

**EFFECTS OF SIMULATION GAMES ON ATTITUDE AND PERFORMANCE
IN MICROORGANISMS AMONG SECONDARY SCHOOL STUDENTS IN ZARIA,
NIGERIA**

BY

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DECLARATION

I declare that the work in this Dissertation entitled “Effects of Simulation Games Strategy on Attitude and Performance in Microorganisms among Secondary School Students Zaria, Kaduna State Nigeria” has been carried out by me in the Department of Science Education. The information derived from the Literature has been duly acknowledged in the text and list of references provided. No part of this Dissertation was previously presented for a higher degree in this or any other Institution.

Grace Onyinye IWUANYANWU

Signature

Date

CERTIFICATION PAGE

This Dissertation entitled “Effects Of Simulation Games Strategy On Attitude And Performance in Biology Among Secondary School Students Zaria Kaduna State Nigeria” (MED/EDUC/02633/10-11), meets the regulation governing the award of the degree of Masters in Science Education of Ahmadu Bello University, Zaria and is approved for its contributions to knowledge and literary presentation.

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DEDICATION

This Dissertation is dedicated to the Almighty God for His mercies, and grace, also for the zeal He gave me to bring this programme to completion. I say to God be the glory, honuor and majesty now and forever amen.

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LIST OF ABBREVIATIONS

MOPT	Microorganism Performance Test
BAQ	Biology Attitude Questionnaire
SSS	Senior Secondary School
SS1	Senior Secondary One
FME	Federal Ministry of Education
STAN	Science Teachers Association of Nigeria
WAEC	West African Examinations Council
NPE	National Policy of Education

OPERATIONAL DEFINITION OF TERMS

- Attitude:** This is the manner of placing or holding the body. It is also a way of Feeling, thinking or behaving towards someone or something.
- Strategy:** A plan designed to achieve a long term aim. It is also the skill used in managing any affair.
- Performance:** Academic Performance is the measure of what a Learner has comprehended over a period of time, during the Teaching and Learning process.
- Simulation:** Simulation is a valuable teaching technique for explaining issues and themes related to global education.
- Simulation Games:** This is Game/ Play with rules that is meant to imitate something or Someone.
- Microorganisms:** These are microscopic Organisms e.g plants and animals, they are too Tiny to be seen with the naked eyes, except with the aid of a Microscope.
- Biology:** This is a branch of Science, it is a subject that studies Living things and their vital processes i.e. plants and animals and their Characteristics.

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ABSTRACT

This study was carried out to determine the “effects of Simulation game on Attitude and Performance in Biology among Secondary School Students, Zaria, Kaduna State Nigeria. The target population was all SS1 Biology students in Zaria Educational zone. Two Schools were sampled using the stratified random sampling techniques. Intact Classes were used, where 153 subjects of 94 males and 59 females were sampled from the total population of 2,005. Three research questions and three null hypotheses guided the conduct of the study. The hypotheses were tested at $P \leq 0.05$ level of significance. A pretest and posttest quasi experimental control design was used. The experimental group was taught microorganism using the simulation game strategy, while the control group was exposed to lecture method. Two validated instruments Microorganisms Performance Test (MOPT) and Biology Attitude Questionnaire (BAQ) were used for both Pretest and Post-test. The reliability of the Instruments was calculated using Split-half method of Gutman. Based on the analysis of the Scores obtained from the Pilot testing of the Microorganisms Performance Test (MOPT), the reliability coefficient for the test was 0.82, while that of Biology Attitude Questionnaire (BAQ) was 0.75. The two Instruments were used to collect data, which were analyzed using independent t-test, Two-Way Analysis of Variance and Kruskai Wallis. The findings revealed that (i). There was a significant difference in the mean scores of the experimental group when taught microorganisms using simulation game strategy compared to their counterparts in the control group when taught using lecture method. (ii) There was a significant difference between the attitude change of the students before and after exposure to simulation game strategy. (iii) There was no significant difference in terms of gender academic performance of male and female students when taught using simulation game strategy and those taught using lecture method. Among the recommendations given, was that simulation game strategy should be encouraged for the teaching and learning of Biology at the secondary school level. Professional associations and educational researches, should organize seminars etc, to sensitize the need for adaptation of the simulation game strategy at the secondary school level.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

The importance of science as a requirement for technological development cannot be over emphasized. Science is a way of solving problems. The study of science helps us to answer the how, what, where and why of our surroundings. According to Shaibu (2008), science is defined as human activity that leads to the production of a body of universal statements called laws, theories, or hypotheses which serve to explain the observable behavior of the universe or some aspects of the universe. Science is important in the development of a country. It is also the root of economic and technology development. Science helps to eliminate ignorance and superstition among the Populace. Science and technology are conceived as the two sides of the same coin, technology itself is the result of scientific knowledge (Ochu, 2010). National development cannot take place without emphasis on science and technology.

According to Acquaye in Oboh (2012), today apart from raising man's standard of living, science has enabled developed nations to improve on their desire to match the fact of advancement made in industrialized countries in all facets of development. These include health, agriculture, Shelter, communication, transportation, environment and many more. Modern development is no longer possible outside, the frame work of science and technology, hence the need to teach science in schools is in line with this observation. Some states in Nigeria such as Oyo, Kano, Niger, Plateau, Sokoto and Kaduna have established special science schools in order to popularize science and make its teaching and learning more effective.

Science generally consists mainly of the three basic science subjects via, biology, chemistry, and physics. According to Obeda (1998) and Oboh (2012), Science has contributed to human civilization by providing.

- Information on the care of the human body
 - Breakthrough in medical science by the discovery of new drugs and invention of excellent diagnostic method;
 - Means of prevention and cure of human diseases;
 - Breakthrough in agricultural techniques and practices, development of improved varieties of crops, control of large number of diseases and pests of agricultural plants and animals.
 - Breakthrough in field of engineering
 - Improvement in man's environment and supply of basic needs such as food, shelter, clothing as well as recreation, transportation, communication and a host of others.
- With the aid of science, new machines and processes have been developed, which not only help to improve the quality of living but also enable science itself to open new fields.

According to Usman (2010), Education in science is man's attempt of trying to understand the world he lives in for the primary purpose of survival and improvement of the quality of his life. Ukwungu (2004) observed that Science Education in Nigeria has continued to be ineffective in promoting the Socio-economic transformation of our nation. Nworgu (2001) also observed that contrary to the spirit of Science, the Science teachers still teach without the necessary activities needed for proper understanding of the concepts. It becomes necessary therefore, for the teacher to know how Science can be presented through the use of appropriate method of teaching.

Biology is the study of life. It is the science that studies living things and it is therefore very vital to man (Fatubarin, 2003). Biology like any other science subject, uses the scientific method usually characterized by accurate observation, careful analysis and faithful recording among others. The teaching and learning of science by effective use of scientific methods in solving problem, enable the students to develop scientific skills and attitudes.

The Federal Ministry of Education of Nigeria in the revised National Policy on Education (FRN, 2013), stressed the need for the teaching and learning of Science Subjects in Secondary Schools. Biology, English Language and Mathematics are made compulsory as basic Subjects that all Students must offer. This has attracted large enrolment of Students in Biology, compared to other Science Subjects in the Senior Secondary Certificate Examination, as was stated by Timothy (2013). As a result of this a large number of Students without interest in Biology, study and sit for the Biology examinations, which has led to Poor Performance in Biology at the Senior Secondary School level. This Underperformance/Underachievement is evident in (Table 1.1), where Senior Secondary School Certificate Examination (SSCE) results of Schools in Kaduna State from 2008 to 2012 are outlined below. This Examination results released revealed that there were poor performance of students in Biology especially in 2011 only 41% of the 78,616 candidates that sat for the WASSCE. May/June passed the examinations. The remaining 57% Failed, of those that sat for the Examination.

Table 1.1: Analysis of SSCE result of science subject in Kaduna state between 2008 - 2012

Year	Subject	Total no of candidates that sat	No of passes	% passes at credit level and above	%passes of P7 & P8	%failure
2008	Biology	53946	17378	32.21	1.74	65.85
	chemistry	18039	6493	35.99	1.89	62.12
	Physics	17954	8122	45.23	1.85	52.90
2009	Biology	54729	16765	30.63	1.88	67.49
	chemistry	19129	9522	49.77	1.72	48.51
	Physics	19129	9522	49.77	1.71	48.52
2010	Biology	63361	33015	52.10	1.58	46.32
	chemistry	23190	1188	61.18	2.26	36.56
	Physics	23116	15077	65.22	2.14	32.64
2011	Biology	78616	32,474	41.31	1.59	57.10
	chemistry	30,933	17,752	57.38	1.61	41.01
	Physics	30810	12902	41.87	1.73	56.40
2012	Biology	91646	33,549	36.60	1.83	61.57
	chemistry	37,347	17,062	45.68	1.39	52.93
	Physics	37257	27460	73.70	1.36	24.94

Source: WAEC Office, Lagos (2014)

The need and importance of biology as a subject cuts across all aspects of human life. Biology is one of the three Science Subjects in Nigerian Educational Curriculum. It is the study of living things and how they interact with one another, and their environments. For students to function proficiently in biology and effectively in the modern society, then attention has to be given to the Secondary School Biology education, which plays a prominent role in the future careers of students (Amoo & Rahman, 2004).

Academic Performance according to Njoku (2013) is the measure of what a Learner has comprehended over a period of time during the Teaching-Learning Process. Performance is the Sum total of the number of Tests given. Level of performance is attained after being examined on a number of given Tests. Such tests are given after series of instruction and

training. This poor performance of students in Biology is of major concern to all and especially those on the mainstreams of science Education in Nigeria (James, 2000). Several factors that led to poor performance in Biology at Senior Secondary School have been researched by various authors, among them was Nwosu (2004) who studied biology students and found out that teaching strategy can also influence the performance of students, positively or negatively. Examination result released from 2008 to 2012 by WAEC revealed that there were poor performance of students especially in 2011 only 41% of the 78,616 candidates that sat for the WASCE May/June passed the examinations. The remaining 57% failed, of those that sat for the examination. (See Table 1.1). Isah (2011) observed that many science students experience difficulty in science courses due to lack of understanding of the method and process of science.

Attitude is a way of feeling, thinking or behaving. Pearson (2003) reported that attitude is a way of feeling, thinking or behaving towards a particular thing. Once the attitude of a student is known, suitable instructional materials can be devised to meet the interest of the student. In this study therefore, attitude deals with the interest, aspiration and behavior exhibited by secondary school students towards the studying and learning of biology. Positive attitude is described as interest which influences choice of subject, particular activities or areas in a given subject area. Attitudes have both perceptual and affective components. A child may acquire certain attitudes about a particular subject through the parents, teachers and adults.

Gender is another variable in this study. Gender is the state of being male or female (with reference to social or cultural differences). The role of gender in academic Performance has led a lot of Researchers to carry out studies on it. According to Ezeliora (2004), gender difference in science can be attributed to the fact that, from birth the girl child is exposed to avoid science. The societal set up did not give her the opportunity to experience the

environment which is the pre-requisite to learning of science; rather, she is kept in doors to do the house work, while her brother is left, to explore the environment. Several Studies have shown that one of the variables affecting learning in general and Science in particular is gender. According to Ishaya (2003), they stated that females are not only under-represented in science but their levels of achievement in Science and Technology is low compared to their male counterpart. Evidence

Evidence of gender differences in science (See appendix ix, Table 4 item 1.3.3) Gender balance in Chief examiner's reports. From 2009-2013, percentages of females to male, are 62.8, 59.6, 57.8, 57.3 and 55.5 while for males they are 37.2, 40.4, 42.2, 42.7 and 44.5. That is to say, that females are enrolling in larger numbers in science than males. In 2011 females performed better than males with more ABC grades of 61.8% while male was 55.5% failure for females. For females, 3.0 and for males it was 4.7 (Chief Examiner's Report, 2011 Table 10). i.e. comparison of Achievement by lettered grade between female and male students.

It is therefore based on this, the study attempts to use the effects of Simulation game Strategy to investigate if Attitude and Performance in Biology among Senior Secondary Schools, has any gender difference.

The desire to improve science through more effective instructional strategies and the increasing awareness in recent years of learner- centeredness has led to selecting other teaching methods like Simulation games strategy and Lecture Method for study on their effectiveness. Meaningful learning and teaching of scientific and technological development needed can be enhanced as stipulated in the National Policy on Education (FRN, 2013). The objective of National Policy on Education will not be achieved as desired if appropriate methods are not employed in the teaching and learning of scientific concepts at various levels of Education.

Simulation games strategy is one of the activities – based strategies of teaching science. Simulation means to imitate something or someone. Ahmed (2009) defines simulation game as a way little children imitate the way elders behave and perform their responsibilities in actual life situations. The most powerful method of learning is through the learning by doing approach, also known as the experiential learning Novak (2000). Experiential learning increases Attitude, Performance and Retention, it motivates Students to learn and also encourage group cooperation.

In this Study, the use of Microorganisms which is a branch in Biology, would probe the Knowledge of the learner and the level of their organization, and also to see why there are failures in this concept at the SSCE Level, See chief Examiner's Report (appendix Xi Table 3.1 Section c). At this point, it is therefore necessary to look into the attitudes of students as it affected their academic Performance.

An acronym VIBAPROFA coined from Virus (VI), Bacteria (BA), protozoa (PRO), Fungi (F), and algae (A); was done for the purpose of this simulation game, and was operated using the cyclic model and simulation process (Chapter three). This was used for the treatment of the experimental group.

The acronym coined from Virus (VI), Bacteria (BA), Protozoa (PRO) Fungi (F), Algae (A) is defined below as follows:-

Virus (VI)

Michael (2005) defines virus as microorganisms that are too tiny to be seen with an ordinary microscope except with the use of electron microscopes. They are the simplest and the smallest microorganism which do not have a cell structure. Some are rod-like in shape while others are spherical.

Bacteria (BA)

These are microorganisms that can be seen with light microscope. They occur in clusters and colonies. A bacterium has a shiny capsule, cell wall, a cell membrane dense cytoplasmic granules with no clear nucleus, but has a nuclear material called DNA (Deoxyribose Nuclear Acid which spreads throughout the cell, according to Michael (2005).

Protozoa (PRO)

Michael (2005) defines Protozoa as the Microorganisms that are microscopic and free-living unicellular animals, e.g Amoeba and Paramecium. Some are Parasites e.g Trypanosomes which cause Trypanosomiasis and Plasmodium which cause Malaria fever.

Fungi (F)

According to Michael (2005). These are saprophytic or parasitic non green plants. The saprophytic fungi cause different types of diseases. Wikipedia (2005) has it that fungi or fungus is any member of a large group of Eukarotic organisms that includes microorganisms such as Yeasts and Moulds as well as most Mushrooms

Algae (A).

Algae are microscopic green plants with the majority mainly found in aquatic environment e.g. diatoms, spirogyra, volvox, chlamydomonas etc. Michael (2005). According to Wikipedia (2014) there is no generally accepted definition of algae. One definition is that algae “have chlorophyll as their primary photosynthetic pigment and lack a sterile covering of cells around their reproductive cells.

The above acronym was used for the treatment of the Experimental group. Gender is under-represented and also has under achievement of girls in Science and Science related Courses (Lawal 2009). According to Nnachi (2002), Positive Attitude of Student towards Science affect their academic achievement. Olorukooba (2001) reported that Students taught using Cooperative learning Strategy had positive attitude to the educational benefits derived

from group work. It is based on this that this Study attempts to investigate if attitude and performance in Microorganism is gender difference when the Students are taught using Simulation games strategy.

1.1.1 Theoretical Framework

The theoretical framework for this study is based on a Constructivist approach. It is an approach that acknowledges a learner's prior experiences, promotes challenging situations and impromptu tangents and supports learning that is imaginative and creative Kalm (1999) in Abdullahi (2013). Constructivist view of learning as a process of transformation verses a replacement or mere stacking of one's former knowledge. Bruner (1962)'s theoretical framework, is based on the theme that learners construct new ideas or concepts based upon existing knowledge. Learning is an active process. Facets of the process include selection and transformation of information, decision making, generating hypotheses, making meaning from information and experiences. Bruner's theories emphasize the significance of categorization in learning –“ to perceive is to categorize, to conceptualize is to categorize, to learn is to form categories, to make decisions is to categorize” according to the author interpreting information and experiences by simulative and differences is a key concept. Enlisted below are Bruner's tenets of constructivism for course design: Student come with a world view, their world view acts as a filter to all their experiences and incoming observations, changing a world view takes work, Students learn by doing, when all participants have a voice, construction of new ideas is promoted. Constructivism works best when the learner prepares something for others to see or hear, Sunny (2009) when the learner prepares visuals such as text, graphics, websites, or activities in which another can participant, or endeavors to explain materials to other students, or works in a group context, where learning is especially powerful. In addition to what is stated about learner-

centeredness is the discovery learning, which is a method of Inquiry-based Constructivist Learning.

Theory discovery learning believes that it is best for learners to discover facts and relationships for themselves. According to Bruner (1962), Models that are based upon discovery learning include: Guided discovery, Problem-based learning, Simulation-based learning, Case-based learning, Incidental learning, among others. We can learn by reading, listening and having experiences. The best way for most people to learn is often a combination of all the learning Processes, but with a strong active component. The use of Simulation Game strategy is hinged on this Inquiry-based Constructivist Learning Theory, which is a kind of ‘trial and error’ as a primary source of knowledge acquisition. This study therefore seeks to investigate the effects of simulation games strategy on the attitude and performance on Biology among senior secondary school students.

1.2 Statement of the Problem

Despite the emphasis on the need to teach biology meaningfully, to equip learners with skills and knowledge relevant for national development, the Academic Performance of students at senior secondary school level is still below expectation as reflected in the Senior Secondary Examination (SSCE) Results (Table 1.1). This poor performance of students in Biology, is of major concern to all and especially those on the mainstreams of science education in Nigeria (James, 2000). Several factors that led to poor Performance in Biology at Senior Secondary School have been observed by various authors, among them was Usman (2002), he observed that lack of improvised materials for practical activities and field work contributed to inadequate preparation and poor performance of students in biology. Teaching strategy can also influence the performance of students positively or negatively such as that found in the study of students in Biology by Nwosu (2004). Examination result released in 2008 to 2012 by WAEC revealed that there were poor performance of students in

Biology especially in 2011 only 41% of the 78,616 candidates that sat for the WASSCE. May/June passed the examinations. The remaining 57% Failed, of those that sat for the Examination. Isah (2011) observed that many science students experience difficulty in science courses due to lack of understanding of the method and process of science.

The traditional methods commonly used by teachers do not cater for the individual rates of learning. Adeneye & Adeleye (2011), stated that, Biology teachers need to identify methods that will be suitable for teaching, such methods must make room for individual differences in learning. Simulation game Strategy has been found to enhance performance since it provides for working in small groups, encouraging participation by everyone and exchange of scientific ideas/concepts when students are given instructional materials to work with. This Study therefore, investigated whether Simulation game Strategy would improve significantly or not, the Performance and attitude of students towards Biology at the Senior Secondary Level.

1.3 Objectives of the Study

The objectives of this study are outlined as follows to:

1. determine the effect of Simulation Games Strategy on academic performance of students when taught Microorganism concepts.
2. find out whether there is Change in the Attitude of Students to Biology when taught Microorganisms Concepts using Simulation Games Strategy.
3. determine whether there is difference in mean Score of male and female Students when taught Microorganisms concepts using Simulation Games Strategy.

1.4 Research Questions

1. What is the mean difference between the academic performance of students in microorganism when taught using simulation games strategy and those taught using lecture method?
2. What is the mean difference in the attitude change of students towards Biology, when taught using Simulation Game Strategy and Lecture Method?
3. What is the difference between the Mean Scores of Male and Female Students when taught Microorganisms Concepts using Simulation Games Strategy and those taught using Lecture Method?

1.5 Null Hypotheses

Based on the Research Questions stated the following null hypotheses are formulated for testing at $P \leq 0.05$

- H0₁:** There is no statistically significant difference between the Mean Performance Scores of Students taught Microorganisms Concepts using Simulation games Strategy and those taught using Lecture Method.
- H0₂:** There is no significant differences in Attitude change to Biology between Students taught Microorganism concepts using Simulation Games Strategy and those taught using Lecture method.
- H0₃:** There is no significant difference between the mean Scores of male and Female Students when taught Microorganism Concepts using Simulation Games Strategy and Lecture method.

1.6 Significance of the Study

This Study on theEffect of Simulation Games Strategies on Attitude and Academic Performance in Biology among Secondary School Students. It was hoped that the findings of

this Study would sensitize Biology teachers to address Students misconceptions in Microorganisms concepts.

Curriculum planners could benefit from this study as it would act as a guideline for the development of syllabuses.

Textbook authors could incorporate Simulation Game Strategy as one of the effective teaching strategy in Biology.

Teachers could hopefully use simulation game strategy to be more activity-based while bearing students learning-centredness in mind.

Student Guidance Counsellors could use the study on attitude of students towards Biology to advise science students to keep offering Biology.

The findings in this Study will hopefully add new information to the existing ones

1.7 Basic Assumptions

The following assumptions are made in this study.

1. Simulation games method is appropriate for the Students to impact the Objectives impacting the objectives and contents of the unit selected for the study to themselves.
2. The method of instruction used in teaching microorganisms does not include Simulation games strategy.
3. The students are of average ability in the learning of simulation games strategy.
4. Senior secondary one biology students have a previous Knowledge of the Topic in their junior classes.

1.8 Scope of the Study

The following delimitations were made upon this study.

This study is specifically focused on one of the states in Nigeria, the study is delimited to all SS1 students in the Government owned co-educational secondary schools in Zaria educational zone, Zaria Kaduna state. The total number of students who offered biology

were from only Fourteen Senior secondary schools, and a sample of 153 students in SS1, were used out of the population of 2,005 Students admitted in 2014/2015 academic year. The study was delimited to investigate the effects of Simulation games strategy on the attitude and performance of biology students. The study is delimited to Microorganisms concepts with the following sub-topics: virus, bacteria, protozoa, fungi and algae. The content was found in SS1 first term syllabus, this was chosen because Zaria Educational zone operates a Spiral Curriculum (appendix X).

- The Topic selected for this study was from the School Syllabus of the SS1 Biology Curriculum, so as not to disrupt the School academic program. The Sub-Topics revolved around major concepts of Virus, Bacteria, Protozoa, Fungi and Algae in which the National Biological Science Curriculum has organized. (appendix x). Microorganisms was one of the areas where students were failing Biology in their WAEC and NECO Examinations (Chief Examiner's report, 2013 appendix ix). It is an aspect of Biology which is studied in SS1 and in higher Institution.
- All these Sub-topics fell within the Scheme of Work of the Second term of SS1, because of the Spiral curriculum that is in use in this Zaria Educational Zone.

Microorganisms (microbiology) is perceived as one of the difficult topics in biology (Chief Examiners Report, 2013).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study aims at investigating the effect of simulation games strategy on academic performance and Attitude among Biology students of Zaria Educational zone, Kaduna State.

In this chapter, the review of literature was treated under the following sub-heading.

- History of Science Education in Nigeria
- Biology as a Science Subject in Nigerian Secondary Schools
- Science Teaching Strategies
- Simulation Games Strategy
- Concepts of Simulation Games Strategy in Science Teaching
- Lecture Method of Instruction
- Simulation Games and Attitude
- Simulation Games and Academic Performance
- Attitude and Academic Performance in Biology at SSCE level
- Gender and Academic Performance in Science at SSCE level
- Overview of Similar Studies
- Implications of Literature Reviewed on the Present Study

2.2 History of Science Education in Nigeria

Science can be seen as a body of knowledge, established by specific methods of discovery, and systematized into more or less established laws after careful examination (Bhatia, 2003). It has been observed, that what makes science different from other branches of knowledge is the method of discovery involved (scientific method) and not science as a subject. Science education can be seen as the inculcation of scientific values, attitudes and

method in an individual with the aim of helping the individual to adopt scientific approach to issues, to make him act intelligently and rationally. According to Wikipedia (2014) science education is the field concerned with sharing science contents and processes with individuals not traditionally considered as part of the scientific community. The learners may be children, college students, or adults within the general public. The field of science education includes work in science content, science process, Scientific method, some social science and some teaching pedagogy. The Standards for Science Education provides expectations for the development of understanding for students through the entire course of their Education and beyond. The traditional subjects included in the standards are physical, life, earth, space and human sciences.

Modern Science was established in Nigeria School Curriculum in the 1940s long before this period, traditional objects and processes were based on scientific knowledge, and principles. Indigenous education was in place through some distinguished Nigerian Educators, they identified seven areas of knowledge which existed in the traditional education as traditional technology and production, traditional science and speculation etc. According to Fafunwa (1974), basic science formed the content of the curriculum of traditional science and speculations. They are physics, chemistry and Biology.

The history of modern teaching in Nigeria schools started when the first missionaries entered Nigerian shore in 1843 through Badagry and established the first primary school there, the Methodist Missionary School. In order to propagate their belief that is Christianity, they needed to train the children. Their major interest was to train Evangelists and catechists who would assist them in the Church in spreading the gospel. The missionaries and the colonial rulers delayed the teaching of science because they wanted clerks and interpreters. They were not interested in development. What existed between 1895 and 1920, was the teaching of the biological related courses to secondary schools like CMS grammar school,

Hope Weddell Training Institute Calabar, Baptist Training College, Ogbomosho. For a very long time, nature studies took the place of science in primary schools in Nigeria.

According to Fafunwa(1974) and Abdullazeez (2011), around 1920, Science teaching was given a boost. In 1960s, there was a worldwide review of the philosophy of science teaching in schools. Many science curriculum Programme were developed for use in both primary and secondary levels. UNESCO/UNICEF and World Bank are working on a continuous basis to make science education, achieve the objectives spelt out by the Federal Government for the Nigerian Child.

According to National Policy on Education (2004) science education shall emphasize the teaching and learning of science process and principles. The goal of science education shall be, to: (i) cultivate inquiry, knowing and rational mind, for the conduct of a good life and democracy (ii) produce scientists for national development (iii) service studies in technology and the cause of technological development (iv) provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life.

Science education has become a subject of concern for a long time and the concern is often centered on the following problems, some of which are inadequate training of teachers , poor attitude of students towards science, inadequate laboratory facilities, poor, teaching methods, lack of instructional materials, inadequate qualified science teacher, poor performance of students among others (Ogumogu, 2011).

At the Secondary School level of Education, Performance in biology has been Poor over the years. Thus, there is the urgent need to direct our efforts to improve the teaching of Biology in Secondary Schools. Students, teachers and the general public are those who stand to benefit from the effectiveness of teaching of Biology.

2.3 Biology as a Science Subject in Nigerian Secondary Schools

As a science subject, Biology at senior secondary school level is often regarded as a “soft” option; which has led to the explanation of the relatively larger number of students enrolment in Biology. Biology is the study of plants and animals, as a core subject for many science disciplines in post primary institutions in Nigeria, it is designed ultimately to produce educated individuals some of whom may take to biological studies in science professional pursuits while others may not.

The study of biology education benefits an individual in a number of ways as stated by (Obiku in Oboh, 2012).

- It promotes understanding of the relationship of man to his environment.
- It promotes the knowledge of the inter-relationship existing between living and non-living things that abound in the environment.
- It impacts factual knowledge and stimulates scientific reflective thinking in order to produce a better informed individual.
- It inculcates scientific skills and attitudes in individuals. The skills include: the ability to observe, identify problems, ask questions, formulate hypothesis, analyze data, make inferences and predictions.
- Biology, also brings into focus the need to maintain good health such as clean water, clean air good sanitation, balanced diet, and vaccines against infectious diseases, exercise and adequate rest.
- Biology stimulates interest in biologically based hobbies such as growing flowers, collecting insects and thereby encouraging leisure activities for individual enjoyment. Also conservation of plants and animals, for the purpose of tourism and leisure attractions.

According to the above mentioned writers, a good knowledge of these benefits will be of utmost importance to students and create a Positive Attitude of learning in them. Hence, the need for effective study of biology in school should be emphasized.

2.4 Science Teaching Strategies

The teaching and learning of science, gains prominence on daily basis because of the consistent emphasis on science and technology due to its application in industrial development.

In focusing attention on science education, we must address the issue of what really is the problem. Various teaching strategies exist, yet poor teaching and learning of science seems to continue to spread in a wider range. In this case, it may be necessary to examine which of these available teaching strategies are Learner - centered and which ones are teacher - centered and try to explain the implications of these with the backing of some theories of learning. Constructivist views of learning are in consonant with empirical findings, that is Concerning the inadequacy of traditional teaching approaches in developing and changing students' fundamental science understanding" (Tyler et al, 2004).

The diversity of learners and the views expressed in many lecture rooms and classrooms, the science teachers' role need to be different from their "knowing all" in the classroom and more about managing the construction of knowledge between participants (Barbosa et al, 2004). The actual difference is the effective management of constructed knowledge which takes place between one science teacher and another. Some teaching methods involve the learners more than others and sometimes even add meaning to everyday life.

The things that science teachers and lecturers teach will directly or indirectly be used in the Students' lives. It is on this basis that they advocated for teachers' need to look beyond

the ‘utility argument of the subject to enrich lives with an understanding of people and the universe. The exact choice of methods could help to bring this to realization.

Effective teaching and learning can be ensured only when the truly professional and committed teacher has a reservoir of teaching methods/strategies to tap from, with respect to the topic he wants to teach, the nature of the students involved and the objectives to be achieved. All these demand a critical analysis on the part of the teacher because all the methods and techniques have something to offer though, none is best for all the topics Ehiosu (2008).

Strategies for teaching biological sciences in Science Education according to Ehiosu (2008) are as follows, lecture method, discussion method, simulation games method, project method, concept mapping, use of Analogues, tropical study, dramatization, role play and assignment, Laboratory method, Inquiry method, Field Trip/Excursion, demonstration method.

The Strategies for Science and Biology curriculum teaching is problem centered, flexible, and cultural as well as scientifically valid. It is human kind centered, multifaceted, embracing local and community relevance; It uses the natural environment, community resources and students themselves as focus of study information in the curriculum in the context of the students as a person in a cultural /social environment. In these strategies curriculum portrays a more accurate view of the nature of science by explicitly making connection between science and society (ie externalism) as well as the isolated working of science (ieInternalism), according to Yager (1993), The Teaching of Biology and Science in general requires their own syllabus, the units should be from the society concepts, Room should be given for economics, ethical, political issues with science topics. Attention is given to communication skills related to discussing, debating and role playing.

The instruction is student centered, individualized and personalized. The method encourages cooperative work on problem solving and issues. The students are considered as an important ingredient in instruction, and teachers build the students up on students' experience, assuming that the students learn from their own experiences. This means that in a science class students are allowed to learn for themselves with little or nothing for their teachers to do except to guide them on issues involving learners' experiences, questions and especially those relating to their lives.

Discussion Method is a student centered method. According to Agbulu (2002), it is a systematic and organized conversations among students and teachers during class-periods. Empirically, these conversations are purposeful and not casual. It is skillfully planned by the class teacher specifically for achieving a set down objective. The teacher's role is not to dispense or communicate knowledge but to act as a moderator.

Advantages of Discussion method are:-it could be used in introducing a lesson, thus motivating students' activities; it develops positive interpersonal relationship, as students interact with their teacher and with their colleagues for the sake of gaining knowledge from each other; it promotes activities participation and involvement of students in the lesson; it provides students with a sense of confidence through frequent exchange of ideas, between students and their teachers.

Disadvantages of Discussion Method:- it takes a lot of time, it does not allow students who lack knowledge or background of the topic being discussed to participate, so they become bored and uninterested in the lesson, since they are not being carried along; Topic under discussion must be structured in a way that it would catch the attention of the students.

Project Method is employed by science teachers to individualize instruction. Denga (2005) stated that project method is born of a philosophy which holds that concepts are carefully understood through observable consequences and that learning involves direct

contact with things she went further to say that it is a combination of assignment and center of interest.

This method is meant to provide the needs of individual students or sometimes small groups so that those with special abilities have opportunity to express themselves.

Advantages of project Method:-Students are fully involved as it calls for Students experiences. It is students –centered: encouraging creativity; it encourages learning by doing which is a natural approach to learning. It fosters good spirit of co-operation among students as they learn more about the topic or skill; the sense of failure is highly reduced by this method.

Disadvantages of Project Method:-It is time consuming and expensive as it requires many resource materials, it may cause the class to be noisy and clumsy due to Students movement and activities, thereby affecting class control; it is not all the subjects that will adhere to this method.

Laboratory Methodis method involves activities being carried out by an individual or group for the purpose of making personal observations of process, products or events. Laboratory method works in teaching manual skills and with increasing the understanding.

Labouratory skills according to Ehiosu (2008) involves techniques such as preparing and preserving sections of animals and plants tissues, together with the use of equipment such as microscope e.t.c. can be used to learn well in a suitable design laboratory class

Advantages of Laboratory Method:-Students learn better knowledge longer because of their practical involvement. The involvement of the students generates interest on the topic being treated. The problem leads to problem –solving.

Field Trips/ Excursionmethod is one of the best ways to concretize instruction that is to take the students out and show them things. Field trip satisfies that type of educational experience. Students may be taken to zoo, to the factory to see ecological problems, to gather

specimen or visit a monument or the site of a battle. Trips such as these, produce the most beneficial educative experience and meaningful learning as well as to lead increased motivation. These must be carefully planned.

Discovery Method, according to Bruner (1962), discovery is an inquiry-based, constructivist learning theory that takes place in problem solving situations where the Learner uses his or her own experience and existing knowledge to discover facts and relationships and new facts are learnt. Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies (brainstorming) and performing experiment. As a result of this students may be more likely to remember concepts and knowledge discovered on their own (on contrast to the Transmissionist model. Models that are based on discovery are learning problem-based learning, case-based learning, simulation based learning, case-based learning, and incidental learning among others.

Advantages of Discovery Method:-It encourages active engagement; promotes motivation; promoted autonomy, responsibility and independence; the development of creativity and problem solving skills; a tailored learning experience.

Disadvantages:-It creates cognitive overload; potential misconceptions are made; teachers may fail to detect misconceptions and problems.

Concept Mapping is a diagram showing relationship among concepts. They are graphical tools for organizing and representing knowledge. Ausabel (1968) sees concept maps as being one way of making the structure of that public knowledge more explicit.

Advantages of concept Mapping:- For idea generation design support, communication enhancement, learning enhancement and assessment; it helps in communicating complex ideas and arguments; for enhancing meta cognition (Learning to learn and thinking about knowledge) it helps to draw out knowledge response; it helps for assessing learners

understanding of learning objectives; concepts and the relation among those concepts for vocabulary development.

Disadvantage of Concept mapping method is teacher centered; it does not make room for creating and self-discovery for learners to rationalize and explore; it does not promote excellent and hard work and it lead to mass failure; the method is less interesting and less challenging.

Role Play is a problems-solving method and can be used effectively in inquiry and discovery teaching. Collahan and Clark (1978) Stated that role play is an unrehearsed dramatization where the player tries to clarify a situation by acting out the role of the participants on the situation.

Advantages of Role Play:- To Clarify attitudes and concepts; To demonstrate attitude and concepts; to portray deeper understanding of social situations; to plan and try out strategies for tackling problems; practice leadership and other skills; to test hypothetical solutions to problems.

From all these methods of teaching that have been discussed the researcher used the discovery approach and play role for this study, as the exact experience of hands-on, minds on activities which encourage higher level learning in problem solving situation like micro-organisms concepts.

2.4.1 Simulation Games Strategy

Simulation Games is a game-based strategy that can be used for teaching and learning at any level of education. Simulation games in the classroom are used to copy what is found in real life situations according to Encisco (2001), Simulation game is defined as an activity that works, fully or partially, on the basis of players' decision, simulation is an excellent supplement to lecture.

According to Cruickshank (1980)in Akinsola (2007), simulation is the product that results when one creates the appearance or effect of something else. They considered Games as contests in which players and opponents operate under rules to gain specified objectives. Generally, simulation employs selected aspects of a real life situation. The usefulness of simulation and games in teaching cannot be undermined mere teaching of the students using topics in the class may not be enough to achieve the desired mastery of the subject matter. Adelakun (1997) says innovation like games played in the class and outside the classroom could improve the mastery of a topic. She says that teachers should not limit themselves to the traditional method of teaching the students alone, but they should accompany their teaching methods with innovative system such as playing of games during instructional delivery. Hall(1977) andObeka, (2009) in their analogy of simulation game, categorized game as subset of activities with special characteristics within the wider context of simulation as illustrated in Figure 2.1.

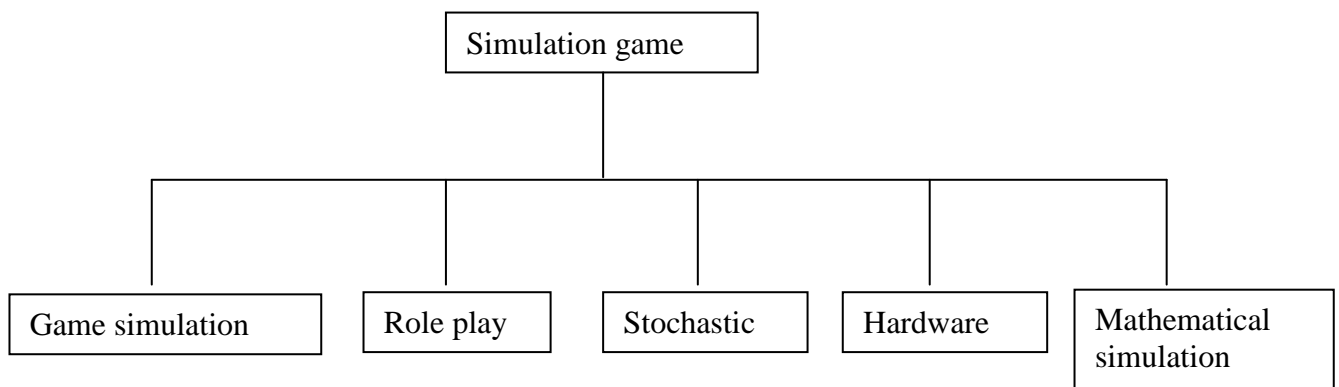


Fig. 2.1: Characteristics of Simulation Games

Source: (Obeka, 2009)

Explanations of the above diagram are seen below:

Game Simulation: refers to the context (play) among adversaries operating under constraints (rules for an objective winner)

Role play: Here implies part of one of the individual groups with organization in simulated environment. It resembles something else.

Stochastic: On the other hand is an operation model, which allows for the working of chance or luck as in the game of monopoly.

Hardware: here refers to computer model showing a reproduction of an aspect of game simulated.

Mathematical simulation: Refers to the deterministic mathematical model.

An example of a model is the researcher's model, VIBAPROFA cyclic model, the acronym represents the following: virus (VI), Bacteria (BA), protozoa (PRO), fungi (F), and Algae (A). It can be seen from (Fig. 3.2), that those alphabets represent some microorganisms

According to Ahmed (2009), the following steps are taken when using simulation games.

- In planning to use simulation games, the first thing the teacher should do is to learn to play the game.
- The teacher must decide on the groupings of the pupils for the game. Equally he has to decide on the sitting arrangement.
- The class should be taught how to handle the games materials, so that they are not ruined. Equally, he should announce the general rules and regulations to the class in order to prevent quarrels emanating from competitors.
- In introducing the game the teacher should make a brief explanation about the rules of the game.
- He should make sure the pupils understand the rules and the language of the game before playing.
- He should first of all play the game with some students, he had already taught for the introduction in front of the class.

- If there are enough copies of the game materials, each group should have one material to play.
- The teacher should go round the class and guide the students as necessary.
- The teacher should call the attention of the class to common problems noticed. He should explain to them as necessary.
- In conclusion, the class meets to discuss their opinions, learning and questions at the end of the period.

Ahmed (2009) also stated the following as the play method

For drama – type plays:

- The play must be simple and straight forward particularly in primary classes
- It should not be too long, choose the actors. Make sure you have two or three students for each character
- The speeches may be memorized or read from pieces of paper.
- The location of the stage in the class room must be a point where all the students can see the play and hear the speakers.
- The important points which the teacher would want the students to understand must be given prominence.
- The discussion session must be used to end the play. During the period, the points to be noted should be reemphasized.
- The objectives of the play activities must be made clear.
- The students should be given the necessary materials.
- The students should be guided.
- The teacher should draw the attention of the students to the points of importance.

Advantages and Disadvantages of Simulation and Games according to Spicer and Obeka (2006), are written below-

Advantages

They stated the following advantages of simulation games;

They help students to achieve specific learning objectives in an active rather than passive manner, they extend the learners experience. They build up the student's interest for the subject of study.

They also provide opportunity for social interaction amongst students and enhance team work.

Disadvantages

According to them, there are numerous disadvantages as seen below:

It is difficult to prepare, it involves group activity, and it is confusing. It is time consuming,

It is expensive and complex to handle in a classroom and learning environment.

2.4.2 Concepts in Simulation Games Teaching in Science

This is an acronym coined from virus (vi), bacteria (Ba), protozoa (PRO) Fungi (F), Algae (A)

Virus (VI)

Michael (2005) defines virus as microorganisms that are too tiny to be seen with an ordinary microscope except with the use of electron microscopes. They are the simplest and the smallest microorganism which do not have a cell structure. Some are rod-like in shape while others are spherical. According to Wikipedia (2005), Virus is a Parasitic Agent that is smaller than a Bacterium and that can only reproduce after infecting a host cell. The different groups of virus are DNA and RNA viruses others are enveloped or without envelope. Examples of viruses are Adenovirus, Picornavirus, Togavirus and coronavirus.

Bacteria (BA)

These are microorganisms that can be seen with light microscope. They occur in clusters or colonies. A bacterium has a shiny capsule, cell wall, a cell membrane, dense cytoplasmic granules with no clear nucleus, but has a nuclear material called DNA (Deoxyribose Nuclear Acid which spreads throughout the cell, according to Michael (2005).

Protozoa (Pro)

Michael (2005) defines Protozoa as the Microorganisms that are microscopic and free-living unicellular animals, e.g. Amoeba and Paramecium. Some are Parasites e.g. Trypanosomes which cause Trypanosomiasis and Plasmodium which cause Malaria fever.

Fungi (F)

According to Michael (2005). These are saprophytic or parasitic non green plants. The saprophytic fungi cause different types of diseases. Wikipedia (2005) has it that fungi or fungus is any member of a large group of Eukaryotic organisms that includes microorganisms such as Yeasts and Moulds as well as most Mushrooms.

Algae (A)

Algae are microscopic green plants with the majority mainly found in aquatic environment e.g. diatoms, Spirogyra, Volvox, Chlamydomonas etc. Michael (2005). According to Wikipedia (2014) there is no generally accepted definition of algae. One definition is that algae "have chlorophyll as their primary photosynthetic pigment and lack a sterile covering of cells around their reproductive cells.

This acronym VIBAPROFA coined from Virus (VI), Bacteria (BA), protozoa (PRO), Fungus (F), and algae (A); was done for the purpose of this simulation game. It was operated using the cyclic model and simulation process (Fig. 3.2 & 3.3) respectively. This was used for the treatment of the experimental group.

2.4.3 Lecture Method

The conventional lecture method is a traditional talk-chalk method of teaching in which the teacher does most of the talk, while the students, listen and take down notes. The lecture method which is also known as Expository Approach is the oldest approach in our schools for teaching both Science and Art subjects according, to Agbulu (2002). The Expository Approach derives its principle from the commonly held notion that in the Teachers - Students relationship, the teacher as an embodiment of knowledge gives out what he knows to his students. The teacher makes practically all the decisions, the mode of instruction, organization of learning experience and materials; sequence; pacing and style of information dissemination. Teachers is therefore, the Expositor and Actor, while the students are Listeners, speaking only when called upon to answer questions, ask questions or demonstrate a procedure.

Ezuedu&Agwagah (1996) described lecture method as a teacher centered method. According to these authors, the following advantages and disadvantages are associated with lecture method.

Advantages

Is saves time; it does not task the students thus it is less tedious; it provides fascinating and aesthetically stimulating experience especially for the new students on topics of interest, it uses cheap and limited apparatus. It encourages note taking among Students.

Disadvantages

It is teacher centered; it views the students as a “tabular rasa” clean slate with nothing to offer. It is dull and less challenging; the method does not create opportunity for creativity and self-discovery for learners to rationalize and explore; the method does not promote excellence and hard work, thus it leads to failure. The technique is instruction-centered and does not challenge the Teachers’ ability hence, teacher could be ill prepared.

Lecture method therefore is a chalk method, teacher- centered and a traditional Ancient approach, which did not promote creativity and academic excellence, thus a need to view others strategies of teaching towards promoting academic excellence in Biology and Science Education. This method will be used to teach the control group, as it the most widely used method of teaching by most teachers of secondary schools.

2.5.1 Simulation Games and Attitude

Instructional strategies adopted by the teachers could influence the cognitive, affective and psychomotor outcomes of the learner, many of the professional teachers do not use appropriate teaching method and teaching aids in the classroom that can stimulate students. Some use sterile and uninspiring methods (Obodo, 2004).

Amoo (2002) found out that students display poor performance, due to lack of interest. Imoko and Agwagah (2006) asserted that the adoption of relevant instructional strategies will enhance meaningful learning and interpretation in Biology. With this in mind, teaching strategies with a lot of activities such as simulation games, plus others that appears attractive to young learners, especially those that could improve attitude in learning should be called for attention.

Despite the roles played by science in the society some students still display negative attitude towards the study of science (Yara, 2009). This has been attributed to the difficulty in some concepts and abstracts nature of some topics in Science (Okoye&Nwakonobi, 2011).

2.5.2 Simulation and Academic Performance

Simulation according to the encyclopedia of education, is an operating model reproduction or limitation of physical and social phenomena consisting of a set of interrelated factors of variables, which function in essentially the same manner as the actual objects. The poor performance of students in secondary schools and in their SSCE and other external examinations has been attracting the attention of many educational researchers.

One of the ways of improving the prevailing problem of low academic performance of in science is that of enriching its contents, methods and strategies of teaching and learning (Onwuakpa&Nweke, 2000). Essentially, the overall academic performance in the science among secondary school students raises doubts on the efficiency of the teaching methods utilized by teachers in schools Ebere (2006).

The persistent poor performance of students at both external examinations in science subject, has given rise to an assumption that most science teachers in secondary schools in Nigeria do not make use of the various forms of teaching strategies to enable them cope with some specific difficulties associated with teaching sciences.

Anchor and Ogbeda (2010).Stated that one of the factors responsible for this poor performance is the inappropriate teaching methods often employed by science teachers in the secondary schools.

2.6 Attitude and Academic Performance in Biology

There are various meanings expressed by many authors on the term “Attitude” according to Willis (2002), asserted that attitude is the way we think, act and feel. He claimed that “we create our own lives with our ideas and action, and they can lead to great success or to frustration and failures”. In view of the above meanings of attitude, whatever performance a student attains in life correlates with the type of attitude he/she has.

Myers (1998)&Oboh (2012) stated that differences in attitudes can be expected with differences is age, sex, socio economic status, cultural and experiential back ground. It was further stated by them that attitude tends to develop incidentally, gradually and unconsciously. Anything that goes on, in the classroom as it affects the child leads to the formation of certain attitudes. One may ask this question ‘whether’ or not these attitudes have any significant effect on academic performance in biology among senior secondary school students.

According to Kadala (2013) stated that Attitude generally, plays a very important role on effective teaching and learning in performance. Attitude could be positive or negative, and each has an impact on teaching and learning effectiveness. It is commonly assumed that positive attitude by Students help in no small measure in bringing about high performance in science. Negative attitude on the contrary could lead to low expectation on student's academic Performance. Teaching strategies can also influence the attitude of students positively or negatively. Reports have shown that improved instructional strategy affects the attitude of students positively. Olorukooba (2001), reported that students taught using cooperative learning strategy had positive attitude to the educational benefits derived from group work. Therefore a strategy that would build confidence in the students and place the student in the central position in the learning and teaching Program will go a long way in enhancing desirable outcomes on the educational process

The factors that affect student's positive attitude to science are mentioned as follows – “social climate in the classroom, availability of text books, teaching aids, laboratory equipment, beliefs and superstition”. At this juncture, one may say that a lot is expected by the teacher to ensure that positive attitude towards science are formed by his students. The science teacher also plays an important role in mediating in between the effects of learning environment on Students' attitudes towards science. Augustina (2004), in her address to the youth in the punch, newspaper stated that “your Attitude determines your Altitude” that is to say that you cannot get higher than you think, so why not think higher? Therefore, no Positive Attitudes, no high Academic Performance in students' learning.

In Education, the assessment and measurement of an individual's academic Performance is his /her Academic Achievement. According to Pearson (2003) Achievement is something important that one succeeds in doing by his own efforts. James (2000), stated that Academic Performance really involves knowledge and how much a student has learnt a

Subject. One way by which this can be determined is with the use of Performance test. Performance test can give student an indication of his progress and acts as a reward for his effort or as a spurs against under performance, it also indicates to the students the importance placed on the things taught by the Teacher. Anthony (1983), in his study on attitude of Nigerian Secondary School Students towards school and their Academic Performance specifically on Physics, Chemistry and Biology revealed that students with Negative attitude to science (Biology) achieved relatively low in the mean scores. In this study, BAQ (Biology Attitude Questionnaire) was used for measuring the difference in the attitude of students toward Biology. While Microorganism Performance Test was used to measure the Performance of the students in Biology (microorganisms).

2.7 Gender and Academic Performance in Science

Studies have shown that one of the variables affecting learning in general and Science in particular is gender. One of the studies on gender and academic performance among them was the study Usman (2000) under took, on the effect of practical activities on performance in integrated Science in Nigeria. He asserted that boys performed better than girls when exposed to the same practical activities in integrated science. Yoloje (2004) stated that if equal opportunities are given to both boys and girls, they will perform equally well. Light-body (2002) stated that research studies have shown that boys and girls show similar achievement levels in mathematics and science until sixth grade, at this point gender gap appears as girls' attitudes and performance towards science. Mari (2005) investigated the reason behind gender difference in Chemistry performance. Obeka (2009) stated that with simulation game strategy, learning is enhanced for both male and female. Nwosu (2001) suggested that gender-stereotyping has to be discouraged in homes, schools, societies to enable girls participate freely in the learning of science. Bichi (2008) observed that girls performed better than boys in problem-solving type of activities. Ishaya (2003) stated that

females are not only under-represented in Science but their level of academic achievement in science and technology is low compared to the males. According to Chief Examiner's report (Table 7, appendixix), Female Students consistently receive more credit passes in Biology than their male counterpart in the year 2009 to 2013. In this present study, the main objectives is to determine whether gender has any influence on attitude of students in Biology as it reflects to their performance at senior secondary school level or not.

2.8 Overview of Similar Studies

Some related studies have investigated Students attitudes to science as it enhances meaningful learning in students and high academic achievement.

The studies viewed below are relevant to this study. Akinsola and Animasahun (2007) studied the effect of simulation games environment on students' achievements and attitude to Mathematics in secondary schools. A sample of 147 SS II students from two schools in Ila-Orangun LGA of Osun State. Instruments used were Achievement Test and Attitude Questionnaire. The research design used was quasi-experimental. t-test and Analysis of Variance statistical tool were used to analyze the data collected for the study. The finding revealed that the use of simulation games environment led to improved achievement and positive attitude towards Mathematics.

Obeka (2009) investigated the effect of simulation game on students' Achievement on geography in Oturkpo, Benue State. He made use of 492 students from SSII Geography who were sampled from four Schools, were used. The instruments used were Environmental Problem Achievement Test (EPAT) and Environmental Problem Interest Inventory (EPII). Design used was quasi-experimental control. Statistical tools used were ANCOVA and MCA (Multiple Classification Analysis) and Scheffe's test. The result of the study indicated that those taught with Simulation games performed better than those taught with lecture method.

This study is similar to the present study, though the study is on Biology and the location is in Zaria.

Ajai (2013) Effects of Games and Simulation Teaching Strategy on Students Academic achievement and Interest in Geometry at the senior secondary school in Gwer Local Government Area of Benue state. Pretest-posttest quasi experimental design was used, 287 SS1 Students from 6 Schools were randomly sampled. The Instruments used were Geometry Achievement Test (GAT) and Geometry Interest Inventory (GII). Statistical tool used was Analysis of Covariance (ANCOVA) to test for the hypothesis. The findings showed that Games Simulation increased students' achievement and Interest in Geometry than the conventional method. This study is similar to the present study in teaching method. The present study is on performance and attitude on Biology, Zaria in Kaduna State.

Adigwe and Okonkwor (2013) Studied Effects of Concept Map and Simulation Games Instructional Approaches on Students' Achievement in Environmental Concepts in Chemistry, among Secondary School Students. 467 subjects from SS2 Chemistry were sampled for the study. Instruments used were Environmental Concept Achievement Test (ECAT). Research design used was pretest-Posttest quasi non-equivalent experimental control. Statistical tools used were ANCOVA and MCA using Scheffe's test. The result revealed that there is no significant instructional effect of teaching strategy on gender.

Mahmud and Usman (2010) studied the effect of discovery method of instruction on gender and academic achievement in genetics among N.C.E students of Federal College of Education Zaria and Kano. 200 students were sampled, 100 subjects from each groups (experimental-discovery and control group-lecture method). Instrument used were Genetics Achievement Test (GAT). Research design used was Pretest-Posttest quasi-experimental control group design. Statistical tool used t-test. The findings of the study showed that

discovery method favored both male and female N.C.E. students, indicating that it is gender friendly.

Mari (2011) investigated the effects of process-based instruction on acquisition of formal reasoning ability in male and female subjects. 38 SSII Chemistry Students were randomly selected from a secondary school in Kaduna state. Instrument used was Assessment of Logical Thinking Test (GALT). Research design used was Pretest-Posttest design. The data was analyzed using t-test statistical tool. The results showed that male and female subjects do not differ significantly in performance after instruction, with Process-based Approach.

Kadala (2013) Effects of Concept Mapping and Project Based Teaching Strategies on Junior Secondary School Students' Achievement and Attitude towards Geometric Concepts in Adamawa State. 351 students of JSS II were sample for the study. Quasi-experimental design was used for the study. Instruments used were Geometry Achievement Test (GAT) and Geometry Attitude Questionnaire (GAQ). Statistical tools used were ANOVA and Scheffe's post hoc. The result showed that there was a positive change of Attitude towards Geometry after treatment with the Instructional Strategies.

Mohammed (2008) studied on effects of science-technology-society instructional strategy on the academic achievement and attitude of students in integrated science at junior secondary school level in Kaduna state. 60 subjects were sampled from Junior Secondary Schools. Integrated Science Achievement Test (IAT) and Integrated Science Attitude Questionnaire (IAQ). Research design used was quasi-experimental control group. t-test for achievement scores and Mann Whitney U-test for Attitude Questionnaire Scores. The result showed that the use of STS instructional strategy significantly improved the attitude of students towards integrated science.

According to Akubuiro & Joshua (2004) who looked into "self-concept, attitude and achievement of secondary school students in science, in southern Cross River State,

Nigeria". The purpose of their study is to determine whether students' attitude toward science can be used to predict Students academic performance in the subject. Random sampling technique was used to select five local government areas. Senior secondary three (SS3) students were used with the total population of four hundred and eighty-three from a total enrollment of six thousand, eight hundred and ninety-four (6894) students. The two instruments utilized in the study were 40-items objective achievement test in physics and chemistry and 60-items questionnaires to measure self-concept and attitude. The results of the study showed that students attitude towards science subject is a very important factor in achievement in science.

The above studies did not investigate the effect of simulation games strategy on SS one Students academic performance and attitude towards Biology. Some of the studies in science in general, focused on fifth and sixth grade students. The above findings will however provide good bases for comparison with the result of this study.

2.9 Implication of Literature on the Present Study

The related Literature reviewed on the area of simulation games strategy using different models have the following implications for this study:

Most of the study cited showed that subjects taught with simulation games strategy had higher academic achievement when compared with those taught using lecture method of instruction. It is in the light of the above that the researcher considered it necessary to help the students learn biology using simulation games strategy. It is hoped that by using VIBAPROFA Simulation Games process which is a simulation Games strategy it will enhance the academic performance of science subjects.

Literature reviewed also revealed that using simulation Game strategy brought about positive attitude of subjects and with no gender difference which brought about higher academic achievement. It was in view of these findings that this study was conducted.

Again the researches done using simulation Game strategy showed that there was improved academic achievements for teaching subjects like chemistry, Geography and Mathematics in Benue, and Osun respectively. They also used SSI and SSII respectively.

It was in the light of these findings that the researcher thought it worth researching to find out if using simulation games strategy will bring about an improved academic performance of secondary school students taught microorganism concepts in Nigeria, especially in Zaria Educational Zone. The uniqueness of the study are as follow. The use of simulation game strategy in teaching microorganism concept on small sub-group using the cyclic simulation game process strategy as a learning strategy for biology students in secondary schools in Nigeria.

ThisStudies on gender have been the comparison of all the performances between the entire male and female students from the two groups of experimental and control. The findings in this study will provide insight into the issues being looked at like performance, attitude and genders. This would determine whether simulation Games strategy is gender friendly to secondary school students or not. Investigations on attitude have been the comparison of the overall attitude of subjects of the experimental and control groups both before and after treatment with the strategy in use. The study on attitude change of subject towards biology using simulation games strategy is not common.

The uniqueness of the study are as follows:

- The use of simulation games strategy on teaching microorganisms' concepts on small sub-group using the cyclic simulation game process strategy as a learning strategy for biology students in secondary schools in Nigeria.
- The use of Flash cardscontaining details on the Topic of discussion for the students to use in the Experimental group.

- The use of Play role to motivate the Students in the Experimental group to learn in order to improve their mean performance scores, improve attitude of students towards Microorganisms and minimize gender difference.

In view of the implication above, it showed that their findings did not investigate the attitude and performance among Biology students in Zaria, Kaduna State, using simulation game strategy. This study therefore investigated the effects of simulation game strategy on Attitude and performance in biology among secondary school students in Zaria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The aim of this study is to investigate the effects of Simulation games strategies on Attitude and Performance among Biology students in SS1. In this chapter, the methods and procedures employed in conducting the research are under the following Sub-headings:-

- Research Design
- Population of the Study
- Sampling and Sampling Techniques
- Instrument for Data Collection
- Validity of Instrument
- Pilot Testing
- Reliability of Instrument
- Administration of Treatment
- Data Collection Procedure
- Procedure for Data Analysis

3.2 Research Design

This study employed a Pretest-Posttest Quasi-experimental Control Group Design as described by Kellinger (1973) and Mohammed (2008). First the Microorganism Performance Test (MOPT)& (BAQ) were used to administer Pretest, to both Experimental and Control Groups. The purpose of the Pretest is to determine if the Experimental and Control Groups were equivalent in the characteristics of interest, in biology before the treatment. This was gotten by subjecting the mean Performance scores of the Pretest of groups, that is for the

Experimental and Control groups to t- test statistical tool in order to determine the equivalence in their level of knowledge and attitude in biology. After that, the experiment group was exposed to the treatment with Simulation Games Teaching Strategy. The Control Group was taught the same selected topic in Biology (Microorganisms) using the Lecture Method. At the end of the treatment, which lasted for four weeks. After that, a posttest was administered to the two groups using the MOPT and BAQ Instruments.

This design was used because of the following advantages as stated byKelingner (1973) and Muhammad (2008).This is a non-random design. It can be used to identify differences between the groups at the beginning of the study.It serves as indicator of gaining understanding and mastery of the selected concepts.It shows whether or not a particular teaching strategy is superior to the other. The assumption in this design is that the uncontrollable events act upon both groups equally so that gain can be attributed to the introduced treatment.

.The design of the study is represented in Figure 3.1

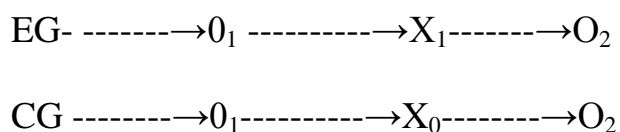


Fig 3.1 Research Design

Key:

CG =Control group [exposed to lecturer method]

EG = Experimental Group (Exposed to Simulation Game)

X₀ = Control Group (Exposed to Lecture method)

X₁ = Experimental (Simulation Game Strategy)

O₁ = Pretest. O₂ = posttest

3.3 Population of the Study

The Population of the study comprised of all SSI biology students of co-educational public schools in Zaria educational zone, Kaduna state. This educational zone had about Fourteen Co-educational Secondary Schools that offered Biology. The total number of subjects in the population is two thousand and five (2005), One thousand three hundred and twenty six (1,326), were males while six hundred and seventy-nine (679) were females. The detail of the Population is presented in Table 3.1.

Table 3.1: Population of the Study

S/N	Name of School	Location	Type of School	Status	Biology students		Total
					Male	Female	
1	GSSS Aminu	Sabongari	Mixed	Public	48	19	67
2	GSSS.	Muchia	Mixed	Public	128	80	208
3	GSSS.	Dinya	Mixed	Public	45	27	72
4	GSSS.	Dakace	Mixed	Public	90	40	130
5	GSSS.	Gyallesu	Mixed	Public	223	82	305
6	GSSS.	Magajiya	Mixed	Public	126	26	152
7	GSSS.	Kaura	Mixed	Public	132	116	248
8	GSSS.	K/kuyanbana	Mixed	Public	185	95	280
9	GSSS.	Yakasai	Mixed	Public	30	04	34
10	GSSS.	Bogari	Mixed	Public	60	31	91
11	GSSS.	Katari	Mixed	Public	79	43	122
12	GSSS.	Muchia	Mixed	Public	40	35	75
13	GSSS.	T/Saibu Snr	Mixed	Public	50	23	73
14	GSSS.	Tudun-Jukun	Mixed	Public	90	58	148
Total					1,326	679	2,005

Source: Zaria educational zone inspectorate division (2015)

Table 3.1 above indicates the number of SS1 biology students in Zaria Educational Zone that enrolled for 2014/2015 examination from the public co-educational schools.

3.4 Sample and Sampling Techniques

Co-educational schools were used for the study in order to take care of the gender issue indicated in chapter one. In order to select the schools from which samples were drawn, representatives from three geographical location (Sabon-Gari, Soba and Zaria). Schools were selected through stratified random sampling by categorizing the schools according to three zones – Zaria City, Soba and SabonGari LGA. Then selections were made using balloting

method. Three schools were selected – GSS Kaura, Aminu GSS and GSS Tudun Saibu. Pre-test was administered to the three schools, the tests were subjected to Analysis of Variance, Pearson’s Correlation (see Appendix VII). There was no significant difference in performance i.e. to show equivalence in the knowledge of Microorganisms concepts.

Through random sampling technique with balloting method, two schools were selected and they were GSS Kaura and Tudun Saibu. Experimental and control groups were randomly assigned to the schools GSS Kaura (80) control group and GSS Tudun Saibu (73) experiment group. The school that was used for control, had three arms of SS 1, one of the intact classes was selected. Intact classes were with a total of 153 subject for which is in line with Franklen and Wallen (2000) is central limit theory that limits a minimum of 30 samples. The details of the sample for this study are presented in Table 3.2.

Table 3.2 shows the two sample schools that were used for this study with Ninety four (94) males and fifty nine (59), a total of (153) subjects.

Table 3.2: Sample for the Study

S/N	Name of school	No of male	No. of Female	Total
1	GSSS. T/Saibu	50	23	73
2	GSSS. Kaura	44	36	80
	Total	94	59	153

Table 3.2 shows the two sample schools that were used for this study with Ninety four (94) males and fifty nine (59) females, a total of (153) subjects.

3.4.1 Selection of Topic to be Taught

The choice of microorganisms was motivated by a number of reasons:

That was part of the National Biological Science Curriculum for SS1.

- The Sub-Topics revolved around major concepts of Virus, Bacteria, Protozoa, Fungi and Algae in which the National Biological Science Curriculum has organized. (appendix xii).
- All these Sub-topics fell within the Scheme of Work of the Second term of SS1, because of the Spiral curriculum that is in use in this Zaria Educational Zone..

Microorganisms (microbiology) is perceived as one of the difficult topics in biology (Chief Examiners Report, 2013).

1. These topics are taught at the senior secondary school and university levels respectively.
2. Microorganisms concept has both academic and social impact

3.5 Instrumentation

This study employed the use of questionnaire and Performance tests as major instruments, for data collection in the research work. They were Microorganisms Performance Test (MOPT) and Biology Attitude Questionnaire (BAQ).

i. Microorganisms Performance Test (MOPT)

The MOPT comprises of 40 multiple choice items were drawn from SSCE/WAEC past Questions from 1988 to 2015, and were validated by two senior Lecturers. These items were used to test subjects in selected Biology Concept Microorganisms. The 40- Multiple choice items were scored one mark for each question, hence it was marked over (40). The Performance test focused on the SS1 Biology Curriculum content on Microorganisms in areas of Virus, Bacteria, Protozoa, Fungi, and Algae. Questions were designed to cover the content units of the five sub-topics selected for the study. (See appendix i). The items measured only objectives in the cognitive domain of the Bloom's (1956) Taxonomy of Educational objectives.

A Table of Specification built by the Researcher was used in generating the MOPT items which guided the design of this instrument. The detailed table of specification ensures representative of each content area in the unit of study (see Table 3.3).

Table 3.3: Table of Specification

	Objective content	Weight	Knowledge	Comprehension	Application	Total
		%	50%	25%	25%	100%
Virus		10	2	1	1	4
Bacteria		10	2	1	1	4
Protozoa		20	3	3	2	8
Fungi		30	5	5	2	12
Algae		30	5	5	2	12
Total		100	17	15	8	40

Source: Obeka(2009)

The weighting was assigned to each content primarily based on the area of coverage, workload and time involved.

ii. Biology Attitude Questionnaire (BAQ)

The Biology Attitude Questionnaire (BAQ) was already validated by its original authors, Ovute&Nworgu (1997). The questionnaire consists of three Sections, Section A consist of introduction, section B consists of six items dealing with personal background of the respondents, (bio-data). Section C consists of 25 items based on positive and negative attitude related factors. This section is based on a five point likert scale with the following responses and scores.

Strongly Agreed (SA)	5
Agreed (A)	4
Undecided (UD)	3
Disagree (D)	2
Strongly disagree (SD)	1

The cut-off point of acceptance used in a five-point scale is 3.50. This is based on real limit of number principle. The mean score of 3.50 and above or below is used to determine the level of acceptance or rejection. The instrument has been adjudged to be particularly suitable for interest rating study in Nigerian secondary schools.

3.5.1 Validity of Instruments

The validation of the instrument (MOPT) took the form of content validation and face validation. The content validation is to ensure that test blue print is strictly adhered to. As for face validation of the test items, this was done by presenting the items to two specialists in the subject, One with the rank of Professor and the other one a senior Lecturer from the Institute of Education and Science Education respectively, all in Ahmadu Bello University Zaria. Their criticisms and observations were incorporated into the modified test items.

Validation of the Lesson Plan

The lesson plan was validated by two experts, one Professor and one senior Lecturer, from the Institution of Education and Science Education respectively, all in Ahmadu Bello University Zaria. They were requested to examine whether:

- i. The lesson plans covered the units of study.
- ii. The lesson objective were clearly stated
- iii. The objectives were appropriated to the students' level.
- iv. Appropriate instructional materials and methods were specified
- v. Students activities were adequate
- vi. Evaluation equated or measured the objectives of the lesson.

The comments of the experts was used to modify the lesson plans in (appendix iv& v).

3.6 Pilot Testing

The instrument, MOPT and BAQ were pilot tested using the students of Govt. Secondary School Dakace Zaria Kaduna State, which was not part of the study sample. The

school had two arms of science and Art classes. Thus the 38 students were randomly selected, comprising of 20 boys and 18 girls which were used for the pilot test. The 40 items instrument of MOPT and BAQ were administered with the assistance of the biology teacher of the school within 40mins each, the main purpose of the pilot test was to find out.

The appropriateness of the instruments in terms of clarity of the items.

The approximate time that will be required by the subjects to complete the test items conveniently.

The reliability of the instrument;

The facility index of the test items.

3.6.1 Reliability of the Instrument

The reliability of the questionnaire has already been determined by its original authors Ovute&Nworgu (1997), using some selected Nigerian secondary schools. The reliability of the instrument was calculated using split-half method of Gutman. Based on the analysis of the scores obtained from the pilot testing of the microorganisms performance test (MOPT), the reliability coefficient for the test was found to be 0.82. While the reliability of the biology attitude questionnaire (BAQ) was 0.75.

3.6.2 Item Analysis of MOPT

This comprises of facility index and discrimination index. The data collected were analyzed to determine the indices of difficulty and discrimination of each of the 40 items. The facility index or difficulty index showed the difficulty level of each item. It measured the percentage of Subjects that got an item right. Facility index of Microorganism Performance Test was determined by using the formula given by Frust (1958) :

$$F = \frac{RU + RL}{N} \times 100$$

Where :

F = Facility index

RU = The number among the upper 27 percent of the subjects who scored the item correctly.

RL = the number among the lower 27 percent of the subjects who scored the item correctly.

N = the total number of respondents in each of the upper and lower groups (not the entire students that sat for the test).

The recommended facility indices according to Frust in Oyebanji (1978) is between 0.3 and 0.7 which is acceptable for achievement test. Between 0.3 and 0.8 facility indices according to Satterly (1986) and Lakpini (2006) is for selecting good test items for achievement test. Items which fell between the range of 0.3 and 0.8 were selected for this study. (appendix VIII).

Discrimination Index

This Index is used to identify high and low achieving students. The discrimination index of test items is its ability to separate or sort out high and low ranking students in a test. Items showing little or no discrimination or items that show a percentage of success in favor of the poor groups should either be eliminated or re-examined for vagueness and ambiguity and such items should be re-worded.

Discrimination index for each item is calculated by subtracting the number of students in the lower group who answered the item correctly from the number in the upper group who got the item right. The figure is divided by half the number of students in both groups or by the number of students in one of the groups.

The discrimination index of the Microorganisms Performance Test (MOPT) was determined

using the formula given by Frust (1958):
$$D = \frac{RU - RL}{1/2N}$$

Where

D = Discrimination index

RU = Number among upper 27 percent of Subjects who scored the item correctly.

RL = Number among the lower 27 percent of the Subject who scored the item correctly.

N = Number of Subjects in each of the upper and lower groups.

Items ranging between 0.3-0.4, are moderately positive Frust (1958). Those with discrimination indices above 0.49 are highly positive, showing that a large proportion of the Students who are more knowledgeable got it correctly more than the poor Students. For this study, the discrimination indices of between 0.3 and 0.8 were selected and those with very low indices were re-worded. (appendix VIII).

3.7 Administration of Treatment

The contact period was for about Six weeks. During the first week, the Researcher familiarizes herself with the Students and Biology Teachers in the two Sampled Schools. Within this Period, the Researcher taught the selected biology topics (Microorganisms) for Six weeks, one week was used for revision of the topics in the Two Schools. After then the administration of the posttest was done. This was done using the same Instrument that was used for Pretest (MOPT & BAQ) The Biology Teachers of the Two Sampled Schools served as Research Assistants who help the Researcher during the Treatment Period. This was done in order not to disrupt the Schools' Timetables. The Experimental Group was taught Microorganisms using the Simulation Game Strategy, while the Control Group was taught the same Biology Concept (Microorganisms) using Lecture Method.

Experimental Group

The experimental group was treated with simulation games strategy, there are about 169 types of simulation games. Among them are those mentioned as follows: cartoon, animation, role playing and games etc. The researcher seeks to employ role play to teach the selected Microorganisms concept. Role play has to do with assigning individual groups with organized parts in simulated environment.

After the validation of instruments, MOPT and BAQ were administered to determine the change in attitude of students and performance on microorganism concepts respectively to the experimental and control groups as pre-test. Treatment was then administered to the groups. The treatment for study is the VIBAPROFA simulation games for the experimental group and lecture method for control group. Based on the control group as assessment scores of the subjects from the school and the pretest result, the experimental group was divided into five groups each. Sub-group comprised of fifteen subjects, except for two of the sub-groups that had 14 subjects each (4 girls and 10 boys) to allow for better interaction between the students within the group and also to take care of the gender issue. The five sub-groups were assigned the names; Virus, Bacteria, Protozoans, Fungi and Algae respectively.

The regular classrooms were used for the lessons. Before the subjects came into the classroom for each lesson for materials needed for the activities for the lesson were placed on their tables. Each lesson started with the subjects going into their appropriate groups. The research assistants introduced the lesson and what the subjects were expected to do. The Vibaprofa simulation package containing explanation of concepts (virus, bacteria, etc) and activities leading to the other stages of the vibaprofa simulation game strategy was given to the subjects. They read and did the activities contained in the package. They also responded to the questions after every activity.

During each lesson, the research assistants moved round the class to encourage group members to help those who had difficulty in understanding and to explain any area of difficulty where no group members was able to be of help to the subjects in the same group. The teaching activities in this package include simulation of Microorganisms concepts by students' interaction in class and discussion/debriefing.

After the Treatment, MOPT and BAQ post-test were administered and collected and marked using the marking scheme in (appendix.ii). Okpala in Obeka (2006), in her work on Power

Simulation designed a Simulation model of ten (10) steps, which the researcher adapted. Treatment with Experimental groups lasted for 40mins. The contact period was for Six weeks, to cover the units of study namely: Virus, Bacteria, Protozoa, Fungi and Algae (VIBAPROFA). Including the period for pretest, revision and posttest. Below is figure 3.2 and 3.3 is the VIBAPROFA Cyclic Simulation and Simulation Process Flow Chart.

The teaching Activities in this Package include Simulation of Microorganism concepts by students' interaction in class, using the following steps:-

- The Researcher uses the Merry-go Round (VIBAPROFA) Cyclic Simulation Model and VIBAPROFA Simulation process (Flow Chart). (See Fig. 3.2 and 3.4)
- Behavioral Objectives
- Introduction
- Presentation:- steps
- Plenary session, group report and discussion
- Debriefing
- Summary and Evaluation
- Assignment

The above stages from the Flow-chart below were used to prepare the Lesson Plan. (See appendix IV and V).

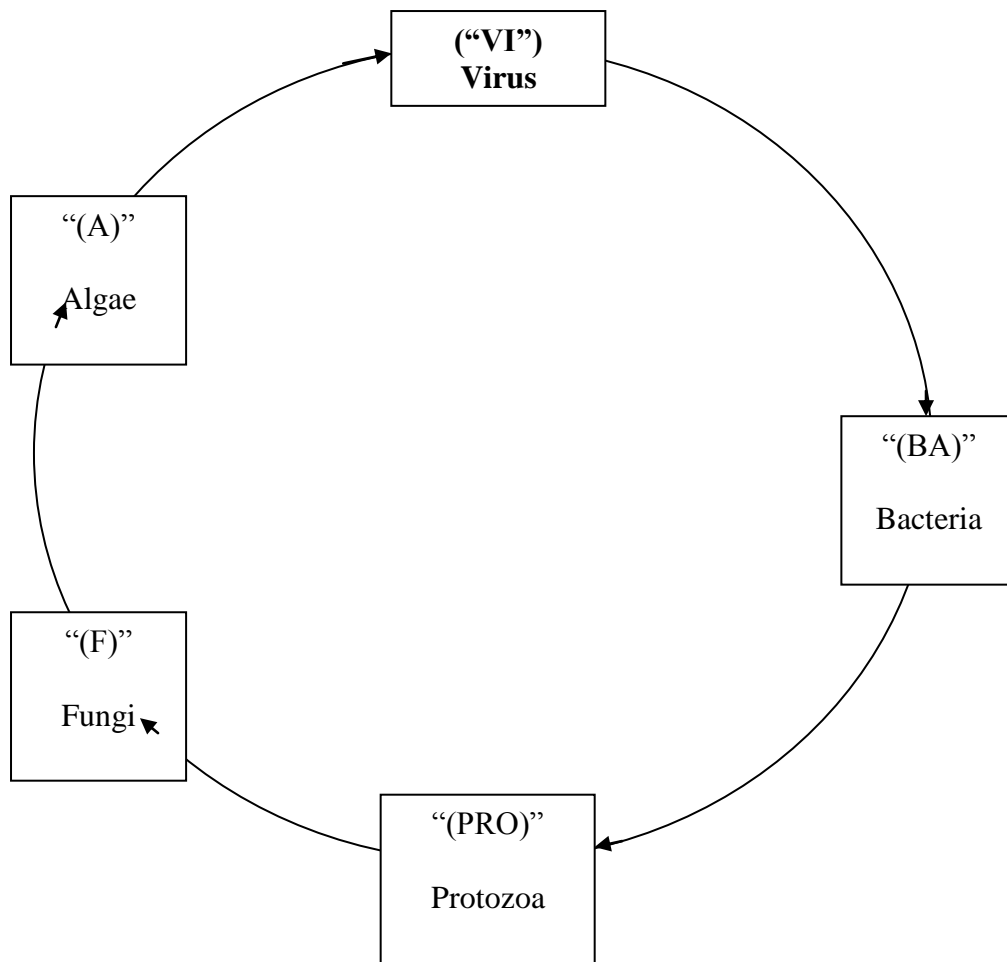


Figure 3.2: The Cyclic Simulation process in VIBAPROFA simulation process:- Merry-Go Round
Source :Adapted from Obeka(2009)

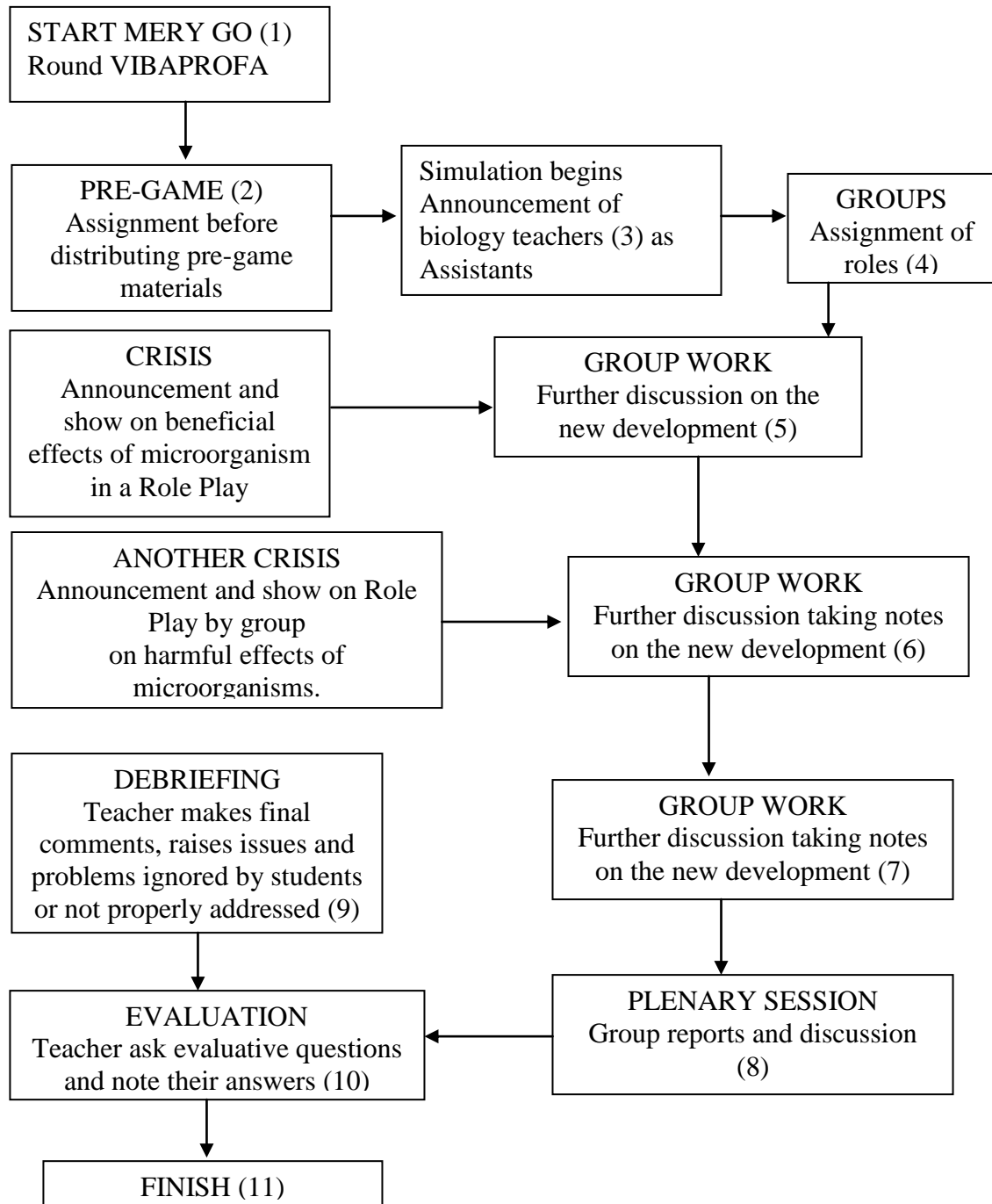


Figure 3.3 Vibaprofa Simulation Process

Source: Adapted from Obeka (2006)

Control Group

The Control group was taught using the lecture method with the following guidelines as in lesson plan (Appendix vii). The Researcher stated the topic of the lesson and the objectives of the Lesson was enumerated and explained. The previous knowledge was reviewed to the subjects. After then, the Researcher presented the Lesson in steps. Important points which the subjects were expected to write down in their note books was copied on the chalk board for them to copy. After that the lesson was concluded by Summarizing the Content of the Lesson. The students were encouraged to read their text books. After every lesson, assignments were given to the students, to be submitted at the beginning of the next lesson. Lesson plans for control group (Lecture method) is presented in (appendix v).

Questions were answered from the students and some questions were asked to them to evaluate their understanding of the lesson. After then, MOPT and BAQ post-test were administered and collected and marked using the marking scheme in (appendix II).

3.8 Data Collection Procedure

The Researcher obtained a letter of introduction from her Department of Science Education in Faculty of Education Ahmadu Bello University Zaria, which she took to the Inspectorate Division of the Ministry of Education, Zaria zone. This was to seek for their approval and permission to allow the Researcher to visit the Schools under her zone. In the first week, the researcher administered the pretest using the MOPT and BAQ instrument. The posttest was administered after the treatments, using the same instrument that was used for the pretest. During the process of administration of the instrument, the Researcher distributed the MOPT and Biology attitude questionnaire (BAQ) items to the study samplesubjects which lasted 40mins each. The Researcher allowed the study subjects to read through the written instructions on how to answer the items of the questionnaire (appendix iii). The instructions were explained to the students verbally and they were allowed to ask questions

for further clarification. It took the subjects about 40 minutes to complete the questionnaire items. In all the schools, the Researcher was assisted by the Biology teachers and Heads of department to ensure the co-operation of the subjects. The Researcher assessed the students by making the MOPT using the marking scheme presented in (appendix II). Scoring 1mark each for 40 multiple questions to give a total of 40 marks.

3.9 Procedure for Data Analysis

The analysis of data collected for the study was done based on data collected. Probability level $p \leq 0.05$ was set for retaining or rejecting the stated hypothesis. The Research Questions were answered using mean and standard deviations. While independent t-test, Kruskai Wallis and Two-way analysis of Variance, were used to analyze the Hypotheses. The stated null hypotheses along with the suitable statistical analysis that were used are as follows:

H₀₁: There is no significant differences in the mean performance scores of students taught microorganisms concepts using simulation games strategy and those taught using lecture method for this hypothesis t-test was used to analyze the post-test scores of both experimental and control group.

H₀₂: There is no significant differences in the attitude change of students when taught microorganisms concepts using simulation games strategy and lecture method. Here, Kruskai Wallis statistical tool was used to analyze the post-test scores of both the experimental and control groups.

H₀₃ : There is no significant differences in the effects of simulation games strategy and lecture method on the mean score of male and female students when taught microorganisms concepts.

t-test was used to analyze the post-test scores of the experimental and control groups. The Null hypothesis was further analyzed using the Two-Way analysis of Variance Statistical tool for Sex (male & female) in both Experimental and Control groups.

The responses on the biology attitude questionnaire (BAQ) which were based on five-point scale of strongly agreed, agreed, undecided, disagreed, and strongly disagreed were assigned numerical values as 5,4,3,2,1 respectively. However negative items were scored in the reverse order. The scores obtained were used to compare Subjects' attitude towards biology both before and after treatment.

CHAPTER FOUR

ANALYSIS OF DATA, RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter consists of Data analysis, Results and Discussion. The analysis involves statistical testing of Research questions and hypotheses which were stated in Chapters one and three. The data collected, were analyzed using the statistical package for the social science (SPSS) computer software. The level of significance adapted is $P \leq 0.05$ which formed the basis for retaining or rejecting each null hypothesis stated.

4.2 Data Analysis and Results

The instruments used for data collection were the following:-

- i. Microorganism Performance Test.
- ii. Biology Attitude Questionnaire.

The data that were obtained in the course of the study were:- Performance scores from the pretest for both the experimental and control groups; Performance scores for the posttest for both experimental and control groups; Attitude Rating scores for the experimental group and the control group before and after the treatment to determine students change in attitude towards Biology. The Data collected for this Study were analyzed based on the Research Questions and Hypotheses formulated.

Research Question One: What is the difference in mean Performance scores of students taught with simulation game strategy (experimental group) and those taught with lecture method (control group).

The descriptive Statistics of mean and standard deviation were used to test this research question and the result is presented in Table 4.1.

Table 4.1: Means and Standard Deviations of Experimental and Control Groups

Variable	N	Mean	Std.dev	Std. Err	MD
Experimental group	73	20.88	2.68	0.31	0.87
Control group	80	20.01	2.65	0.30	

The Table 4.1 above reveals that difference existed in the mean Performance scores of Simulation Game strategy (experimental group) and lecture method (control group), their calculated mean Performance scores were 20.88 and 20.01 respectively. Their Standard Deviations are 2.68 and 2.65 respectively. The mean difference of the Experimental group and Control group is 0.87, in favour of the Experimental group. This implies that Experimental group had significantly higher mean Score than Control group. That is to say that the effect of the treatment had impact on Experimental group.

Research Question Two: What is the difference in Attitude change towards Biology, when taught microorganism concepts, using Simulation game strategy and Lecture method?

Table 4.2: MeanRanking Difference in Attitude Change towards Biology inExperimental and Control Groups

Groups		N	Mean Rank	Mean Rank Difference
Attitude level	Before (Experimental)	73	64.88	60.32
	After (Experimental)	73	125.20	
	Before (Control)	80	43.29	37.63
	After (Control)	80	81.02	
	Total	153		44.18

The result in Table 4.2 showed that difference existed in Attitude change to Biology between students taught microorganism concepts, using simulation game strategy and those taught using lecture method. The mean Rank Attitude levels were 64.88, 125.20, 43.29 and 81.02 by students before experimental, after experimental, before control and after control groups respectively. This indicates that among the experimental group, their Attitude level had changed from 64.88 to 125.20, while among those in control group, their Attitude had changed from 43.29 to 81.02. The Mean Rank Differences were 60.32 & 37.63 respectively. Mean Rank Difference for after experiment and after control was 44.18 in favour of the experimental group. This shows that the experimental had mean scores more than the control group, which means that the treatment had effect on the experimental group.

Research Question Three: What is the mean scores of male and female students when taught microorganism concepts using simulation games strategy and lecture method?

Table 4.3: Means and Standard Deviationsof Male and Female Students in Experimental Group and Control Group

GROUP	SEX	N	Mean	Std. Deviation	Mean difference
EXPERIMENTAL GROUP	MALE	50	20.96	2.88	
	FEMALE	23	20.70	2.23	0.26
	Total	73	20.88	2.68	
CONTROL GROUP	MALE	44	19.57	2.92	0.99
	FEMALE	36	20.56	2.19	
	Total	80	20.01	2.65	
Total	MALE	94	20.31	2.96	
	FEMALE	59	20.61	1.19	0.30
	Total	153	20.43	2.69	

Table 4.3 shows the male and female mean scores as 20.96 and 20.70 respectively, of Simulation Game Strategy and Lecture method male and female mean scores as 19.57 and 20.56 respectively. Irrespective of groups, male and female mean scores were 20.31 and 20.61 respectively. The mean differences are 0.26 and 0.99, for male and females in both experimental and control groups. The mean difference of sex, irrespective of group was 0.30. This results shows that there was difference between the mean scores of male and female students when taught microorganism concepts using simulation games strategy and lecture method. The difference was in favour of the male students in the experimental group. The control group did not do as well as the control group.

4.3 Hypothesis Testing

The three Null Hypotheses were analyzed using the independent t-test, Kruskai-Wallis and Two-Way analysis of Variance statistical tools respectively.

Null Hypothesis One: there is no significant difference between the mean Performance scores of the students taught microorganisms concepts using the simulation game strategy (Experiment Group) and those taught using the Lecture method (control group).

Null Hypothesis One:

Table 4.4: Independent t-test Analysis on the Difference in the Mean Performance Scores of Students of Experimental and Control Groups

Scores of Students of Experimental and Control Groups								
Group	N	Mean	Std.Dev	Std.Err	DF	t-cal.	t-Crit.	Sig. p
Experimental	73	20.88	2.68	0.31	151	2.01	1.96	0.05
Control	80	20.01	2.65	0.30				
P < 0.05								

Table 4.4 Results showed that there is significant difference existing between the mean Performance scores of students taught with simulation games strategy (experiment) and those taught using lecture method (control). Reason being that the calculated p value of 0.05 is equal to the 0.05 alpha level of significance, while the t-calculated value of 2.01 is higher than the t-critical value of 1.96, at 151 degree of freedom. This implies that students taught with simulation games strategy (experiment group) have significantly higher mean performance scores than those taught with lecture method (control group). Consequently, the null hypothesis which states that there is no significant difference in the mean performance scores of student taught with simulation games strategy (experimental group) and those taught with lecture method (control group), is hereby rejected.

Null Hypothesis Two: there is no significant difference in attitude change to Biology between students taught microorganism concepts, using simulation games strategy and those taught using lecture method.

Null Hypothesis Two:**Table 4.5: Kruskai- Wallis Analysis on the Difference in Attitude Change of Students towards Biology in Experimental and Control Groups**

	Groups	N	Mean Rank	D f	Chi Square	MRD	P- Value
Experimental	Before	73	64.88	3	68.10	60.32	0.01
	After	73	125.20				
Control	Before	80	43.29			37.73	
	After	80	81.02				
						44.18	
	Total	153					

$P \leq 0.05$

The result showed that significant difference existed in attitude change to Biology between students taught micro-organism concepts, using simulation game strategy and those taught using lecture method.

This is because the calculated significant value of 0.01 is less than the 0.05 alpha value of significance.

The attitude meanrank levels were 64.88, 125.20, 43.29 and 81.02 by students in before experimental, after experimental, before control and after control group respectively. This indicates that their attitude level has been changed from 64.88 to 125.20, while among those in control group; their attitude has changed from 43.29 to 81.02. The Mean Rank Differences are 60.32 and 37.73. Comparing the after experimental and after control, the Mean rank difference is 44.18. This implies that a significant positive attitude change to Biology has taken place among the students, in favour of the experimental group.

Therefore, the null hypothesis, which state that there is no significant difference in Attitude change to Biology between students taught microorganism concepts using Simulation Game Strategy and those taught using Lecture method, is therefore rejected.

Null Hypothesis Three: There is no significant difference between the mean scores of males and female students when taught microorganisms concepts using the simulation game strategy and lecture method.

Null Hypothesis Three:

Table 4.6: The Two-Way Analysis of Variance for Mean Scores of Gender for Experimental and Control Groups

Source	Type iii Sum of square	D f	Mean square	F	Sig
Intercept	58674.10	3	58674.10	8330.31	0.01
Group	20.59	1	20.59	2.92	0.09
Sex	4.59	1	4.59	0.65	0.42
Group & Sex	13.75	1	13.75	1.95	0.16
Error	1049.47	149	7.04		
Total	1098.39	152			

$P \leq 0.05$

Result in Table 4.6 showed that there is no significant difference between the mean scores of male and female students when taught microorganism concepts using simulation games strategy and lecture method. The calculated intercept p value of 0.01 is less than the 0.05. The calculated group p value of 0.09 is higher than the 0.05. The calculated sex p value of 0.42 was also higher than 0.05. More importantly the p value of sex and group of 0.16 was also found to be higher than the 0.05, hence no significance difference. The null hypothesis is therefore accepted.

4.4 Summary of Findings

At the end of the study, the following findings were obtained.

1. There was a significant difference between the subjects of the experimental and control groups in their performance in microorganisms, in favour of the experimental group. i.e. those taught using the simulation games strategy performed significantly better than those taught using lecture method.

2. The simulation game strategy group showed significantly better or more positive attitude towards Biology learning compared to their counterparts in the Lecture method group.
3. There was no significant difference between the mean academic performance scores of males and females within the simulation game strategy group and lecture method group.

4.5 Discussion of Results

This study determined the effect of simulation games strategy and lecture method in teaching of microorganism concepts. Three hypotheses were stated and tested based on the scores of the subjects obtained from MOPT and BAQ. Analysis of the data obtained were presented in Tables 4.4 - 4.6 in accordance with the stated hypotheses.

From the findings on Table 4.4, it showed that, there was significant difference between the performance scores of students exposed to simulation game strategy and those exposed to lecture method. Those taught using simulation game strategy performed significantly better than those taught using lecture method. This finding is in line with those of Akinsola and Animasahun (2007) who found that students had a better academic achievement when taught using simulation game strategy. This is also in line with the findings of Obeka (2009); Ezeudu&Ezinwanne (2013) that those treated with simulation strategy achieved better than those treated with lecture method. This is an indication that the adoption of appropriate instructional Strategies would enhance meaningful learning in Biology. This implies that games and Simulations techniques can be adopted as a strategy for effective teaching of Biology concepts. The finding of this study is in conflict with Egbughara (1988) and Aruwape (2002) which asserted that games have no significant effect on Students' achievement. That is to say that the finding of this study implies that the

adoption of relevant instructional strategies will enhance meaningful learning and higher mean performance scores in Biology.

From Table 4.5, the results revealed that simulation game strategy group showed significantly improved attitude towards Biology learning when compared with their counterparts in the lecture method group. This is in line with findings of Akubuiro & Joshua (2004) whose result revealed that students' attitude towards science subjects is a very important factor in achievement in science. This is also similar to that of Mohammed (2008) who reported that the use of STS instructional strategy significantly improved the attitude of students of Integrated Science. Also according to Anthony (1983) negative attitude of Students to science achieved relatively low in the mean scores. Olorukooba (2001) reported that Students taught using corporative learning strategy had positive attitude to the educational benefits derived from group work.

The result on Table 4.6, revealed that there was no significant difference in the performance scores of male and female students when taught microorganism concepts using simulation game strategy and lecture method. This finding agrees with that of Adigwe and Okonkwor (2013) that male and female students achieved highly with no significant difference in their mean scores after treatment with simulation method. Also in agreement with Mari (2011) that male and female students do not differ significantly in performance after instruction. Mahmud and Usman (2010) also supported this finding, stating that discovering method favours both male and female students indicating that it is gender friendly. On the contrary, Njoku (2007), Kajuru and Kauru (2000) independently reported that Boys achieved significantly better than girls in Science, technical and mathematics subjects. This might have been attributed to the method of instruction used in teaching such Subjects. A major importance of this finding is that cooperative learning strategy is gender friendly.

Table 4.6 shows that the interactive effects of (i) teaching strategy and gender (ii) teaching strategy and attitude (iii) Teaching strategy and performance. This report is in compliance with Adigwe and Okonwok (2013), Akubuiro and Joshua (2004) but in variance with Egbughara (1988) and Anuwape (2002) which asserted that teaching strategy have no significant effect on students' achievement.

The results showed that students taught using Simulation game method had a higher post-test meanperformance Score in Control group. This was further confirmed bythe hypothesis testing which shows a significant different between the Performance of students taught using games and Simulation technique and those taught using the lecture method. The better performance of the experimental group could be as a result of the fact that the Students were stimulated to learn by the use of Simulation games which brought about completeness and liveliness for the students to learn.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study investigated the Effects of simulation game strategy on the Attitude and Performance in Biology among Senior Secondary Schools Zaria, Kaduna. This chapter contains a summary of the study and methodology used, the conclusion from the study and the recommendations based on the findings from the study, on how to improve academic performance in Biology at Senior Secondary School. This Chapter is presented in the following Sub-headings:-

- Summary
- Summary of Major Findings
- Conclusion
- Contributions to Knowledge
- Recommendations
- Limitation of the Study
- Suggestion for Further Studies

5.2 Summary

This study examined the effects of simulation game strategy on Attitude and performance in Biology among Senior Secondary Schools. The variables of concern in this study are Performance Scores, Attitude, Gender difference.

The study was restricted to SS1 students in two schools in Zaria Educational zone, to allow for an in-dept study within the short specified time frame of the study. The study was quasi experimental in nature, involving teaching by the Researcher, both for the experimental and Control groups using the simulation game strategy and the lecture method respectively. The instruction was related to the group through the strategy during the treatment. The

concepts selected for the study were:- Virus, Bacteria, Protozoa, Fungi, Algae. The lessons were planned based on the scheme of work for these concepts as outlined in the SS1 Biology syllabus. Pre-test was first administered in the first week, followed by intensive teaching for four weeks and revision for one week, after which the post test was administered.

In addition to this, Biology Attitude Questionnaire was administered to both the experimental and control groups to determine the relative effects of the two teaching learning strategies on student's attitude to the learning materials.

Summary of major findings:

- i. There was a significant difference between the subjects in the experimental and control groups in their academic performance in Micro-organisms, in favour of the experimental group. That is those that were taught using the simulation game strategy did significantly better than those taught using lecture method.
- ii. The simulation game strategy group showed significantly improved attitude towards Biology learning compared to their counterparts in the Lecture method group.
- iii. There was no significant difference in the mean academic performance of scores of males and females when taught using the simulation game strategy and lecture method.

5.3 Conclusions

Based on the findings emanating from the study the following conclusions were drawn:-

1. Simulation games strategy can be used effectively to improve the performance of students and their overall achievements in microorganism concepts and other Biology concepts that can be presented in a game (role-play), charts and examples in real life.

2. Simulation games strategy helped the students to improve their attitude to Biology and regarded it as being less difficult.
3. The result for gender difference using simulation games strategy showed that there is no significant difference. Which implies that simulation game strategy, helped the male and female subject to perform equally well. It is gender friendly.

5.4 Contributions to Knowledge

Science Education is dynamic in nature, which is based on frontier of new knowledge. The researcher investigated on the effect of simulation game strategy on attitude and performance in biology among secondary school students, Zaria Kaduna. The researcher from her findings now provides new innovations on the effective use of simulation game strategy in teaching biology in SS1. They are as follows:

- 1 The researcher developed a Technique-VIBAPROFA Simulation Process which was introduced to the students for the first time. This technique was more effective in the task of producing desirable attitude to biology in the subjects used as the experimental group.
- 2 The researcher found out that VIBAPROFA Simulation Process could be conveniently incorporated into the SS1 curriculum, as an effective teaching device when it was used in the teaching of microorganism concepts, there was a significant effect on the performance of the students.
- 3 The researcher found out that VIBAPROFA Simulation Process improved performance for both male and female students, therefore it is gender friendly and should be used to improve gender equality in science education.
- 4 The findings of this Study provided new information to existing Literature, which could help Researchers to update their findings.

5.5 Recommendations

Based on the findings of this research, the following recommendations are suggested:-

1. Educational organizations such as Science Teachers Association of Nigeria (STAN) and National Education Research and Development Centre (NERDC) should organize seminars, workshops and conferences on simulation game strategy as teaching method for Biology teachers at the secondary school level.
2. Curriculum planners should look into the effectiveness of simulation game strategy and consider it, being suitable for the teaching of science concepts, with its potentiality to bring about meaningful learning and also improve academic performance.
3. The Federal Ministry of Education should provide adequate funds to sponsor Biology teachers for retraining on simulation game strategy which is required to improve students' performance.
4. Microorganisms concepts is only found in SS One syllabus, there is need for curriculum planners to spread it up to SS 2 and SS 3 syllabus to enable the students to retain more what they have learnt in the SSCE (Senior Secondary Certificate Examination) and other external examinations.

5.6 Limitations of the Study

The study is concerned with how simulation game strategy affects the academic performance of students and their attitude in Biology. The following are the limitations of the study:-

1. In this study, only two schools were used, and this limits the scope of generalization.
2. Students used for this study were not quite conversant with the simulation game strategy so time was spent on explaining and subsequently learning.

3. The schools used for this study were state government owned schools. Other types of schools like private and federal schools were not involved. May be if other schools were tried, they may give different results.

5.7 Suggestions for Further Studies

The simulation game strategy has been shown to improve students understanding of concepts. It appears that further studies would help to confirm and support the effectiveness of the strategy, especially in other parts of Nigeria beside Zaria Kaduna state were this study was carried out. Other areas to be researched into, include the following:-

1. The effect of the use of simulation game strategy in other science subject teaching and learning such as chemistry, physics, mathematics, agric. Science etc. over a long time, need to be carried out.
2. Since the study was done using senior secondary one (SS1) student's similar studies should be conducted with Junior Secondary school students in Kaduna and other parts of the nation.
3. The study should be carried out on a bigger population and different types of schools, in different state of Nigeria.

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APPENDIX I

MICROORGANISM PERFORMANCE TESTS (MOPT)

DEPARTMENT OF SCIENCE EDUCATION
FACULTY OF EDUCATION
A.B.U. ZARIA.

Dear Respondents,

Below are some Questions on Students Performance in Microorganism concepts, please kindly answer the questions by ticking the correct options

1. Growth in micro-organism can be increase in size, mass, size and number of cells of the colony. True () or False ()
2. Diseases can be transmitted and spread through the followings
 - i. Air i.e. air borne pathogens (iii) Water, i.e. water borne
 - ii. Food i.e. food born True () or False ()
3. Microorganisms are tiny organisms which cannot be seen with the naked eye except with the aid of a (a) telescope, b) mirror (c) board (d) microscope
4. All microorganisms are grouped into the following except, a) virus (b) bacteria (c) protozoa (d) worms.
5. One of the beneficial effects of microorganisms is (a) nitrogen fixation (b) sources of vitamin B (c) for baking (d) all of the above
6. Virus causes one of these diseases
 - a) Chicken pox (b) Galadima (c) malaria (d) typhoid fever
7. _____ and _____ are two examples of vectors
 - a) Tsetse fly and anopheles (female) mosquito (b) black fly and fever (c) house fly and man (d) sleeping sickness and river blindness
8. The following are the areas where microorganisms affect human lives except
 - a. Disease b. Nature (agriculture) c. Medicine d. Politicking
9. Typhoid fever is one of the disease cause by fungi
True () or False ()
10. Which of the microorganisms are found in the water areas (aquatic)
 - a. Viruses' b. Fungi c. Bacteria d. Algae
11. Microorganism are found everywhere in the biosphere

- Tue () or False ()
12. One of the diseases caused by protozoans (mosquitoes) is _____
a. Malaria fever b. Ring worm c. Whooping cough d. Kwashiokor
 13. Algae (sea weed) are important source of food
True () or False ()
 14. “VIBAPROFA” acronym means?
a. Vintage bad production farm b. Vision by problem faced c. Vincent, barn, produce, fat d. Virus, bacteria, protozoans, fungi and algae.
 15. Examples of viruses are _____ and _____
a. Piconar virus and Toga virus b. Rice and Beans c. Cat and dog d. Cry and laughter
 16. Ebola and measles are examples of disease caused by _____
a. Bacteria b. Fungi c. Viruses d. Protozoans
 17. A virus is a parasitic agent that is smaller than a bacterium and that can only reproduce after infecting a host cell. True () or False ()
 18. ----- occur in clusters or colonies
a. Bacteria b. Virus c. Protozoa d. Warm
 19. Harmful effects of microorganism can be controlled through the following except.
a. Use of drugs/antibiotics b. Preserving food by salting c. Immunization or Vaccination d. Sandwiching our bread
 20. Diatom and volvox are examples of
a. Fungi b. Virus c. Algae d. Protozoa
 21. Microorganism can enter the body through the following except _____
a. The mouth b. The nose c. Smiling d. Blood
 22. Two examples of protozoans are _____ and _____
a. Amoeba and Paramecium b. Doves and Pigeons c. Mackerel and Tilapia d. Sade and Audu
 23. Red water disease is caused by an example of Protozoa called -----
a. Red fly b. Black fly c. Babesia spp. d. Bees
 24. _____ is the branch of biology which study microorganism
a. Citology b. Microbiology c. Disease biology d. Genetics
 25. Name one health organization that help to fight the spread of diseases caused by microorganisms.

- a. Physical and health education (PHE) b. World Health Organization (WHO) c. Nigeria Union of Teachers (NUT) d. Science Teachers Association of Nigeria (STAN)
26. Vectors are carriers of disease True () or False ()
27. Tetanus is one of the diseases caused by _____
a. Cockroaches b. Ants c. Bacteria d. Fungi
28. The following are required for increase in the growth of microorganisms
Food, temperature and Humidity
True () or False ()
29. Microorganism are used for the manufacturing of drugs like _____ and _____
a. Antibiotics and vaccines b. Iodine c. Panadole d. Multivitamins
30. The following are applicable in the school environment to avoid spread of diseases except
a. Good pipe-borne water b. Good refuse-disposal c. Good ventilation d. Good grades
31. Mucor on bread is a sign of
a. Ant growth b. Bees growth c. Virus growth d. Fungal growth
32. Which of the statements below most appropriately explain the work of health organizations.
a. They help to provide drugs and vaccination in case of emergency b. They carry out security operations c. They do politics
33. Culturing involves the techniques of growing microorganisms in special media in the laboratory. True () False ().
34. Agar is extracted from algae. True () or False ()
35. Which of the statements is true about virus _____
a. They are microorganisms that are too tiny to be seen with an ordinary microscope except with an electron microscope
b. They are big birds in the nest
c. They are green plants in the garden.
d. They are fishes in the ocean.
36. These two plant diseases are caused by Fungi Onion twister disease and Okro damping off True () or False ()
37. Which of the following is a living organisms (WAEC, 2014)

- a. Muscle b. Nucleus c. Yeast d. Mitochondrion
38. Which of the following organisms is the most specialized? (WAEC, 2014)
- a. Paramecium b. Amoeba c. Spirogyra d. Rhizopus
39. The following organisms have structures for movement except (WAEC, 2014)
- a. Amoeba b. Spirogyra c. Volvox d. Paramecium
40. Which of the following features does not necessarily place paramecium at a higher level of organization over Amoeba? (SSCE, 2008)
- a. Presence of Cilia b. Absence of Pseudopodia c. Presence of micro and mega nuclei
- d. Presence of more than one food vacuole

APPENDIX II

MARKING SCHEME FOR (MOPT)

- | | | | |
|-----|-------|-----|------|
| 1. | True | 23. | c |
| 2. | True | 24. | b |
| 3. | d | 25. | b |
| 4. | d | 26. | True |
| 5. | d | 27. | c |
| 6. | a | 28. | True |
| 7. | a | 29. | a |
| 8. | d | 30. | d |
| 9. | false | 31. | d |
| 10. | d | 32. | a |
| 11. | True | 33. | True |
| 12. | a | 34. | True |
| 13. | True | 35. | a |
| 14. | d | 36. | True |
| 15. | a | 37. | c |
| 16. | c | 38. | a |
| 17. | True | 39. | b |
| 18. | a | 40. | a |
| 19. | d | | |
| 20. | c | | |
| 21. | c | | |
| 22. | a | | |

Total 1mk x 40 = 40marks

APPENDIX III

BIOLOGY ATTITUDINAL QUESTIONNAIRE(BAQ)

Dear Respondent,

This Questionnaire is meant to determine The Effects of Simulation Games Strategy on Attitude and Performance in Biology among students in Zaria, with a view to suggest possible solutions.

Below is a list items designed to investigate Attitude of students towards Biology concepts in Concept mapping and Simulation You are requested to freely rate yourself to indicate your attitude towards the items.

All information you will provide in this exercise will be strictly used for the research exercise only and will be treated under strict confidentiality.

Section “B” Bio-Data

Instructions: Please fill in the blank spaces where necessary and/or tick (✓) to the response that best applies to you.

- a. Name of your School: _____
- b. School location: _____
- c. Sex: male () Female ()
- d. Age: 10-12 year's () 13 – 15 years () 16 – 18 years () 19-21 years ()
- e. Science student () Art student ()
- f. Private school () government school ()

Section C

Instruction: Please tick () the appropriate column using the following keys:

SA = strongly agree, A = Agree, UD = Undecided, D = Disagree; SD = strongly disagree.

S/N	Statement	SA	A	UD	D	SD
1	I would like to be a biologist					
2	Poor performance by others made me dislike Biology.					
3	Biologists are useful in the society.					
4	I dread examinations in biology					
5	Biology is a waste of time					
6	I enjoy going for biology examinations					
7	I find biology lesson difficult to understand					
8	Biology concepts are confusing to me					
9	Biology helps me solve problems					
10	My daily activities involves biology					
11	Students say that biology is hard to pass					
12	I look forward to biology lessons					
13	I will like to be taught using simulation games method in Biology I like being taught using simulation games method in biology lesson					
14	Diagrams in biology are hard to understand					
15	I learn about biology from nature					
16	Biology helps me to understand other subjects					
17	Biology teachers does not teach it well					
18	Biology is a good subject					
19	I have heard about simulation in our biology					
20	I have participated in simulation games activities organized by our Biology Teacher before now.					
21	Biology teacher makes me dislike biology					
22	We can continue to survive with the contribution of biology					
23	My biology teacher is not friendly					
24	Job opportunities for those who study biology are much more than those who study Physics or Chemistry.					
25	I just don't feel I can learn biology					

APPENDIX IV

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION GAME STRATEGY)

WEEK ONE

School: Tudun Saibu
Class: SS 1
Subject: Biology
Topic: Microorganisms I
Time 45mins

Teaching Aid

- i. Cardboard chart showing types of microorganisms namely virus, bacteria, protozoa fungi and Algae
- iv Flash Cards (Role Cards)
- ii Chalk board
- iii VIBAPROFA Simulation Cyclic Model

Behavioral objectives: By the end of the exercise, the students should be able to

- Define Microorganisms
- Identify the presence of Microorganisms by the Colonies they form.
- Measure the rate of growth of Microorganisms.

Introduction

The Researcher outlines and explains the Objectives of the Lesson. He then presents the following teaching aids.

Card board chart showing examples of microorganisms.

VIBAPROFA Simulation Process chart (see Appendixvi). He pastes the charts on the Chalkboard showing diagrams of Virus, Bacteria, Protozoans, Fungi and Algae.

He will ask the students what they observed as the students explain one after the other. That is Brainstorming.

Presentation

Step 1

The Researcher presents the pre-game materials/merry go round action.

- i. Merry go round VIBAPROFA Cyclic Simulation Model. Fig.3.2)
- ii. Definition of new words from the simulation Process Chart (see appendix Xii-Xiv)

- iii. Assessment of simulation role Cards: the students were given flash cards containing definitions of Microorganisms- Viruses, Bacteria, Protozoans, Fungi and Algae according to their various groups.

iv. Announcement of the Research Assistant (Biology Teacher).

The Researcher defines the relevant concepts namely: Microorganisms and explains the entire VIBAPROFA Cyclic Simulation Model.

Step 2 Activity 1: The Research Assistance Supervises the group, and allocation of roles to the different groups.

Step 3 Activity 2:

Discussions by the different groups of Students on how to identify the Microorganisms on Spoilt food and will act it in a Role Play, pretending to act like the Microorganisms. With Labels and real life objects. Eg presenting a Bread with Molds grown on it.

Step 4 Activity 3

Plenary session group reports and discussion/ debate.

Debriefing:

The Researcher makes final comments, raises, issues and problems that are identified, ignored or not properly addressed.

Summary and Evaluation

The teacher will summarize the activity by asking the students to present their questions and then ask them few questions on what they have discussed and learnt as follows

Evaluation

- Define the term “microorganisms”
- How can you identify the presence of microorganisms?
- Explain the two ways by which we can measure the rate of growth of microorganisms.

Assignment

Observe a decayed Bread and record your findings.

The teacher’ Summary is stated below:

“Microorganisms are tiny organisms which cannot be seen with the naked eye except with the aid of a microscope”.

The following procedures should be followed inorder to identify the presence of Microorganisms.

The students are shared into working groups and each given a culture medium with the petri dishes labelled KLMN and O respectively.

- Expose Petri dish K to air for about 10 - 15 mins and then cover it
- Put in petri dish I, M and N a few drops of pond, river and stream water respectively.
- Allow petri dish O to serve as control i.e do not introduce anything into it
- Leave all the petri-dishes in the laboratory for 3 - 4 days.
- Observe all the petri dishes for any development while noting the difference in each of the petri dishes.
- Record the characteristics (colour, pattern of growth, appearance in colonies) of micro-organisms in each petri-dish.

There are two major ways of measuring growth on microorganisms. These are as follows

iFirst method: A bacteria sample is inoculated into a nutrient agar (a clear liquid culture medium). As the bacteria population increases, the clear liquid medium becomes cloudy or turbid. Progressive increase in turbidity indicates a relative increase in the number of bacteria cells.

iiSecond method:

In this method, small samples of bacteria are taken from the nutrient and dropped on the agar at regular interval of time each sample is diluted several times and is inoculated on to a nutrient agar medium in a petri dish and incubated. The number of colonies formed in each petri dish is counted. As each colony is formed by the multiplication of a single bacterium, the number of colonies indicate the number of living bacterium cells in the diluted sample.

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION GAME)

WEEK TWO

School: Tudun Saibu
Class: SSI
Subject: Biology
Topic: Microorganisms I
Sub-topic: Virus
Time: 45mins

Teaching aid

- i. A model showing a virus with its labels
- ii. Chalk board
- iii. A diagram of carbon recycling
- iv. Flash cards containing brief details about Virus in line with the Objectives stated below.
- v. VIBAPROFA Simulation Model (Cycle simulation process:- merry-go-round)

Behavioural Objectives: By the end of the exercise, the students should be able to

- Define Virus as a Microorganism with some of its examples
- Enumerate Beneficial effects of Virus
- Identify the harmful effects of Virus
- Explain Causes and Mode of transmissions of Virus diseases

Introduction

The Researcher will occupy the students in a merry-go-round session, and passes round the followings for the student to familiarize themselves with the experimental exercise i.e.

- i. VIBAPROFA Simulation (process)
 - ii. Flash Cards containing brief details about Virus as outlined in the Objectives above
- He asks the student what they observed as the students explain one after the other.

Presentation

Step 1

The teacher presents the pre-game materials/merry go-round action.

- i. Merry go round VIBAPROFA
- ii. Definition of new words from the simulation role package.

- iii. Assessment of simulation role package.

Step 2 Activity 1

The Researcher announce Virus as an example of Microorganism in our environment and allocation of roles to the student.

Step 3 Activity 2

Group work on the definition of Virus and its examples and beneficial effects

- Further discussion as students make notes on Virus and the beneficial effects of Virus

Step 4 Activity 3

Discussion on the Harmful effects of Virus in our Environment, after then, students come out from this group to act according to their different roles eg some Students presenting some harmful effects of Virus on a Label, such as Ebola, Measles and Polio etc.

Step 5

Discussion on the Causes and transmission of Virus diseases eg through Air –borne, Contact with effected Persons.

Step 6

Plenary session group reports/ debate

Debriefing

Teacher makes final comments, raises, issues and problems that are not properly treated.

Summary and Evaluation

Evaluation

- Give the definition of Virus
- Outline some beneficial effects of Virus
- Give two examples of harmful effects of Virus
- List two types of Virus disease and how they are transmitted.

Assignment

Find out some other beneficial effects of Virus.

The teacher's Summary are stated below:

Viruses: these are Microorganisms that are too tiny to be seen with an Ordinary Microscope except with the use of Electron Microscopes. They are the simplest and the smallest Microorganism which do not have a Cell structure. Some are rod-like in shape while others are spherical.

Some examples of Virus, are as follows:-

Adenovirus, Picornavirus, Togavirus and Caronavirus

Beneficial Effects of Viruses are as follows:-

- For the treatment of infections in humans e.g Bacteriophages
- For the destruction of Carbon in the Marine Environment ie Carbon recycling.

Harmful effects of Viruses are as follows:-

- 1a. Animal disease caused by Viruses e.g Poliomyelitis, Infective Hepatitis, Measles etc.
- b. Plant diseases caused by Viruses e.g rosette disease cassava mosaic maize streak, swollen shoot disease etc.
- c. Causes of death: Viruses can also cause the death of plants and animals

Spreading/Transmission of virus diseases are through the following:-Air- borne Pathogens and Contact with the infected Persons.

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION)

WEEK THREE

School: Tudun Saibu
Class: SS1
Subject: Biology
Topic: Microorganisms iii
Sub-topic: Bacteria
Time 45mins

Teaching: Aid:

- i. A model showing a Bacteria with its labels
- ii. Chalk board
- iii. A bottle of Yoghurt and a bottle of dirty water in a container
- iv. Flash cards containing brief details about Virus in line with the Objectives stated below.
- v. VIBAPROFA Simulation Model (Cycle simulation process:- merry-go-round)

Behavioral objectives: By the end of the exercise, the students should be able to

- Define Bacteria as a Microorganism with some of its examples
- Enumerate some Beneficial effects of Bacteria
- Identify the harmful effects of Bacteria
- Explain Causes and Mode of transmissions of Bacteria diseases

Introduction

The Researcher occupies the students in a merry-go-round session, and passes round the followings for the student to familiarize themselves with the experimental exercise i.e.

- i. VIBAPROFA Simulation (process)
- ii. Flash Cards containing brief details about Bacteria according to the objectives above

He asks the student what they observed as the students explain one after the other.

Presentation

Step 1

The Researcher presents the pre-game materials/merry go-round action.

- iv. Merry go round VIBAPROFA
- v. Definition of new words from the simulation role package.
- vi. Assessment of simulation role package.

Step 2 Activity 1

The Researcher announce Bacteria as an example of Microorganism in our environment and allocation of roles to the student.

Step 3 Activity 2

Group work on the definition of Virus and its examples and beneficial effects

- Further discussion as students make notes on Virus and the beneficial effects of Virus

Step 4 Activity 3

Discussion on the Harmful effects of Bacteria in our Environment, after then, students come out from this group to act according to their different roles eg some Students presenting on some beneficial effects of Bacteria ie one of the students comes out to display with a bottle of Yoghurt, while others on harmful effects of Bacteria, where some student decorated to look like and effected persons with Leprosy, Typhoid fever and Tuberculosis.

Step 5 Activity 4

Discussion on the Causes and transmission of Bacteria diseases eg through Water-borne, Air-borne and Contact with effected Persons. Students in this group come to display with a dirty water in a container and an effected person with Tuberculosis tries to cough facing an unaffected person.

Step 6

Plenary session group reports/ debate

Debriefing

Teacher makes final comments, raises, issues and problems that are not properly treated.

Summary and Evaluation

Evaluation

- Give the definition of Bacteria
- Outline some beneficial effects of Bacteria
- Give two examples of harmful effects of Bacteria
- List two types of Bacteria diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Bacteria.

The teacher's Summary are stated below:

Bacteria: are microorganisms that can easily be seen with light microscope. They occur in clusters or colonies. A bacterium has a shiny capsule, cell wall, a cell membrane, a dense cytoplasmic granules with no clear nucleus, but has a nuclear material called DNA (deoxyribose nuclear acid) which spreads through the cell.

In nature: Some bacteria are used in compost formation, nitrogen fixation, maintenance of soil fertility, digestion of cellulose, decomposition, silage making and sewage treatment.

In medicine: some fungi and bacteria are used for the manufacture of drugs and vaccines

Bacteria and yeast are used as sources of vitamin B and also enzymes.

In industries: some fungi (yeast) are used for baking and for preparing alcoholic drinks. Certain bacteria are used for making cheese, yoghurt and for retting of jute i.e for sack making, curing of tobacco and tanning of hides and skins.

‘Harmful effect’ this is the damage done by an organisms or object to another object or organism.

The harmful effects of Bacteria are stated below:-

1. Spoilage of food: Bacteria are generally known to cause food spoilage.
2. Deterioration of materials: Microorganisms are also responsible for the deterioration of material like wood, cotton, paper and leather etc.

Some diseases caused by Protozoa are as follows:-

- 1a. Animal disease caused by bacteria e.g tuberculosis, leprosy, tetanus, typhoid fever, cholera, dysentery etc.
- b. Plant disease caused by bacteria e.g leaf blight of cassava, tomato rot, onion rot, yam rot etc

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION GAMES)

WEEK FOUR

School: Tudun Saibu

Class SS1

Subject: Biology

Topic: Microorganisms iv

Sub- topic: Protozoa

Time: 45mins

Teaching: Aid:

- i. A model showing a Protozoa example Amoeba with its labels
- ii. Chalk board
- iii. Microscopic Lenses
- iv. A specimen of Microorganisms was brought from a nearby lake and put in a Petri-dish
- v. Flash cards containing brief details about Protozoa in line with the Objectives stated below.
- vi. VIBAPROFA Simulation Model (Cycle simulation process:- merry-go-round)

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Protozoa as a Microorganism with some of its examples
- Enumerate Beneficial effects of Protozoa
- Identify the harmful effects of Protozoa
- Explain Causes and Mode of transmissions of Protozoa diseases

Introduction

The Researcher occupies the students in a merry-go-round session, and passes round the followings for the student to familiarize themselves with the experimental exercise i.e.

- i. VIBAPROFA Simulation (process)
- ii. Flash Cards containing brief details about Protozoa

He asks the student what they observed as the students explain one after the other.

Presentation

Step 1

The Researcher presents the pre-game materials/merry go-round action.

- i. Merry go round VIBAPROFA

- ii. Definition of new words from the simulation role package.
- iii. Assessment of simulation role package.

Step 2 Activity 1

The Researcher announces Protozoa as an example of Microorganism in our environment and allocation of roles to the student.

Step 3 Activity 2

- Group work on the definition of Protozoa and its examples and beneficial effects
- Further discussion as students make notes on definition of Protozoa and its beneficial effects.

Step 4 Activity 3

Discussion on the Harmful effects of Protozoa in our Environment, after then, students come out from this group to act according to their different roles eg some Students presenting on some beneficial effects of Protozoa. One of the Students from the Protozoa group presents a sample of a Manure in a container in the class as one of the benefits of Protozoa. While some Students come out from this same group to display as patients suffering from some diseases caused by Protozoa eg Malaria Fever, Sleeping Sickness, by acting them in a Role play.

Step 5 Activity 4

Discussion on the Causes and transmission of Protozoan diseases eg through Disease Vectors such as Mosquitoes and Tsetse-flies. Students come out from their groups to show how Mosquito and Tse-tse fly could bite a Person, they do these by acting in a Role play.

Step 6

Plenary session group reports/ debate

Debriefing

Teacher makes final comments, raises, issues and problems that are not properly treated.

Summary and Evaluation

Evaluation

- Give the definition of Protozoa
- Outline some beneficial effects of Protozoa
- Give two examples of harmful effects of Protozoa
- List two types of Protozoa diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Protozoa.

The teacher's Summary is stated below:

Protozoa: These microorganisms are microscopic free-living, unicellular animals. e.g Amoeba and paramecium. Some are parasites e.g trypanosomes which cause trypanosomiasis and plasmodium which cause malaria fever.

Beneficial effects of Protozoa are as follows:-For Organic matter decomposition; for the digestion of Cellulose in Cow and termites' guts; for Nutrient mobilization.

Harmful effects of Protozoa are as follows:-Trypanosomiasis (Sleeping Sickness); Dysentery, Red water fever by Babesia spp. Amoebiasis; Malaria fever (by Plasmodium); Trychonomiasis and Coccidiosis

Spreading/ Transmission of Protozoa diseases are through the following:- Through Animal Diseases Vectors e.g Mosquito, Tse-tse fly and Babesia.

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION METHOD)

WEEK FIVE

School: Tudun Saibu
Class SS1
Subject: Biology
Topic: Microorganisms v
Sub- topic: Fungi
Time: 45mins

Teaching Aids:-

- i. A model showing a Bacteria with its labels
- ii. Chalk board
- iii. A bottle of Yoghurt and sea water in a container
- iv. Flash cards containing brief details about Virus in line with the Objectives stated below.
- v. VIBAPROFA Simulation Model (Cycle simulation process:- merry-go-round)

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Fungi as a Microorganism with some of its examples
- Enumerate Beneficial effects of Fungi
- Identify the harmful effects of Fungi
- Explain Causes and Mode of transmissions of Fungi diseases

Introduction

The Researcher occupies the students in a merry-go-round session, and passes round the followings for the student to familiarize themselves with the experimental exercise i.e.

- i. VIBAPROFA Simulation (process)
- ii. Flash Cards containing brief details about Fungi

He asks the student what they observed as the students explain one after the other.

Presentation

Step 1

The Researcher presents the pre-game materials/merry go-round action.

Merry go round VIBAPROFA

Definition of new words from the simulation role package.

Assessment of simulation role package.

Step 2 Activity 1

The Researcher announces Fungi as an example of Microorganism in our environment and allocation of roles to the student.

Step 3 Activity 2

Group work on the definition of Fungi and its examples and beneficial effects

Further discussion as students make notes on definition of Fungi and its beneficial effects.

Step 4 Activity 3

Discussion on the Harmful effects of Fungi in our Environment, after then, students come out from this group to act according to their different roles eg some Students presenting on some beneficial effects of Fungi ie One of the Students from the Fungi group presents a sample of a Yeast for making Bread in a container in the class. While some Students come out from this same group to display as patients suffering from some diseases caused by Fungi eg Ringworm and Spoilt foodas harmful effects by acting them in a Role play.

Step 5 Activity 4

Discussion on the Causes and transmission of fungi diseases eg through Air-borne Pathogens such as dusty wind, like Sand Storm.Students come out from the group to display a diagram of a Stormy wind in the class.

Step 6

Plenary session group reports/ debate

Debriefing

Teacher makes final comments, raises, issues and problems that are not properly treated.

Summary and Evaluation

Evaluation

- Give the definition of Fungi
- Outline some beneficial effects of Fungi
- Give two examples of harmful effects of Fungi
- List two types of Fungi diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Fungi.

The teacher's Summary is stated bellow:

Fungi: These are Saprophytic or parasitic non-green plants. The saprophytic Fungi are beneficial while the parasitic Fungi cause different types of diseases.

Beneficial effects of Fungi are as follows:- For Nutrient Cycling and exchange; for decomposition of Organic matter; Yeast for making Bread, Beer etc.

Harmful effects of Fungi are as follows:-

Spoilage of Food; Animal diseases caused by fungi e.g Ring worm, Athlete's Foot, thrush, Allergies etc.

Plant diseases caused by Fungi e.g maize smut, rice blight, leaf spot, cocoa black pod, okro clamp etc.

Spread/ Transmission of diseases are through the following:-Dusty wind carrying Fungi Pathogens.

LESSON PLAN: EXPERIMENTAL METHOD (VIBAPROFA SIMULATION METHOD)

WEEK SIX

School: Tudun Saibu

Class SS1

Subject: Biology

Topic: Microorganisms vi

Sub- topic: Algae

Time: 45mins

Teaching Aids

- i. A model showing an Algaewith its labels
- ii. Chalk board
- iii. a sample of Spirogyra in a Petri-dish
- iv. Microscopic lenses
- v. Flash cards containing brief details about Algae in line with the Objectives stated below.
- vi. VIBAPROFA Simulation Model (Cycle simulation process:- merry-go-round)

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Algae as a Microorganism with some of its examples
- Enumerate Beneficial effects of Algae
- Identify the harmful effects of Algae
- Explain Causes and Mode of transmissions of Algae diseases

Introduction

The Researcher occupies the students in a merry-go-round session, and passes round the followings for the student to familiarize themselves with the experimental exercise i.e.

- i VIBAPROFA Simulation (process)
- ii Flash Cards containing brief details about Algae

He asks the student what they observed as the students explain one after the other.

Presentation

Step 1

The Researcher presents the pre-game materials/merry go-round action.

Merry go round VIBAPROFA

Definition of new words from the simulation role package.Assessment of simulation role package.

Step 2 Activity 1

The Researcher announces Algae as an example of Microorganism in our environment and allocation of roles to the student.

Step 3 Activity 2

Group work on the definition of Algae and its examples and beneficial effects

Further discussion as students make notes on definition of Algae and its beneficial effects.

Step 4 Activity 3

Discussion on the Harmful effects of Algae in our Environment, after then, students come out from this group to act according to their different roles eg some Students presenting on some beneficial effects of Algae. One of the Students from the Algae group presents a sample. While some Students come out from this same group to declare that there are no known Harmful effects and disease found in Algae yet.

Step 5 Activity 4

Discussion on the Causes and transmission of Algae diseases:- there are no known harmful effects and diseases caused by Algae.

Debriefing

Teacher makes final comments, raises, issues and problems that are not properly treated.

Summary and Evaluation

Evaluation

- Give the definition of Algae
- Outline some beneficial effects of Algae
- Give two examples of harmful effects of Algae
- List two types of Algae diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Algae.

The teacher's Summary is stated below:

Algae: Algae are microscopic green plants with the majority, mainly Found in aquatic environment e.g Diatoms, spirogyra, volvox, chlamydomonas, oscillatoria and Nostoc. Beneficial effects of Algae are as follows:-

-As energy source e.g Algae, Biodiesel etc; For making Chemical dyes and Colouring agents; For pollution control; Edible Sea Weed for Food; Agar- a gelatinous substance for growing microorganisms in the Laboratory.

Harmful effects of Fungi:- there are no known harmful effects of Algae yet.

APPENDIX V

LESSON PLAN: LECTURE METHOD (Control Method)

WEEK ONE

Date:

School: GSSS Kaura

Class: SS I

Subject: Biology

Topic: Microorganisms ii

Duration: 45mins

Teaching Aids: i. Chalkboard ii. Chalk iii. A model of an examples of Microorganisms

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

- Define the term “microorganisms
- identify the presence of microorganisms by the colonies they form and
- Measure the rate of growth of microorganisms

Introduction: The teacher introduces the lesson by outlining the Objectives of the Lesson.

Presentation

Step 1: The teacher defines the word “microorganism” and explains it.

Step 2: The teacher explains where the microorganisms could be found in our Environment ie in the air, pond water, river and stream, and in a Culture medium.

Step 3: The teacher explains how to measure the rate of growth of microorganisms.

Step 4: Students should be taking down important points as the lesson progresses

The Teacher gives general Summary of the lesson and clarifies difficult concepts and mis-concepts

Evaluation

- Define the term “microorganisms’
- How can you identify the presence of microorganisms?
- Explain the two ways by which we can measure the rate of growth of microorganisms.

Assignment

Observe a decayed Bread and record your findings.

The teacher’ Summary is stated below:

“Microorganisms are tiny organisms which cannot be seen with the naked eye except with the aid of a microscope”.

The following procedures should be followed:

The students are shared into working groups and each given a culture medium with the petri dishes labelled KLMN and O respectively.

- Expose Petri dish K to air for about 10 - 15 mins and then cover it
- Put in petri dish I, M and N a few drops of water from pond, river and stream respectively
- Allow petri dish O to serve as control i.e do not introduce anything into it
- Leave all the petri-dishes in the laboratory for 3 - 4 days.
- Observe all the petri dishes for any development while noting and difference in each of the petri dishes.
- Record the characteristics (colour, pattern of growth, appearance in colonies) of micro-organisms in each petri-dish.

There are two major ways of measuring growth of microorganisms. These are as follows

- First method: A bacteria sample is inoculated into a nutrient agar (a clear liquid culture medium). As the bacteria population increases, the clear liquid medium becomes cloudy or turbid. Progressive increase in turbidity indicates a relative increase in the number of bacteria cells.
- Second method: In this method, small samples of bacteria are taken from the nutrient and dropped on agar at regular interval of time each sample is diluted several times and is inoculated on an agar medium in a petri dish and incubated. The number of colonies formed in each petri dish is counted. As each colony is formed by the multiplication of a single bacterium, the number of colonies indicate the number of living bacterium cells in the diluted sample.

LESSON PLAN LECTURE METHOD (Control method)

WEEK TWO

Date:

School: GSSS Kaura

Class: SS I

Subject: Biology

Duration: 45mins

Topic: Microorganisms ii

Sub-topic: Virus

Teaching Aids: i. Chalkboard ii. Chalk iii. A model of an examples of a Virus

Behavioural Objectives: By the end of the exercise, the students should be able to

- Define Virus as a Microorganism with some of its examples
- Enumerate Beneficial effects of Virus
- Identify the harmful effects of Virus
- Explain Causes and Mode of transmissions of Virus diseases

Introduction

The teacher introduces the lesson by stating the topic of the lesson and listing the Objectives which the Students are expected to achieve. Then he shows the students a model of an example of a Virus.

Presentation

Step 1: The teacher defines Virus, lists and explains some examples of Virus

Step 2: The teacher enumerates and explains the beneficial effects of Virus while Students were taking down important points as the lesson progresses

Step 3: The teacher lists and explains some harmful effects of Virus

Step 4: The teacher explains causes and mode of transmission of Virus diseases

Step 5: The teacher gives a general summary of the lesson and clarifies difficult concepts and misconcepts

Summary and Evaluation

Evaluation

- Give the definition of Virus
- Outline some beneficial effects of Virus
- Give two examples of harmful effects of Virus
- List two types of Virus disease and how they are transmitted.

Assignment

Find out some other beneficial effects of Virus.

The teacher's Summary are stated below:

Viruses: these are Microorganisms that are too tiny to be seen with an Ordinary Microscope except with the use of Electron Microscopes. They are the simplest and the smallest Microorganism which do not have a Cell structure. Some are rod-like in shape while others are spherical.

Some examples of Virus, are as follows:-

Adenovirus, Picornavirus, Togavirus and Caronavirus

Beneficial Effects of Viruses are as follows:-

- For the treatment of infections in humans e.g Bacteriophages
- For the destruction of Carbon in the Marine Environment ie Carbon recycling.

Harmful effects of Viruses are as follows:-

- 1a. Animal disease caused by Viruses e.g Poliomyelitis, Infective Hepatitis, Measles etc.
- b. Plant diseases caused by Viruses e.g rosette disease cassava mosaic maize streak, swollen shoot disease etc.
- c. Causes of death: Viruses can also cause the death of plants and animals

Spreading/Transmission of virus diseases are through the following:- Air- borne Pathogens and Contact with the infected Persons.

LECTURE METHOD (Control Method)

WEEK THREE

Date:

School: GSSS Kaura

Class: SS I

Subject: Biology

Duration: 45mins

Topic: Microorganisms iii

Sub-topic: Bacteria

Teaching Aids: i. Chalkboard ii. Chalk iii. A model of an examples of a Bacteria

Behavioral objectives: By the end of the exercise, the students should be able to

- Define Bacteria as a Microorganism with some of its examples
- Enumerate some Beneficial effects of Bacteria
- Identify the harmful effects of Bacteria
- Explain Causes and Mode of transmissions of Bacteria diseases

Introduction: The teacher introduces the lesson by stating the topic of the lesson and listing the Objectives which the Students are expected to achieve. Then he shows the students a model of an example of a Bacteria.

Presentation:

Step 1: The teacher defines Bacteria, lists and explains some examples of Virus

Step 2: The teacher enumerates and explains the beneficial effects of Bacteria while Students were taking down important points as the lesson progresses

Step 3: The teacher lists and explains some harmful effects of Bacteria

Step 4: The teacher explains causes and mode of transmission of Bacteria diseases

Step 5: The teacher gives general Summary of the lesson and clarifies difficult concepts and misconcepts.

Summary and Evaluation

Evaluation

- Give the definition of Bacteria
- Outline some beneficial effects of Bacteria
- Give two examples of harmful effects of Bacteria
- List two types of Bacteria diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Bacteria.

The teacher's Summary are stated below:

Bacteria: are microorganisms that can easily be seen with light microscope. They occur in clusters or colonies. A bacterium has a shiny capsule, cell wall, a cell membrane, a dense cytoplasmic granules with no clear nucleus, but has a nuclear material called DNA (deoxyribose nuclear acid) which spreads through the cell.

In nature: Some bacteria are used in compost formation, nitrogen fixation, maintenance of soil fertility, digestion of cellulose, decomposition, silage making and sewage treatment.

In medicine: some fungi and bacteria are used for the manufacture of drugs and vaccines

Bacteria and yeast are used as sources of vitamin B and also enzymes.

In industries: some fungi (yeast) are used for baking and for preparing alcoholic drinks. Certain bacteria are used for making cheese, yoghurt and for retting of jute i.e for sack making, curing of tobacco and tanning of hides and skins.

‘Harmful effect’ this is the damage done by an organisms or object to another object or organism.

The harmful effects of Bacteria are stated below:-

1. Spoilage of food: Bacteria are generally known to cause food spoilage.
2. Deterioration of materials: Microorganisms are also responsible for the deterioration of material like wood, cotton, paper and leather etc.

Some diseases caused by Protozoa are as follows:-

- 1a. Animal disease caused by bacteria e.g tuberculosis, leprosy, tetanus, typhoid fever, cholera, dysentery etc.
- b. Plant disease caused by bacteria e.g leaf blight of cassava, tomato rot, onion rot, yam rot etc

LECTURE METHOD (Control Method)

WEEK FOUR

Date:

School: GSSS Kaura

Class: SS I

Subject: Biology

Duration: 45mins

Topic: Microorganismsiv

Sub-topic: Protozoa

Teaching Aids:i.Chalkboard ii. Chalk iii. A model of an examples of a Protozoa

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Protozoa as a Microorganism with some of its examples
- Enumerate Beneficial effects of Protozoa
- Identify the harmful effects of Protozoa
- Explain Causes and Mode of transmissions of Protozoa diseases

Introduction:The teacher introduces the lesson by stating the topic of the lesson and listing the Objectives which the Students are expected to achieve. Thenhe shows the students a model of an example of a Protozoa.

Presentation

Step I: The teacher defines Protozoa, lists and explains some examples ofProtozoa

Step 2: The teacher enumerates and explains the beneficial effects of Protozoa while Students were taking down important points as the lesson progresses

Step 3:The teacher lists and explains some harmful effects of Protozoa

Step 4: The teacher explains causes and mode of transmission of Protozoa diseases

Step 4: The teacher gives general summary of the lesson and clarifies difficult concepts and misconcepts.

Summary and Evaluation

Evaluation

- Give the definition of Protozoa
- Outline some beneficial effects of Protozoa
- Give two examples of harmful effects of Protozoa
- List two types of Protozoa diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Protozoa.

The teacher's Summary is stated bellow:

Protozoa: These microorganisms are microscopic free-living, unicellular animals. e.g Amoeba and paramecium. Some are parasites e.g trypanosomes which cause trypanosomiasis and plasmodium which cause malaria fever.

Beneficial effects of Protozoa are as follows:- For Organic matter decomposition; for the digestion of Cellulose in Cow and termites' guts; for Nutrient mobilization.

Harmful effects of Protozoa are as follows:-Trypanosomiasis (Sleeping Sickness); Dysentery, Red water fever by Babesia spp. Amoebiasis; Malaria fever (by Plasmodium); Trychonomiasis and Coccidiosis

Spreading/ Transmission of Protozoa diseases are through the following:- Through Animal Diseases Vectors e.g Mosquito, Tse-tse fly and Babesia.

LECTURE METHOD (Control Method)

WEEK FIVE

Date:

School: Kaura GSSS

Class: SS I

Subject: Biology

Duration: 45mins

Topic: Microorganismsiv

Sub-topic: Fungi

Teaching Aids:i.Chalkboard ii. Chalk iii. A model of an examples of a Fungi

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Fungi as a Microorganism with some of its examples
- Enumerate Beneficial effects of Fungi
- Identify the harmful effects of Fungi
- Explain Causes and Mode of transmissions of Fungi diseases

Introduction:The teacher introduces the lesson by stating the topic of the lesson and listing the Objectives which the Students are expected to achieve.Thenhe shows the students a model of an example of a Fungi (Mushroom).

Presentation

Step I: The teacher defines Fungi, lists and explains some examples ofFungi

Step 2: The teacher enumerates and explains the beneficial effects of whileFungi

Students were taking down important points as the lesson progresses

Step 3:The teacher lists and explains some harmful effects of Fungi

Step 4: The teacher explains causes and mode of transmission of Fungi diseases

Step 4: The teacher gives general summary of the lesson and clarifies difficult concepts and misconcepts.

Evaluation

- Give the definition of Fungi
- Outline some beneficial effects of Fungi
- Give two examples of harmful effects of Fungi
- List two types of Fungi diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Fungi.

The teacher's Summary is stated bellow:

Fungi: These are Saprophytic or parasitic non-green plants. The saprophytic Fungi are beneficial while the parasitic Fungi cause different types of diseases.

Beneficial effects of Fungi are as follows:- For Nutrient Cycling and exchange; for decomposition of Organic matter; Yeast for making Bread, Beer etc.

Harmful effects of Fungi are as follows:-

Spoilage of Food; Animal diseases caused by fungi e.g Ring worm, Athlete's Foot, thrush, Allergies etc.

Plant diseases caused by Fungi e.g maize smut, rice blight, leaf spot, cocoa black pod, okro clamp etc.

Spread/ Transmission of diseases are through the following:- Dusty wind carrying Fungi Pathogens.

LECTURE METHOD (Control Method)

WEEK SIX

Date:

School: Kaura GSSS

Class: SS I

Subject: Biology

Duration: 45mins

Topic: Microorganismsiv

Sub-topic: Algae

Teaching Aids:i.Chalkboard ii. Chalk iii. A model of an examples of a Algae

Behavioural objectives: by the end of the exercise, the students should be able to

- Define Algae as a Microorganism with some of its examples
- Enumerate Beneficial effects of Algae
- Identify the harmful effects of Algae
- Explain Causes and Mode of transmissions of Algae diseases

Introduction:The teacher introduces the lesson by stating the topic of the lesson and listing the Objectives which the Students are expected to achieve.Thenhe shows the students,an example of an Algae (Spirogyra) in a petri-dish.

Presentation

Step I: The teacher defines Algae, lists and explains some examples of Algae

Step 2: The teacher enumerates and explains the beneficial effects of Algaewhile

Students were taking down important points as the lesson progresses

Step 3: The teacher lists and explains some harmful effects of Algae

Step 4: The teacher explains causes and mode of transmission of Algae diseases

Step 4: The teacher gives general summary of the lesson and clarifies difficult concepts and misconcepts.

Summary and Evaluation

Evaluation

- Give the definition of Algae
- Outline some beneficial effects of Algae
- Give two examples of harmful effects of Algae
- List two types of Algae diseases and how they are transmitted.

Assignment

Find out some other beneficial effects of Algae.

The teacher's Summary is stated bellow:

Algae: Algae are microscopic green plants with the majority, mainly Found in aquatic environment e.g Diatoms, spirogyra, volvox, chlamydomonas, oscillatoria and Nostoc.

Beneficial effects of Algae are as follows:-

-As energy source e.g Algae, Biodiesel etc; For making Chemical dyes and Colouring agents; For pollution control; Edible Sea Weed for Food; Agar- a gelatinous substance for growing microorganisms in the Laboratory.

Harmful effects of Fungi:- there are no known harmful effects of Algae yet.

APPENDIX VIA

PILOT TESTING RESULT IN PERCENTAGE

BAT (Biology Achievement Test)

S/N	Pre-Test	Post- Test
1	35	25
2	40	40
3	40	40
4	50	50
5	50	60
6	25	35
7	40	40
8	40	35
9	45	40
10	30	30
11	35	40
12	30	30
13	35	50
14	40	10
15	40	13
16	50	35
17	45	50
18	20	40
19	50	30
20	50	50
21	60	50
22	50	45
23	35	45
24	55	30
25	35	45
26	20	55
27	30	30
28	30	30
29	35	50
30	40	25
31	40	25
32	35	40
33	35	25
34	35	20
35	50	65
36	25	25
37	35	35
38	15	25

APPENDIX VIB **ANALYSIS OF PILOT TESTING SCORES**

Notes		
Output Created		19-Feb-2015 05:33:51
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	38
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		CORRELATIONS /VARIABLES=pretestachievement posttestachievement /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.047
	Elapsed Time	00:00:00.173

Correlations			
		pretestachievement	posttestachievement
		t	nt
pretestachievement	Pearson Correlation	1	.294
	Sig. (2-tailed)		.078
	N	38	37
posttestachievement	Pearson Correlation	.294	1
	Sig. (2-tailed)	.078	
	N	37	37

APPENDIX VII

COMPARISON OF THE MEAN PERFORMANCE SCORES OF THE PRETEST FOR THE EXPERIMENTAL AND CONTROL GROUPS TO SHOW EQUIVALENCE

Groups	N	X	SD	DF	t-Cal	t-Crit	p-Value	Remark
Experiment	40	18.55	2.59	78	1.86	1.76	0.16	Not significant
Control	40	17.28	3.47		1.86			

$P < 0.05$

Not significant at $P \leq 0.05$ $df = 78$

From table above, t- calculated is 1.86 and t- critical from statistical table is 1.76 ie t- cal. Is more than t-critical.

This implies that there is (no) significant difference between the experimental and the control group in their pre-test mean scores. This means that the students in both groups were equivalent in terms of their prior knowledge on the selected topics at the start of the study.

APPENDIX VIII
ITEM ANALYSIS FOR THE PERFORMANCE TEST INSTRUMENT

Item No	Item difficulty (RU+RL)/N \times 100	Item discrimination index (RU-RL/0.5N)
1	0.6	0.6
2	0.5	0.4
3	0.5	0.5
4	0.3	0.6
5	0.3	0.3
6	0.4	0.4
7	0.5	0.5
8	0.4	0.5
9	0.3	0.4
10	0.3	0.5
11	0.3	0.6
12	0.3	0.6
13	0.4	0.4
14	0.3	0.4
15	0.5	0.5
16	0.3	0.4
17	0.3	0.4
18	0.5	0.4
19	0.3	0.5
20	0.6	0.4
21	0.4	0.4
22	0.3	0.5
23	0.4	0.6
24	0.3	0.3
25	0.3	0.6
26	0.5	0.5
27	0.4	0.6
28	0.3	0.5
29	0.2	0.4
30	0.3	0.4
31	0.6	0.6
32	0.3	0.3
33	0.7	0.5
34	0.5	0.2
35	0.1	0.5
36	0.7	0.7
37	0.4	0.4
38	0.4	0.4
39	0.3	0.8
40	0.3	0.4

APPENDIX IX

CHIEF EXAMINER'S REPORT



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION 2013

BIOLOGY

CHIEF EXAMINER'S REPORT

1.3.3 Gender balance

Tables 3 and 4 show the data for female and male biology candidature at each level. The data show that the preponderance of female candidature over male is greater at Higher level than at Ordinary level. It can also be seen that at each level, over the five years in question, the gap has narrowed between female and male candidature in biology.

Year	Total Higher level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2009	20102	13244	6858	65.9	34.1
2010	20971	13678	7293	65.2	34.8
2011	22676	14267	8409	62.9	37.1
2012	22740	14057	8683	61.8	38.2
2013	23433	14182	9251	60.5	39.5

Table 3: Gender composition of Higher level cohort, 2009 to 2013

Year	Total Ordinary level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2009	7999	5024	2975	62.8	37.2
2010	8278	4934	3344	59.6	40.4
2011	7673	4432	3241	57.8	42.2
2012	7801	4471	3330	57.3	42.7
2013	8064	4478	3586	55.5	44.5

Table 4: Gender composition of Ordinary level cohort, 2009 to 2013

Table 7 compares the distribution (%) of Ordinary level main grades between female (F) and male (M) candidates from 2010 to 2013.

Year		A	B	C	A B C	D	E	F	NG	E F NG
2009	F	2.7	23.3	33.7	59.7	25.8	9.0	4.1	0.3	13.4
	M	2.3	21.5	31.2	55.0	25.7	11.3	6.4	0.6	18.3
2010	F	2.9	27.7	33.6	64.2	23.3	8.3	3.7	0.6	12.6
	M	3.3	24.7	32.3	60.3	23.2	9.3	5.8	1.3	16.4
2011	F	2.5	21.8	37.5	61.8	26.6	8.3	3.0	0.2	13.5
	M	1.7	18.8	35.0	55.5	28.9	10.2	4.7	0.6	15.5
2012	F	1.5	19.7	39.6	60.8	27.0	9.1	3.0	0.2	12.3
	M	1.1	15.6	38.8	55.5	29.6	9.8	4.1	1.0	14.9
2013	F	2.5	25.1	35.6	61.2	26.1	8.2	2.4	0.1	10.7
	M	1.6	17.3	33.8	52.7	30.7	10.4	5.1	1.1	16.6

Table 10: Comparison of achievement by lettered grade between female and male candidates in Ordinary level biology, 2009 – 2013 (% achieving each grade).

It is clear from these data that female candidates consistently received more ABC grades and fewer EFNG grades than male candidates in the years 2010 to 2013 at Ordinary level biology.

3. Analysis of Candidate Performance

3.1 General Commentary on Engagement and Performance

Table 11 shows the rank order of questions, section by section, of candidate answering in the 2013 Higher level biology examination from the point of view of popularity (number of attempts per question) and average number of marks earned per question. These data are taken from a random sample of 1300 examination scripts (5.5% of the total candidature).

Question Number	Topic	Rank Order in popularity	Average mark	Rank order in average mark
Section A				
1	Nutrients	3	14.4	=1
2	Ecology	1	12.4	4
3	Animal body temperature	5	11.7	5
4	Flowering plant reproduction	6	8.3	6
5	Cell water relations	2	13.6	3
6	Nucleic acids	4	14.4	=1
Section B				
7	Ecology	2	21.5	1
8	Enzymes	3	19.8	2
9	Miscellaneous practical activities	1	17.7	3
Section C				
10	Human endocrine system / plant growth regulators	6	32.7	5
11	Genetics / evolution / cell cycle	5	34.4	4
12	Microbiology/ immunity	4	31.9	6
13	Human reproduction	1	40.2	1
14	Photosynthesis/ respiration	3	39.4	2
15	Parasites/ nutrient cycles/ prey-predator cycles.	2	37.1	3

Table 11: Rank ordering of attempts and marks per question, Higher Level Biology 2013.

APPENDIX X
SS One First Term Syllabus

Theme: The Organism and its Environment

Topic	Performance Objectives	Content	Activities		Teaching and Learning Materials	Evaluation Guide
			Teacher	Student		
13 Micro-organisms	Students should be able to: 1. Recognize the presence of microbes by the calories they form. 2. Measure the rate of growth of microbes 3. List the beneficial effects of microbes from everyday experiences 4. Recognize that some disease causing organisms are air-borne, water-borne, and are spread through our food	1. Growth of micro-organisms: monitor growth rate of microorganisms. 2. Beneficial effects e.g. in nature, medicine and industries 3. Harmful effects of some microbes i. Types of disease causing microorganisms ii. Diseases caused by microorganisms iii. Ways in which disease causing (pathogenic) microorganisms spread and are transmitted	1. Demonstrate culturing and monitor growth rate of microorganisms 2. Discuss with students the economics importance of microorganisms and give students project to carry out to assess the effects of microorganisms	1. Measure and record growth of a given microorganisms from a prepared culture; plot a growth curve and interpret it 2. Perform experiments on fermentation to produce alcohol, fruit juice, etc. 3. Students produce yoghurt from fresh milk 4. Students list the names of some microorganisms and the diseases they cause.	Graph sheets Palm wine, yeast, sugar, milk, orange, juice and pineapple juice Graph showing mode of spread of few microorganisms	Students to: 1. State the relationship among growth rate of microorganisms and environmental factors 2. State the main ingredients for the production of yoghurt 3. List some diseases caused by microorganism 4. Discuss some beneficial effects of microorganism

Source: National Education Research and Development Council (NERDC 2012)

APPENDIX XI

VIBAPROFA Simulation Package (Key Words)

1. Pre-Game Material: Student brain storming ideas i.e. previous knowledge about micro organisms
2. Role Cards: Each group was given a set of cards which briefly described a person and his or her role. Here the experimental group was grouped into five sub-groups and was assigned the role of discussing Virus, Bacteria, Protozoa, fungi and Algae according to the content of the unit study.
3. Crises Card: a crises card contains an unexpected incident related to the issue being discussed and which was bound to influence any decision made.
4. Plenary Session: this was a session where all groups participated and shared, in this session, groups reported, presented and debated upon issues according to their names
5. Debriefing: The teacher as the referee made final comments, raised some issues omitted and corrected misconceptions/ mistakes.

APPENDIX XII

ROLE CARD

This is the card comprising of the act or part of a function. The experimental group was sub-divided into five groups namely Virus, Bacteria, Protozoa, Fungi, and Algae. This sub-groups were asked to discuss on the sub-topics assigned to them according to the content of the study. This was done as follows:-

Virus group:

1. A model of a Virus with its labels was displayed in class by one of the group members
2. Beneficial effects of virus: Here, one of the group members displayed a diagram of carbon recycling. This is because virus helps to destroy carbon in the marine environment.
3. Harmful effects of virus: examples of diseases caused by virus are Ebola, measles, polio some members of the group were decorated to appear to have the diseases in real life and then came out to display in class.
4. Causes and transmission of virus disease: That is through air borne pathogens, here two of the members of the group two sat together then the infected person among them started coughing and sneezing to the other 's face then after some time the uninfected one started coughing also, which means that he had contacted the disease through breathing in the air pathogens.

Bacteria group: some members of this Group were asked to display the sub-topics below as in the case of the virus group.

1. Example of a model of bacteria with labels was presented to class by one of the group members.

2. The beneficial effect of bacteria was displayed e.g Yoghurt and cheese through fermentation. A real yoghurt and cheese was brought to the class for display
3. Harmful effect of bacteria: i.e disease caused by bacteria e.g Tuberculosis, Typhoid fever and leprosy, were displayed in the class in a role play.
4. Causes and transmission of bacteria diseases. Through drinking of dirty water, eating infected food, was displayed in a role play in the class.

Protozoa group: As in virus, actors display thus:-

1. A picture of an example of a protozoa like paramecium or Amoeba, they were also brought in real life from a nearby lake in a container and viewed through a microscope in a Petri-dish.
2. Beneficial effect of protozoa:- For organic matter decomposition, here real manure was presented in the class by one of the group members..
3. Harmful effect of Protozoa:- Diseases caused by protozoa e.g Trypanosomiasis (sleeping sickness) and Malaria fever were demonstrated in the class by some of the members of the group in a role play.
4. Cause and transmission of protozoa diseases:- through animal vectors or carriers e.g Tsetse fly and Mosquito respectively their models were displayed in the class.

Fungi Group: as in Virus

1. A model of a mushroom was presented also a real bread with moulds on it was also presented as examples of fungi
2. Beneficial effect of Fungi:- Yeast for production of bread antibiotics, pesticides etc. these were also displayed with labels in the class.
3. Harmful effect of Virus:- disease caused are Ring worm, spoilage of food, which was also displayed and acted in the class.

4. Cause and transmission through air borne pathogen from dusty air and through effected person e.g using the comb of a ringworm affected person, this was acted in a role play in class.

Algae group As in virus

1. A picture/diagram of algae and sample from a nearby lake was put in a petri dish for them to see e.g spirogyra
2. Beneficial effect of Algae:- it is used for making fertilizers, also used as alternative to dye for colouring, as a pollution control and as edible weed. Members of this group came out to the class and acted them in a play.
3. No harmful effect have been found now for Algae.
4. No disease caused or transmitted by Algae yet.

APPENDIX XIII

FLASH CARDS

These comprised of cards made of cardboard papers containing brief notes or display of items to be discussed by each group.

These cards contained a detailed information about the various groups namely virus, Bacteria, Protozoa, Fungi and algae. Their definitions, examples, beneficial effect, harmful effects, the diseases they cause and how they are spread and are transmitted. The cards were shared to the various groups according to their names.