entry behaviour: Students have learnt supporting tissues in plants

Test of Entry behavior: To test the student's pre-requisite knowledge, the teacher will ask the students to list supporting tissues in plants

Instructional procedure:

Step I: Introduction

Teacher's activity: The teacher set induces the students by asking them questions based on their previous knowledge as follows:

1. Define a tissue
2. Name supporting tissues in plants

Students' Activities: The students answer the teacher's questions.

Step II: Supporting tissues in animals

Teacher's activity: The teacher defines skeleton as a rigid frame work which gives support and shape to an organism . The skeleton has materials which include chitin, cartilage and bone.

Chitin is a tough, light and flexible material that is a major component of skeleton of arthropods. It is a dead material. Often, chitin is strengthened by deposits of hardened protein and minerals.

Cartilage is tough and flexible tissue that is found in body parts of the body eg ear, nose, ribscage throat, joint. Cartilage is often known as "biscuitbone". It is found in the embryos of all vertebrate and throughout life in cartilaginous fish. It consists of living cells (chondroblast), carbohydrate and protein fibers. It acts as shock absorber, cushioning the effects of bones moving against bone when we move. Cartilage does not have its own blood supply but depends on oxygen and nutrients that diffuse across from nearby tissue.

Bone is the major component of the vertebrate skeleton. It consists of living cells called Osteocytes, protein fibres(collagen) and minerals mainly calcium phosphate (CaPo4) and calcium carbonate (CaC03).

In a young vertebrate embryo, the skeleton is made up of cartilage. As the embryo grows, the bone cells replace the cartilage cells with the addition of minerals which hardens the cartilage tissue. This is process called ossification

Students' Activities: The students answer the teacher's questions

Step III: **Functions of the Skeleton**

Teacher's activity: The teacher asks the students these questions:

Having had your skeleton all through your life, what do you think are the functions of the skeleton? The skeleton is rigid and performs three major functions. What are these functions?

(1) Support

(2) Protection

(3) Locomotion

(Repeat the functions of the skeleton). The skeleton also gives the body its shape and helps in respiratory movement.

Support: How does the skeleton give the body support? If the weight of the body is not supported on two legs, can the arms and hands be free to do other things? Most animals cannot stand on two legs. They have to use their fore legs and their hind legs to support themselves. Without the skeleton, the body will be shapeless.

Protection: How does skeleton perform the function of protection? It provides a framework, which suspends internal organs of the body. What are some of these organs? Yes, the eyes, heart,

lungs and brain. Okay. What parts of the skeleton protect these organs? The skull protects the eyes and brain while the ribs protect the heart and lungs.

Locomotion: Locomotion is the ability to move from place to place. How does the skeleton make movement possible? The skeleton makes movement possible by providing series of levers (eg. Limb bones) to which muscles can be attached.

Respiratory Movement: The ribs and sternum bones located in the chest area form a bony cage that takes part in breathing movement

Students' Activities: The students answer the teacher's questions and ask questions where they do not understand

Step IV: Types of Skeleton

Teacher's activity: The teacher defines skeleton and guides the students to discover the types of skeleton by asking these questions:

How do you think you will look like without a skeleton in your body? What shape would your hands and head have? Would you be able to run or write a letter? Who among you has at one time or the other had a broken hand or leg? Were you able to stand erect, walk or even use the hand to do work? Do arthropods have skeleton? If yes; how do their skeletons differ from that of man? Observe the two skeletons carefully (skeleton of man and skeleton of an arthropod). Examples of arthropods are cockroach, housefly spider etc. The skeleton of arthropods performs the same functions as that of man, but there is a difference between these skeleton types. What is the difference? Does the grasshopper for example, have a skeleton covered by flesh? Does man have that? Right, the exoskeleton is a type of skeleton that is external and this is obtainable in arthropods. It is also found in some reptiles because of the presence of scales. For example, crocodiles, lizard. The endoskeleton is a type of skeleton that is internal and is found in man and some animals. So the similarity is that both are supporting tissues while the difference is in the positioning of this skeleton type.

Students' Activities: The students answer the teacher's questions and ask questions where they do not understand for teacher's clarification

Step V: Sections of mammalian skeleton

Teacher's activities: The teacher discusses with the students the sections of the skeleton. The mammalian skeleton consists of two major sections axial and appendicular skeleton. The axial forms the main central axis of the body and the appendicular skeleton consists of the parts that

articulates with axial skeleton. Study the diagrams carefully taking note of their shapes and structure.

Students' Activities: The students answer the teacher's questions and ask questions where they need clarification.

Evaluation: The teacher evaluates the students by asking the following questions:

1. Define skeleton
2. List the skeletal materials
3) State the types of skeleton
3) State the functions of the skeleton
4) Mention the sections that make-up the skeletal system

Assignment: The teacher gives the students assignment as contained in the worksheet.

WORKSHEET

Name of Student: ----------

Exercises

1. The rigid framework of the body is termed _____
2. The skeletal materials are
   _____
   _____
   _____
3. The types of skeleton are
   _____
   _____
4. State the functions of skeleton
   _____
   _____
   _____
5. The sections of skeleton are
   _____
   _____
6. Pinna contains _____skeletal material
7. Define ecdysis _____

WEEK 2

Subject: Biology

Class: SSII

Topic: Axial skeleton

Duration: 45 Minutes

Specific objectives: By the end of the lesson, the students should be able to:

1. Name the bones that make up the axial skeleton
2. Mention the number of bones make up the vertebral column
3. Name the first two cervical vertebrae
4. Draw a typical vertebra
5. Identify the features of all the vertebrae.
6. Name the organs protected by the ribs.

Instructional materials: Laptop and projector

Instructional Strategies/ Techniques: Questioning, Stimulus variation, Use of examples, reinforcement and planned repetition

Entry behavior: Students have learnt the meaning of skeleton, skeletal materials, functions of skeleton and the sections of the skeletal system

Test of entry Behavior: Teacher asks students to mention the types of skeleton in animal and functions of skeleton

Instructional procedure:

Step I: Introduction

Teacher's activity: The teacher set induces the students by asking them questions based on their previous knowledge as follows:

1. Define skeleton
2. Name the supporting tissues in animal
3. State the functions of skeleton

Students' Activities: The students answer the teachers' questions

Step II: The skull.

Teacher's activities: The teacher discusses the skull with the students. Can you touch your skull? The bones of your head are called skull. The upper portion of the skull is known as cranium. How many bones make up the cranium? The cranium consists of 8 bones. The cranium bones protect the brain. The skull also has the following features

(iv) Two pairs of cavities which protect the eyes and ears

(v) The upper jaw is known as the maxilla

(vi) The lower jaw is known as mandible.

Students' Activities: The students answer the teacher's questions.

Step III: The backbone or the vertebral column.

Teacher's activities: The teacher discusses the vertebral column with the students. What do you think is the function of the backbone? What can you learn about your backbone by feeling it? Firstly, run your fingers up and down your backbone. How does it feel? How many bones make up the backbone? There are thirty three (33) bones that make up the vertebral column and each of them is called a vertebra. By the time one becomes an adult, some of the bones of the lower end of the spinal column will have fused. Then the vertebral column will have only twenty bones. The hole inside the vertebra contains what? The spinal cord. The spinal cord is part of the nervous system, its top is connected to the brain and it is protected by the vertebrae. There are pads of cartilage between every two vertebrae. What function do you think they perform? The pads prevent the vertebrae from rubbing against each other. They are called the invertebral discs. There are five vertebrae in backbone. In a descending order, they are cervical vertebra, thoracic vertebra, lumbar vertebra, sacral vertebra and caudal vertebra.

Students' activities: The students answer the teacher's questions and ask questions where they do not understand for clarification.

Step IV: Structure of a typical vertebra

Teacher's activities: The teacher tells the students to identify the features of a typical vertebra. These include the Centrum which is a solid piece of bone below the neural canal. Can you identify the neural canal? The neural canal is for the passage of the spinal cord. It is surrounded by the neural arch. The neural spine projects upwards and dorsally. A pair of transverse processes extends sideways from the arch. Facets are used for articulation with other parts of the skeleton. Did you see holes and canals on the vertebra through which nerves and blood vessels enter and leave the spinal cord? They are the vertebrarterial canals. Now, what are the features of a typical vertebra?

Students' activities: The students answer the teacher's questions and ask questions where they do not understand for clarification.

Step V: Distinguishing features of the vertebrae

Teacher's activities: The teacher tells the students to observe and identify the features of cervical vertebra

i. It has a short neural spine
ii. Each transverse process is pierced by a hole which forms part of the vertebrarterial canal
iii. The outer parts of each transverse process is divided into two .The cervical vertebra is of two types; the atlas and axis and each of them has its own characteristic feature. The atlas is next to the skull. The features of atlas

i. It has a very large neural canal
ii. It has a broad and flat transverse process
iii. It has two large facets at the front which articulate with knobs on the base of the skull.

The features of the axis are;

i. It has a prominent neural spine which projects forward
ii. Centrum which projects in front as the odontoid process.

The features of thoracic vertebra

It has the following features;

i. A long neural spine which is prominent
ii. A well developed transverse processes which articulate with the ribs

The lumber vertebra is the strongest of all the vertebrae

i. Well developed transverse process
ii. The centrum which is large and thick
iii. A number of projections from the centrum which provide attachment for muscles of the abdominal region.

The sacral vertebra:

i .They fuse to form a rigid structure known as sacrum
ii. They have narrow neural canal
iii. The transverse processes of the first two articulate with the pelvic girdle.
iv. The neural spine is reduced.

The last is the caudal vertebra and it is distinguished by the following features;

i. They are fused
ii. They resemble a solid mass of stone
iii. They lack neural canal, neural spine and transverse process. Now identify the features of caudal vertebra.

Students' Activities: The students answer the teacher's questions and ask questions where they need clarification

Step VI: Ribs and Sternum

Teacher's activity: The teacher discusses with the students the ribs and sternum .The ribs and sternum which is the last part of the axial skeleton. The rib bones protect the lungs and heart. Move your hand up and down the center of your chest. What do you feel? That is the sternum. Now, feel the side of the breast bone, are there bones there? What bones are they? They are your ribs. How many ribs can you feel? You can't count them. 12 pairs of ribs and sternum form the ribcage. However, in humans only the first ten pairs are attached to the sternum. The last two pairs remain free and are known as floating ribs. They are only fastened to the back bone.

Students' Activities: The students answer the teacher's questions and ask questions where they need clarification.

Evaluation: The teacher evaluates the students by asking them the following questions:

1. Name the bones that make up the axial skeleton
2. Mention the number of bones make up the vertebral column
3. Name the first two cervical vertebrae
4. Draw a typical vertebra
5. Identify the features of all the vertebrae.
6. Name the organs protected by the ribs.

Assignment: The teacher gives the students assignment as contained in the worksheet.

WORKSHEET

Name of Student:_____

1. The bones that make up the axial skeleton are
   _____
   _____
2. The ribs protect _____ and _____
3. The two pairs of ribs that are only attached to the backbone are called
   _____
4. The five types of vertebral column are
   _____
   _____
   _____
   _____
   _____
5. The vertebra next to the skull is called_____

_____is the strongest of all the vertebrae

WEEK 3

Subject: Biology
Class: SS II
Topic: The Appendicular Skeleton
Duration: 45 Minutes
Specific Objective: By the end of the lesson, the students should be able to:

1. Name the bones that make up the appendicular skeleton.

2. Draw and label a typical joint.

3. Mention the various types of joints and where they can be found in the body

4. Describe the kind(s) of movement allowed by the different joint.

Instructional materials: Laptop, CD, projector

Instructional Strategies/Techniques: Questioning, Stimulus variation, Use of examples, Reinforcement and Planned repetition.

Entry Behaviour: Students have learnt about the axial skeleton and can answer questions on them.
Test of entry Behaviour: The teacher asks the students to mention the features of the skull and mention the organs protected by the ribs
Step I: Introduction
Teacher's activities: The teacher set induces the students by asking them the following questions
i. Name the bones that make up the axial skeleton

ii. Mention the organs protected by the ribs

Students' activities: The students listen and answer the teacher's questions
Step II: Appendicular skeleton
Teacher's activities: The teacher discusses the bones of the appendicular skeleton with the students. The appendicular skeleton consists of what? The limbs and limb girdles. The fore limbs refer to the arms while the hind limbs refer to the legs. Point your legs. The girdles are the pectoral and pelvic girdles. They are the bones of the shoulder and waist respectively.

Now, feel the two long bones near the base of your neck. They are your collar bones or the clavicle. Where is each attached to at both ends? At one end, each collar bone is attached to the breast bone and at the other end is attached to the shoulder blade or scapula.

Feel the bones of your arm and hands. Your upper arm has one long thick bone called humerus; the two bones of the forearm, the radius and ulna, the multiple bones of the wrist and palm are called carpals and metacarpals respectively and the finger bones, the phalanges.

The teacher tells the students that the next bone to study is the hipbone or pelvic. Point to your hip bones, are there bones there? There are two bones, each shaped like a bowl. Do you

know a bowl? B-O-W-L. Each of them attached to the lower end of the backbone. Do you remember the backbone? The pelvic girdle consists of ilium, ishium and pubis all of which are fused together on each side of the body as the innominate bone. These two halves are rigidly joined at the last lumber vertebra to the base of the spine at the back while in the front they are less rigidly joined at the pubis by the fibro cartilage of pubis symphysis. The distal ends of these bones form the cavity called acetabulum into which the head of fermur fits to form ball and socket joint.

The teacher tells the students to feel the bones of your legs. How many long, thick bones can you feel? One. This is called the femur. There are two long bones in each lower leg; the tibia and fibula. What are the functions of the bones of the legs? The bones of the legs help to support the weight of the body. The tarsals are seven small bones in the ankle while the metatarsals are five long bones in the foot which end up in the toes or phalanges.

Students activities: The students observe, listen and answer the teacher's questions and ask questions for clarification where they do not understand.

Step III: Joints and Types of joint

Teacher's activities: The teacher guides the students discover joints and types of joint.

Pieces of wood or steel in the framework of a building must be fastened together. The same is true of the framework of your body. The bones must be connected if they are to give your body support, shape and protection. Have you seen how the bones in the leg of a chicken are connected? Now when you get home;

4. Obtain a whole, cooked chicken leg that has the meat removed. Clean the bones by boiling them in soapy water
5. Examine the place where the bones of the leg connect. Does the leg bend at this point?
6. Try to pull the bones apart, what holds them together?

The place where two or more bones meet is called a joint. Joints allow movement. At a joint, the bones are held together by strong tissues ligaments which prevents dislocation during movement

Joints may either be immovable that is, tightly fixed together so that no movement is possible (for example, sutured joints of the skull, fused joint as in sacral vertebrae, bones bound tightly by ligaments as in the two halves of the pubic symphysis) or movable. Most of the joints in your body are movable joints, they are found in places where the skeleton can move. There are

different kinds of movable joints and each kind allows bones to be moved in a certain way. They are

1. Ball and socket joint
2. Hinge joint
3. Gliding joint
4. Pivot joint (repeat all)

In what ways do the movable joints in your body allow your bones to move? Bend your elbows, knees and fingers. In what way do these parts move? Okay, they move in only one direction. This is called a hinge joint because it permits only up and down movement. Take a look at the diagram to see what a hinge joint looks like.

Now, stand and swing your leg in a small circle. In how many different directions can you move your leg? Look at the picture of a ball and socket joint. The place where femur fits into your hipbone is an example. At the upper end of the femur is a round part called the ball? The ball fits into a hole, or socket in the hipbone. Swing your arm. Is there a ball and socket joint in your shoulder? How do you know? The ball and socket joint allows the biggest amount of movement; in all direction.

Now, let us look at another type of movable joint. This is the gliding joints. Bend forward and backward. Can you move your backbone in the same directions that you were able to move your legs? The vertebrae of your backbone are connected by joint that allow the bones to slide over one another. Movable joint of this kind is called gliding joint.

The pivot joint allows rotation of one part of the body on another. Now, move your head in as many directions as you can; up, down, left, right. The nodding of the head is an example of a pivot joint and it found between the atlas and axis, this can be seen in the above diagram. **Students' activities:** The students answer the teacher's questions and ask questions where they need clarification

Step IV: Movement at the joint

Teacher's activities: The teacher tells the students let us look at how movement takes place at a joint. A joint is moved by muscles attached to the skeleton. A muscle consists of a long, thread-like fibre arranged in cells and surrounded by a sheath of connective tissues. Muscles cells have a unique property. When stimulated by a nervous impulse, they contract or shorten to about two thirds to half their resting length. Can you show me your muscles? Each of the muscles which help to move a joint are attached to different bones and are attached in such a way that when the

muscles contract, the bones are moved relative to each other. For example, the biceps muscles which bend the elbow are attached at one end to the scapula and at the other end to the radius. Muscles are attached to the bones by tendons. Tendons are tough elastic fibers and protect muscles from wear, because, they pass over the ends of bones. At least, two muscles are needed to bring about movement at a joint. For example, the elbow is bent by the biceps and straightened by the triceps as follows;

3. When biceps contrast, it becomes shorter and fatter and so bends the elbow
4. The triceps muscles passes across the elbow joint on the opposite side from the biceps so that when it contracts, the elbow is straightened. The biceps and triceps muscles are antagonistic in action. The muscle which causes bending in this case is called a flexor muscles while the one which causes straightening is called the extensor. Therefore, contraction or relaxation of the muscles cells bring about movement at a joint.

Students' Activities: The students listen and answer the teacher's questions and ask the teacher questions where they do not understand for clarification.

Evaluation: The teacher evaluates the students by asking them the following questions:

1. Name the bones that make up the appendicular skeleton.
2. Draw and label a typical joint.
3. Mention the various types of joints and where they can be found in the body
4. Describe the kind(s) of movement allowed by the different joint.

Assignment: The teacher gives the students assignment as contained in the worksheet.

WORKSHEET

Name of Student: ----------

Exercises

1. The bones that make up the appendicular skeleton are
   _____
   _____
2. The bones that make up the pectoral girdle are
   _____
   _____
3. A place where two or more bones meet is called _____
4. The four main types of movable joints are
   _____
   _____
   _____
   _____
5. Elbow joint is an example _____ type of joint

The teacher tells them to prepare for their test.

LESSON NOTES ON SKELETAL SYSTEM BASED ON POWER POINT PRESENTATION INSTRUCTIONAL APPROACH.

WEEK 1

Supporting tissues in Animals

1

SUPPORTING TISSUES IN ANIMAL:SKELETON

➢Skeleton is the rigid framework which gives support and shape to an organism.

Define skeleton.

2

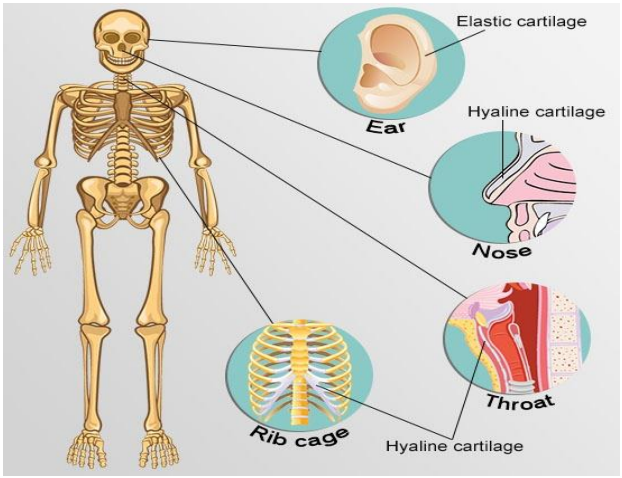
SKELETAL MATERIALS

➢The skeleton has materials which include chitin, cartilage and bone

➢Chitin: This is a tough, light and flexible material that is a major component of the skeleton of arthropods

3

➢Cartilage: This is tough and flexible tissue that is found in many parts of the body eg ear, nose, throat, ribcage.



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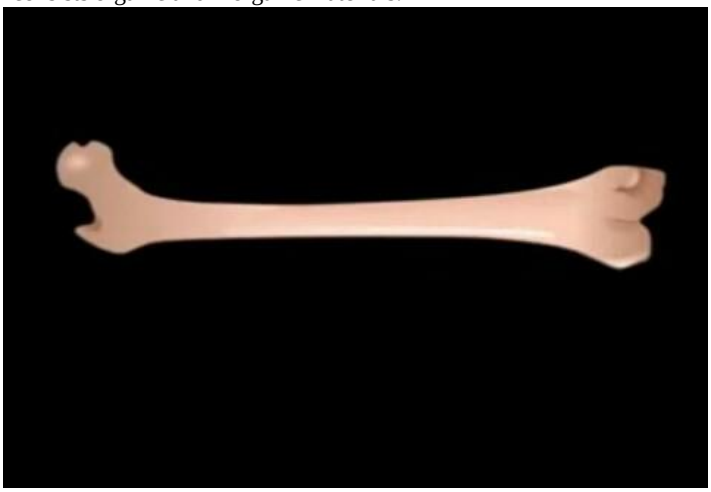
➢Bone: This is the major component of the vertebrate skeleton. It consists organic and inorganic materials.



5

FUNCTIONS OF SKELETON

➢The skeleton performs three major functions namely

- support
- protection and
- locomotion.

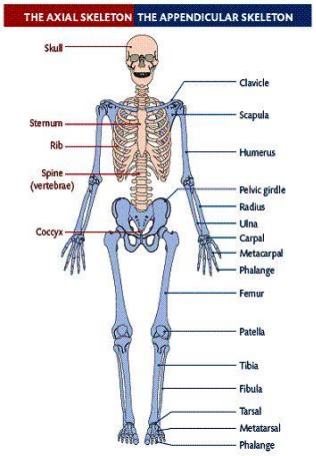
➢The skeleton also helps in respiration and production of red blood cell.

State the function of skeleton

6

TYPES OF SKELETON

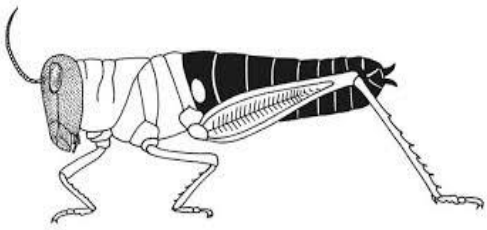
Endoskeleton: It is a type of skeleton that is internal and is found in man and other vertebrates.



The Labeled Skeleton of a man

7

Exoskeleton: It is a type of skeleton that is external and found in arthropods.



The skeleton of an arthropod

Mention the two types of skeleton and where they can be found

8

SECTIONS OF MAMMALIAN SKELETON

The Mammalian skeleton consists of two major sections

❖AXIAL SKELETON

❖APPENDICULAR SKELETON.

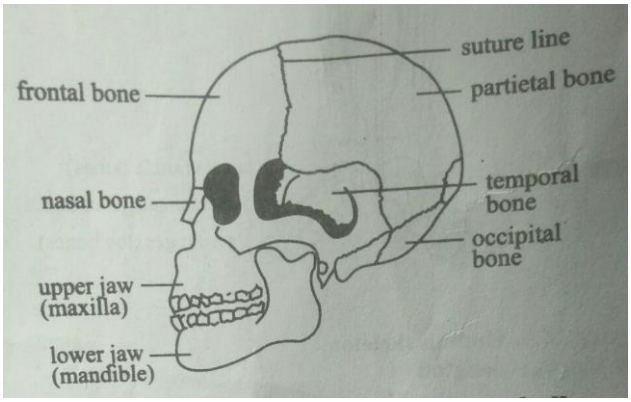
List sections that make up the skeletal system.

WEEK 2

AXIAL SKELETON

THE SKULL

The Axial skeleton consists of skull, vertebral column (backbone) and rib cage (sternum and ribs).



Human Skull

11

- The bones of the head are called the skull.
- The upper portion of the skull is known as cranium and consists of eight bones.
- The cranium contains the brain.
- The upper Jaw is known as maxilla.
- The lower jaw is known as mandible.

Name the bones that make up the axial skeleton.

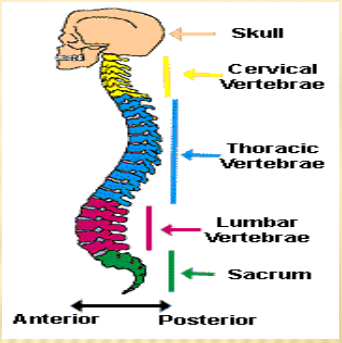
Identify the features of skull

12

THE BACKBONE OR VERTEBRAL COLUMN.

➢The vertebral column (backbone) is the central supporting structure of the skeleton. In humans, it consists of 33 ring like bones called vertebrae

➢The vertebrae can be divided into five main regions; cervical vertebra, thoracic vertebra, lumbar vertebra, sacral vertebra and caudal vertebra.



Mention the number of bones that make up the vertebral column.

13

The Features of a Typical Vertebra

(i) The centrum

(ii) The neural arch

(iii) The neural spine

(iv) Transverse processes

(v) Facets.

Mention the number of bones that make up the vertebral column.

Name the features of a typical vertebra

14

DISTINGUISHING FEATURES OF THE VERTEBRAE.

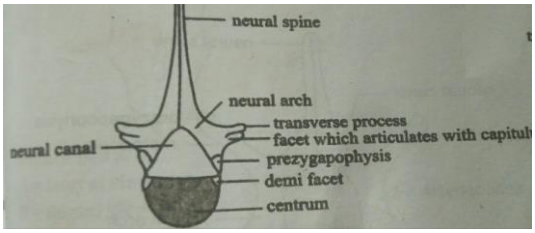
THE CERVICAL VERTEBRA

1. It has a short neural spine
2. It has transverse process
3. It has vertebrarterial canal

N.B: There are two types of cervical vertebra namely atlas and axis vertebra.

THE THORACIC VERTEBRA

1. A long neural spine which is prominent
2. It has a pair of short transverse process



Anterior view of the thoracic vertebra.

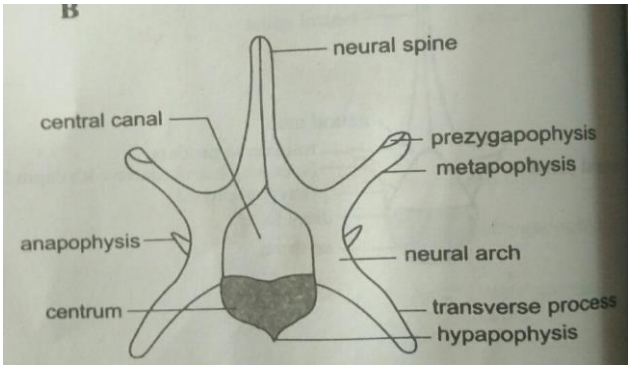
15

THE LUMBAR VERTEBRA

1.The centrum is large and thick

2.Well developed transverse process

3.A number of projections from the centrum which provide attachment for muscles of the abdominal region



Anterior view of the lumbar vertebra

16

SACRAL VERTEBRA

1. They fuse to form a rigid structure known as sacrum
2. They have narrow neural canal
3. The transverse process of the first two articulate with the pelvic girdle
4. A reduced neural spine

CAUDAL VERTEBRA

1. They are fused
2. They resemble a solid mass of stone
3. They lack neural canal, neural spine and transverse process.

Identify the features of all the vertebrae

17

RIBS AND STERNUM

- Twelve pairs of ribs and sternum form the ribcage
- In humans, the sternum is a single bone.
- There are 10 pairs of ribs attached to the sternum and backbone while 2 pairs are fastened only to the backbone.
- These 2 pairs of ribs are called floating ribs.

18

Rib cage

Name the organs protected by the ribs.
Define floating ribs.

19

WEEK 3

APPENDICULAR SKELETON

20

THE APPENDICULAR SKELETON

- This is the second part of the skeleton.
- It consists of the limbs and limb girdles.
- The limbs can also be called arms and legs.
- The fore limbs refer to the arms while the hind limbs refer to the legs.
- The limb girdles are the pectoral and pelvic girdles. They are the bones of the shoulder and waist respectively.

21

THE SHOULDERS AND ARMS

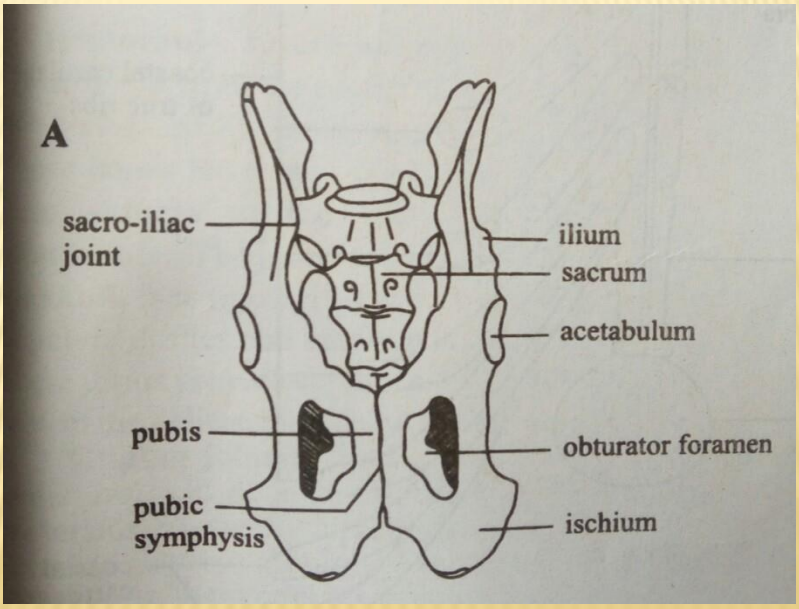
- The forelimb is attached to the pectoral girdle. The pectoral girdle consists of the clavicle or collar bone and the scapula or shoulder blade. The upper arm is called the humerus which is a long thick bone and is attached to the scapula at one end and to the other end, two long bones in the lower arm called the ulna and radius. The lower arm, is the wrist bone also called carpals which continue into five long bones in the palm called the metacarpals. The metacarpals end up in the fingers or phalanges.

22

HIP BONE OR PELVIC GIRDLE

- There are two hipbones, each shaped like a B-O-W-L. Each of them are attached to the lower end of the backbone.
- The two halves of the girdle are fixed at the median line known as the pubis symphysis.
- Each half of the pelvic girdle is known as an innominate bone. The innominate bone is made up of three pieces of bones called ilium, ischium and pubis.
- It has an acetabulum where the head of the femur fits.

23



24

THE HIND LIMBS OR LEG

- The femur is a long thick bone attached to two long bones called tibia and fibula. The tibia and fibula is attached to the tarsal which are seven small bones in the ankle.
- The tarsal continue into five long bones in the foot called metatarsals which eventually end up in the toes or phalanges.

Name the bones that make up the appendicular skeleton.

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JOINTS AND TYPES OF JOINT

- Joint is place where two or more bones meet. The bones meeting at a joint are held together by strong ligaments which prevent dislocation during movement.

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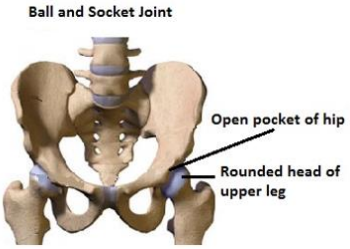
TYPES OF JOINT

1. Immovable joints tightly fixed together so that no movement is possible.
2. Movable joints: allow movement in a particular direction or in all directions.

➢There are different kinds of movable joints namely;

1. Ball and socket joint: This allows movement in all direction. Example is where femur fits into your hipbone.



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HINGE JOINT: This allows movement in only one direction.
Example is found at the knee.

GLIDING JOINT: This allows movement in a sliding manner.
Example, is the vertebrae of your backbone.

PIVOT JOINT: This allows rotation of one part of the body on another. Example is the nodding of the head and left and right movement of the head on the neck.

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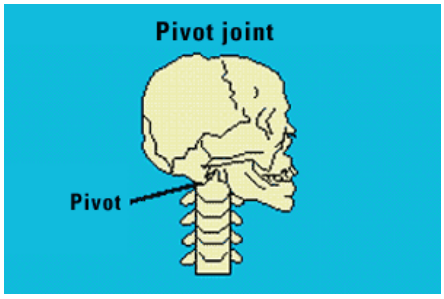

Immovable joint can be found on the skull.

➢The zig-zag lines on the skull are joints. Immovable joints do not allow movement of bones while movable joints do.

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Movement at the Joint

➢A joint is moved by muscles attached to the skeleton. A muscle consists of a long, thread like fiber arranged in cells and surrounded by a sheath of connective tissues.

➢Muscle cells contract or shorten to about two-third to half their resting length.

➢Muscles are attached to the bones by tendons.

➢Two muscles are needed to bring about movement at a joint.

➢These are biceps and triceps muscles. The two muscles are antagonistic in action.

➢The biceps contract and becomes shorter and fatter and so bends the elbow.

➢The triceps muscles passes across the elbow joint on the opposite side from the biceps so that when it contracts, the elbow is straightened. The contraction or relaxation of the muscle cells bring about movement at a joint.

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APPENDIX G

WAEC CHIEF EXAMINERS REPORT (2018)

BIOLOGY PAPER 2 MAY JUNE 2018

GENERAL COMMENT

The performance of candidates this year was slightly poorer than that of last year with raw mean of 30 and standard deviation of 9.00 when compared with the raw mean score of 31 and standard deviation of 11.92 of WASSCE for SC, 2017.The total number of candidates that sat for the examination 1,087,884.

The observed weaknesses are as follow:

- Poor spelling of some technical terms examples spyrogyra for spirogyra; dysentry for dysentery; thyphoid for typhoid; diarhea for diarrhoea.
- Poor expression in questions requiring explanation.
- Poor drawings of diagrams.
- Inability to compare biological processes appropriately.
- Not giving a title to the diagram

The following solutions were proffered to overcome these weaknesses:

- Students should study the correct spellings of technical terms.
- Teachers should be encouraged to attend WAEC coordination.
- Teachers should make students draw often while making emphasis to the view of the diagram.
- Teachers should teach students the rules guiding drawing of biological diagrams.
- Teachers and students should endeavour to useChief Examiners Reports to study.

Source: WAEC Chief Examiners Report (2018). Retrieved from https://waeconline.org.ng/e-learning/Biology/Bio227mc.html.

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- Home Economics ▾
- Civil And Mechanical ▾

Biology Paper 2 Nov/Dec 2015

Menu

General Comments

Weakness/Remedies

Candidate's Strength

Candidates Weakness

The observed weaknesses of the candidates this year include:

- inability to correctly group blood, Guinea pig, Hibiscus flower, human skeleton and *Plasmodium* into their levels of organization;
- inability to draw diagrams as required ;
- not drawing to specification, using broken lines/not showing guidelines ;
- inability to correctly answer questions that require corresponding answers;
- inability to present points sequentially;
- writing answers for the factors affecting competition for the factors resulting in overcrowding;
- poor spelling of some technical terms;
- writing wrong or unbalanced equation for photosynthesis;
- inability to give details in their description of terms;
- drawing the structure of a whole leaf rather than the transverse section of the leaf as required.

The following remedies were proffered to overcome these weaknesses:

- candidates should learn spellings of biological and scientific words/terms;
- candidates should pay attention to diagrams especially drawing of internal structures;
- candidates should read textbooks that have enough description of topics rather than Biology key points;
- candidates should study past questions and Chief Examiner's Report;
- candidates should study often and prepare ahead of exams.

APPENDIX H

POPULATION OF SS2 STUDENTS IN OBOLLO AFOR EDUCATION ZONE ACCORDING TO THE THREE LOCAL GOVERNMENTS THAT MAKE UP THE ZONE

UDENU LOCAL GOVERNMENT AREA

S/N	NAME OF SCHOOLS	MALE	FEMALE	TOTAL
1	CSS OBOLLO AFOR	64	90	154
2	SPS OBOLLO EKE	15	27	42
3	CSS OBOLLO EKE	6	9	15
4	CSS IBENDDA OBOLLO	2	6	8
5	CSS OBOLLO ETITI	24	62	86
6	ACSS OBOLLO ETITI	31	49	80
7	CSSS AMALLA	17	28	45
8	CSS UMUNDU	36	61	97
9	CSS IMILIKE AGU	23	50	73
10	EHS EZIMO AGU	15	30	45
11	CGSS IMILIKE ULO	-	77	77
12	BHS ORBA	76	-	76
13	CSS ORBA	35	49	84
14	GSS OWERE-EZE ORBA	-	142	142
15	CSS OGBODUABA	29	30	59
16	CSS EZIMO UNO	33	32	65
	TOTAL	**406**	**742**	**1148**

IGBO-EZE SOUTH

S/N	NAME OF SCHOOLS	MALE	FEMALE	TOTAL
1	IGSS IHEAKA	-	235	235
2	BSS OVOKO	193	-	193
3	CSS UHUNOWERRE	31	56	87
4	CSS IHEAKPU AWKA	103	167	270
5	CSS ITCHI	40	50	90
6	CSS UNADU	24	70	94
7	CSS ALOR AGU	25	49	74
8	CSS NKALAGU OBUKPA	48	58	106
9	BSS IBAGWA AKA	33	-	33
10	GSS IBAGWA – AKA	-	80	89
	TOTAL	**497**	**765**	**1262**

IGBO-EZE NORTH

S/N	NAME OF SCHOOLS	MALE	FEMALE	TOTAL
1	CHS INYI	50	73	123
2	CSS AMORBAI NYI	4	12	16
3	CSS UDA	50	95	145
4	CSS AMUFIE UMUITODO	48	75	123
5	CHS OKPO	36	54	90
6	CHS OLIDO	70	86	156
7	CHS UMUIDA	80	110	190
8	CHS OGRUTE	25	36	61
9	CSS IGOGORO	72	83	155
10	CSS NKPAMTE ULO	-	-	-
11	CSS ISIUGWU	58	87	145
12	CSS UMUOPU	87	100	187
13	AHS AJI	50	69	119
14	CSS IMUFU	46	58	104
15	ISS ENUGU EZIKE	89	90	179
16	CSS AGUIBEJE	50	71	121
17	CSS UMUAGAMA	43	54	97
18	CSS UMUOGBUAGU	21	31	52
19	MCSS EKPOSHI	98	102	200
20	CSS AMACHALLA	37	61	98
21	USS UGBAIKE	17	40	57
22	CSS ETTE	-	-	-
	TOTAL	**1031**	**1387**	**2418**
	GRAND TOTAL			**4828**

Source: (Planning and Research Unit Obollo Afor Education Zone, 2018).