# EFFECTS OF PROJECT-BASED APPROACH ON ACQUISITION OF ENTREPRENEURIAL SKILLS, RETENTION AND PERFORMANCE IN BIOLOGY AMONG SECONDARY SCHOOL STUDENTS IN NIGER STATE, NIGERIA

**BY**

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**ZARIA, NIGERIA**

**MAY, 2019**

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**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY, ZARIA, IN PATIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE EDUCATION**

**DEPARTMENT OF SCIENCE EDUCATION,**
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**MAY, 2019**

## DECLARATION

I, Ibrahim Bala MOHAMMED (P16EDSC9183/PhD/EDU/12431/2011-12) declare that this thesis entitled "Effects of Project-based Approach on Acquisition of Entrepreneurial Skills, Retention and Performance in Biology, among Secondary School Students, in Niger State, Nigeria" was carried out by me in the Department of Science Education. It has never been presented anywhere either wholly or partially for the purpose of the award of a higher degree. Sources of information derived from the literature have been duly acknowledged by the means of references.

**Ibahim Bala MOHAMMED**_____ _____

Signature Date

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## CERTIFICATION

This thesis entitled "*Effects of Project-based Approach on Acquisition of Entrepreneurial Skills, Retention and Performance in Biology, among Secondary School Students, in Niger State, Nigeria*" by Ibrahim Bala MOHAMMED (P16EDSC9183/PhD/EDU/12431/2011-12) has been read and approved as meeting the regulations governing the award of the degree of Doctor of Philosophy (Ph.D.) 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 thesis is dedicated to my parents; Alhaji Mohammadu Madi Kutigi , Hajiya Amina Mohammed and Mallama Amina Mohammed, my children; Aisha, Dahiru, Amina, Fatima, Dhahibu, Nurudeen, Ummul Qulthum, Rukkayya, Dahira Abida, Mustapha and members of academic institutions.

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## OPERATIONAL DEFINITION OF TERMS

The following terms are operationally defined as used in the study

**Project-based Approach:** is a teaching and learning process carried out in form of practical assignment by learners in real life situation.

**Diagnostic Adaptive Testing Skills (DATS):** is an individualistic Formative Assessment Strategy for finding solution to problem in real life situation.

**Traditional Fixed Length Examination (TFLM) :** is a summative form of evaluation that determine learning performance at the end of a course.

**Entrepreneur:** is a person who through his/her skills and innovations create, organizes and manages business risk for the sake of profit.

**Entrepreneurship:** is the process that involves risking financial materials and human resources in a new way on the course of creating a new business concept or opportunity. Or it is the act of becoming an entrepreneur.

**Entrepreneurial Skills:** are occupational survivals skills that make individual self-reliance, self-employed and self-sufficient.

**Entrepreneurship Training:** is the informal or apprenticeship system of training that provides occupational skills for identifying business opportunities.

**Entrepreneurship Education:** is the formal and functional process of providing individuals in a confined school environment with the concepts and skills to recognize opportunities for life sustainability

## LIST OF ABBREVATIONS

| | | |
|---|---|---|
| SMASE | - | Strengthening Mathematics and Science Education |
| PBECD | - | Post Basic Education and Career Development |
| PATMPF | - | Project-based Approach Training Manual in Poultry& Fishery |
| TLM | - | Traditional Lecture Method |
| BAT | - | Biology Achievement Test |
| BCET | - | Biology Concept for Entrepreneurship Test. |
| SAT | - | Skill Acquisition Test |
| DATS | - | Diagnostic Adaptive Testing Skill |
| TFLE | - | Traditional Fixed Length Examination |

/

## ABSTRACT

This study investigated the Effect of Project-based Approach on Acquisition of Entrepreneurial Skills, Retention and Performance in Biology, among Secondary School Students, in Niger State, Nigeria. The study adopted pre-test, post-test, quasi-experimental design. The population consisted of 149,290 public senior secondary school students in the state. Three secondary schools were purposively sampled from the seven educational zones in the state. The sample size was 150(75 male 75 female) SSII Biology students assigned to three groups (two Experimental groups (EG1&EG2) and one Control Group (CG)} with 50 subjects per each group. Three instruments (1) Biology Concept Entrepreneurship Test (BCET), (2) Entrepreneurial Skill Acquisition Test (ESAT) and (3) Biology Achievement Test (BAT)were used in collecting data after validation. The reliability coefficients of the instruments using PPMCC were estimated at r = 0.71, r = 0.78 and r = 0.68 respectively. Results from this study provided answers to six stated research questions using descriptive statistics in form of mean, standard deviation and standard error. Hypotheses testing were carried out using t-test, Scheffe test, ANOVA and ANCOVA at $P \leq 0.05$ level of significance. One among the hypotheses states that there is no significant difference in students' performance means scores when exposed to Project-based Approach and their counterparts taught using Lecture Method. ANOVA and Scheffe test were conducted to identify the cause of the significant difference. One of the findings revealed that there was significant difference in performance mean scores of students taught biology concepts for entrepreneurship using Project-based Approach. There is significant difference in students' ability levels in skills acquisition using DATS as assessment tool over those exposed to TFLE as assessment tools of Project-based Approach in biology. Based on the findings recommendations were made one of which was, a common curriculum should be developed to maximise students' retention and performance in acquisition of meaningful knowledge and skills in biology through Project-based Approach.

# CHAPTER ONE

# THE PROBLEM

## 1.1 Introduction

The key to any meaningful development is found in deliberate human development and as such every training in human resource development is geared towards sustainability which yields a productive economy. Therefore, to achieve a sustainable economy, there is the need to imbibe the spirit of creativity as a bench mark through acquired skills to exploit the desired change by converting it into human capital opportunities.

Jongur, Kabuta and Abba (2009) assert that Nigeria being the richest country in Africa yet it remains under developed. More particular Nigeria's intellectual citizens fail to realize the essence of the available potentialities thereby unable to tap the untapped resources in order to build a self-sustainable and buoyant economy. This situation has made the Nigerian economy to be more of product-consumer or importer of manufactured goods instead of being producer from her own resources (Jongur, Kabuta & Abba, 2009). As a result, this has reduced the job opportunities for the teaming number of unemployed youth which led to youth unemployment, youth restiveness and economic deterioration. These situations have increased the need for Nigeria to emphasize and strengthen its economy through educational industries that would emphasize job creation, wealth generation and value reorientation for its teaming population. Skill acquisition through entrepreneurship education can be used as renaissance to ameliorate the situation in which Obeka (2013) opined that entrepreneurship education is a key driver to national economy.

The education sector calls for curriculum reforms so as to overcome the challenges of poverty and unemployment. Specifically, science education is believed to be an instrument of national development. This is so because it serves as a reformer through projects or associations. These projects or associations include among others: Nigeria

Integrated Science Project (NISP), Science Teachers Association of Nigeria (STAN), Nigeria Secondary School Science Project (NSSSP), Comparative Education Study and Adaptation Centre (CESAC). Thus, the reforms programmes among others include: Composite Objectives of Biology Education (COBE), Basic Science for Nigeria Secondary Schools (BSNSS), Science Technology and Mathematics (STM), Science Technology Engineering and Mathematics (STEM) Strengthening Mathematics and Science Education (SMASE) among others.

Upon doing so, these educational reforms are to provide learners with diverse basic knowledge; acquisition of life-long skills through education; wealth generation and educational advancement so as to function effectively in the society. It is on this note that National Policy on Education (FRN, 2013) spelt out some specific goals that encourage periodic review, effectiveness and relevance of curriculum at all levels of education in Nigeria to meet the needs of society and the world of work. This is to encourage the promotion of functional education for skills acquisition, job creation, and poverty reduction. Between 2003 to date, there had been a number of educational reforms of national and global initiatives through programmes like Millennium Development Goals (MDGs), National Economic Empowerment and Development Strategies (NEEDS) and Science Technology and Mathematics (STM) that focus directly on how to address educational and economic challenges. The major challenge of the reforms in the education sector, are the need to harmonize the objectives of NEEDS and MDGs. The objective of MDGs initiative, emphasised poverty reduction, while NEEDS fine-tuned this to emphases on value re-orientation, job creation, wealth generation, self-reliance and the use of education to empower youth. Thus, STM came with its objectives as to address the utility value of Science, Technology and Mathematics not as a means to seek employment elsewhere, but as acquisition of skills for life-long career prospect in invention. Therefore,

would enable learners to be able to think creatively, constructively and independently of others.

Therefore, NERDC and STAN harmonized these objectives and reviewed, restructured and realigned Nigeria curriculum to accommodate entrepreneurship as a form of teaching skills acquisition among secondary school students at all educational levels for the attainment of these aforementioned noble objectives. This is in line with Nnorom (2009) and National Policy on Education, (FRN, 2013) assertion for educational reform to meet the need and aspiration of individuals at all level and the society at general particularly in skill acquisition.

Entrepreneurial Skill acquisition is a form of training designed for an individual or group of people to acquire the abilities to perform activity that are meaningful to the aspiration of the society. Idoko (2014) maintained that for skill to be acquired, appropriate knowledge, attitudes, and experiences learnt will enable the learner to develop intellectual, emotional and moral character which prepares him/her for a better and sustainable life. Idoko (2011) further emphasised that skill acquisition is the manifestation of ideas and knowledge through training which is geared towards instilling in an individual the spirit of entrepreneurship needed for meaningful development. Therefore, skill acquisition and entrepreneurship are two indispensable concepts in which individuals are given opportunity to acquire relevant and meaningful skills needed for self-reliance and self-sustenance. Thus, the acquired skill becomes meaningful if profitable opportunities can be identified and successfully achieved. Akpomi (2009) also emphasise that skill acquisition through entrepreneurship education is valuable to all students, including those who are taking courses other than business and management studies, therefore, the need to prepare individuals with the mindset to acquire hand–on skill of entrepreneurship-based interest

right at the appropriate school level which is highly imperative. Consequently, this would make learners to be useful citizen at any point of completing their basic formal education.

The actualization of educational objectives as stressed in Nation Policy on Education, (FRN,2013) requires the need to equip youths who are not proceeding to Senior Secondary School (SSS) a means of preparing their minds for wealth creation and skill acquisition through entrepreneurship education. These objectives of Post-Basic Education and Career Development (PBECD) that is (Senior Secondary Schools) as stressed in the NPE states that the students should be provided with entrepreneurial, technical and vocational job-specific skills in Agricultural, industrial and commercial areas, but the situation persist despite educational reform programmes. Fenton, Manuel and Mukundu (2013) allay the fear that the problems of the modern world is making individuals at all levels to apply their theoretical knowledge to solve practical real life problems such as environmental and economic challenges.

The term "Entrepreneur" according to Aminu (2008) comes from a French word *Entreprendre*, which means to undertake business for profit gain. In the same vein, entrepreneur is regarded as the person who perceives business opportunity and takes advantages of the scarce resources to make up a sustainable life (Obeka, 2013). Entrepreneur is an individual that undertakes risk by recognising business opportunity, organize and manage the scarce resources to develop a profitable venture for life sustainability through change. Arogundade (2011) described Entrepreneur as a person that search for change, respond to change, and exploits change by converting change into profitable business opportunity. Entrepreneurship Training (ET) started as an informal form as could be a life-long learning process starting earlier before elementary school and progressing through all levels of skill acquisitions outside school (Gidado, 2015). Therefore, any activities that are not properly organized being an informal often lead to

frustration, waste of time, effort and resources before success is achieved. However, education through formal programme in schools is a recent enterprise and has become a major academic discipline in the 21st century for economic renaissance (Volkmann, 2004 & Femi, 2010). In the year 2003, entrepreneurship education becomes contemporary issue of global concern as remediation to poverty and economic recession. Thus, educational disciplines fine-tuned themselves to skill acquisition through entrepreneurship education so as to produce functional learners to life endeavours. Entrepreneurship education is therefore a process of providing individuals with the insight experience, self-esteem and knowledge of concepts and skills to recognize opportunities. In the light of this, Volkmann (2004) remarks that "One becomes an entrepreneur not by birth but by education as well as by experience". Thus, the teaching of skill acquisition through entrepreneurship education is highly significant in all our secondary schools. The aim of entrepreneurship Education in science is thus, to produce large and qualitative manpower in science and technology so as to develop a scientifically literate society that can solve its own problems. To achieve this, entrepreneurship-based Education requires appropriate instructional strategy for it to be functional and reveals the innermost part of the learner. Thus, Project-based Approach (PA) would provide the appropriate mindset to this effect.

Project-based approach is a teaching and learning strategy in which a defined problem is planned with a specific goal to be accomplished in real life situation following sequential steps or stages (Eze & Okoye, 2001). According to Lawrence, Ken and Patrick (2015), Project-based approach is seen as a way of teaching through practical assignments in which several sub-themes or sub-ideas arising from a bigger one can be allocated to groups of students to work on. It is essentially a learning strategy designed and conducted by the learner under the guidance of the teacher in true-life learners' manner of the environment. Project-based approach can be set to measure the individuals capability, tacit

knowledge and experience acquired to solve life related problems with minimum supervision. This may be carried out individually or in a group under the guidance of the teacher to achieve set objectives (Akpomi 2009, Fenton *et al.*, 2013&Yusuf, 2015). Learning through this process is acquired by direct experience because by so doing, the students get motivated to acquire both academic and practical skills (Nneji, 2006).

Project-based approach is a form of Project-Based Learning (PBL) that enhances development of many practical work skills. Therefore, Project-based approach is a means of fostering students' curiosity, inquiry and hand-on activity which makes it possible for learner to transfer knowledge on higher order of cognitive levels to solve problems in real life situation. Science is a way of discovery through experimentation. Thus, for science to be functional enterprise, it requires the interplay of science process skills of which Project Approach is the functional strategy for the skill acquisition.

Project-based approach use in teaching biology is made up of four stages; presented in two forms which are:

(a) Preparatory form

(b) Constructive form.

Preparatory form of Project-based approach involves preparation and preservation of specimens such as hearts, lungs, frogs, snails and fishes for practical studies. Learners are trained with the relevant skills on how to prepare and preserve the specimens like end-products which requires manipulative skills such as animal feeds, drug and culturing of organisms, fish and poultry products for sale (Okeke, Egbunonu & Ugbaja, 2009).

Constructive Form of Project-based approach, on the other hand, involves training individual on the building or constructing models to aid instruction in Biology. This involves construction of fish pond for stocking fish or animal pens or cages for rearing animals (Okeke, Egbunoun & Ugbaja, 2009). The use of Project-based approach can be

carried out in laboratory or workshop which could be for a short time covering few lessons for a day or for a long term which may cover some lessons for some days. The four stages employed in using Project-based approach in teaching biology are: (i) Planning Stage; (ii) Class or Site Organization Stage; (iii) Project Implementation Stage and (iv) Assessment Stage (NTI, 2001). The inter play of these stages require the use of appropriate science process skills.

Thus, Science process skills are acquired capabilities that can be learned through experience and applied for further understanding of nature so as to proffer solutions to any existing problem about nature. Science process skills particularly require the use of technical skills such as observing, hypothesing, measuring, interpreting of data, inferring, communicating and diagnosing which are indispensable in developing life related activity-based entrepreneurship education (Adeyemo, 2009). The use of Project-based approach in teaching entrepreneurial skill is Production – based oriented method of teaching which require all the aforementioned integration of science process skills. Science teachers need some essential entrepreneurial skills that will increase their efficiency and effectiveness in knowledge delivery and management of resources in the school environment. These entrepreneurial skills that put into play science process skills are: instructional leadership skills, management skills, communication skills, collaboration skills, vision development skills, analysis skills, process skills, evaluation skills and parsimony (cost cutting) or economy skills associated with project-base approach. Therefore, Project-based approach use Diagnostic Adaptive Testing Skills (DATS) as amalgamated science process skills as its interface. NTI (2001), Adeyemo (2009), Njelita and Udogu (2009) and Nnorom (2009) outlined the following skills as a saddle for learners to sit on when acquiring skills in biology:

Manipulative or Technical skills: which involve the use of instruments, experimentation, demonstration, repair and construction involving hand-on activities.

Social or Managerial skills**:** involve the following: Communicative skill: this requires the act of asking questions, discussion, explanation, monitoring, reporting and advertisement among others. This stresses the need to use hand-on activities and heart-on activities (cognitive and affective domain respectively). Acquisition/Commercial skills: this involves the skill of rewarding, classification, comparing, contrasting, evaluating, recording, organizing, sorting, selling, buying to mention but few. It stresses the use of hand-on and heart-on activities (cognitive and affective domain respectively).

The topics that lend themselves to entrepreneurship training in teaching biology as outlined by (Nayak, 2002; Njelita and Udogu, 2009) are as follows: Bee Keeping; Aquaculture; Floriculture; Horticulture; Aquarium; Poultry; Snailery or Snail Farm; Water, Food and Beverages Production Skill;

Bee Keeping: This is the act of preparing artificial hive to attract honey bee to colonies. Honey can then be extracted from the colonies for consumption and for sale. Honey if consume cures respiratory allergies and asthma. This entrepreneurial skill can be treated under social insects in Biology.

Aquaculture: This deals with fish farming and crab culture among others. The practice of these activities can be done in or out of school for commercial purpose. It can be treated under integration of some invertebrate and vertebrate topics as well as Ecology.

Floriculture: Growing of flowers for ornamental and domestic values. This skill can be practiced under relevance of Biology to agriculture students where they can be encouraged to grow flower in pots or empty containers.

Horticulture: Growing fruits and vegetable for home consumption and local distant market sale. Planting of medicinal plants for identification and marketing can be studied under relevance of Biology to agriculture.

Aquarium: Students could be taught to rear fish in aquaria, which can be sold in the market or exported. This skill could be practiced under production in vertebrate for example, fish.

Poultry: This involves rearing of birds for human consumption and for sales. The by-products for example, the fecal dropping and eggs, meats, are also sold to make more money. This entrepreneurial could be studied under reproduction in vertebrates (birds).

Snailery or Snail Farming: This is the act of farming snails for commercial purpose and for home consumption. This skill could be studied under reproduction in invertebrates (snails).

Water, Food and Beverages Production Skill: example is Fermentation of beverages

### 1.1.1 Theoretical Framework

The theoretical framework for this study is based on constructivism which is basically a theory on observation and scientific process of how learners construct their own knowledge in real life situation. Bruner (1960) and Piaget (1961) postulated that students create their own world through active process and that, learners are not passive absorbers but active constructors of knowledge. The theory of constructivism buttressed the definition of Project-based approach through which learners construct practical assignment and reveal tacit knowledge with minimum guidance from their teacher. In line with the theory, Project-based approach provides learners the curiosity and activeness to freely exploit nature until opportunity is identified and success is achieved.

The Project-based approach is born out of broaden psychological framework of constructivism (Brownstern, 2001), which has a in the early 1900s Dewey the father of progressive education proposed learning by doing. He promoted teaching strategies that helped students actively engage in learning about topics that are relevant to their lives

Project-based approach relies on the notion that if learners are given opportunities to construct their own meaning based on their experiences of participating in a project with their peers, then multiple opportunities of meaningful learning occurs (Broadhead 2001).

Constructivist Von Glasserfeld (1990) stresses that knowledge is constructed in the mind of the learner as adaptive in the sense that it is constantly modified by the learner's prior experience. The learner through adaptive learning construct project from experience acquired in real life situation. Project-based approach requires learners to construct new idea into physical object for livelihood through acquired prior experience. Thus Project-based approach is an action oriented approach that fosters acquisition of scientific skills or knowledge through learning by doing or direct experience. As Dewey (1956) maintained that learning is actualized in the domain of experience and those learners learn more by exploring opportunities through active thinking. Dewey91933) and Kilpatrick(1935) postulated that Project-based learning requires 'act of thinking' so as to achieve 'purposeful activity' through 'learning by doing' where learner under guidance, encounter a conceptual or practical obstacle, plan a solution, try bit out, and reflect upon their result to create new venture.

Theory of entrepreneurial value creation explains the entrepreneurial experience in its fullest form, the entrepreneurial intention and process; and the discovery of an entrepreneurial opportunity. Therefore, this study focuses on entrepreneurial process of value creation theory. This involves entrepreneur and entrepreneurship. An entrepreneur is a person that identify opportunity, match the entrepreneurial resources at hand with the opportunity to effectuate an entrepreneurial competence, create sustainable value and the appropriation of entrepreneurial reward (Mishra & Zachary2014). To be precise entrepreneurial process and opportunity would emphasize for this purpose considering the theory of Economic Development of Entrepreneurship and Opportunity–based

Entrepreneurship theory. In The theory of Economic Development of Entrepreneurship Schumpeter(1934) emphasized the role of entrepreneur as the ‘ man of action’ and the bearer of economic change that combine productive factors and coordinate productive resources. Considering Australian Market Process of Economic Development of Entrepreneurship theory by Schumpeter(1934) described entrepreneur as “human in action” in the context of economy of knowledge. Therefore , entrepreneurship is regarded as a driver of market-based system where individual create something new to satisfy the market needs; system-level change occurs and the benefit of knowledge is reaped. Therefore entrepreneur effectuate knowledge when they believe it will procure some individually-defined benefit.

Sarasvathy (2001)advanced the theory of effectuation to describe the nature of the entrepreneurial process. Sarasvathy posited the entrepreneurial process is an effectuation process not a causation process. Causation process take a particular effect as a given phenomenon and focus on selecting the means to create that effect, whereas effectuation process take a set of means as a given phenomenon and focus on selecting between possible effects using available means. It is when knowledge is being effectuated that causative change is set out and profitable opportunity is being identified.

Opportunity–based entrepreneurship theory buttressed Shumpeter theory and Sarasvathy stressed that entrepreneur do not cause change as claimed by Schumpeter but exploit the opportunity that cause the change.(consumer preference). Therefore he defined entrepreneur to this context as the person that search for change, respond to change, exploit change as an opportunity. Thus, Project-based approach use in acquiring entrepreneurial skills train individual to be man of action through learning by doing so as to identify purposeful opportunities for life sustainability.

## 1.2 Statement of the Problem

Skill acquisition through entrepreneurship education for graduates of tertiary institutions has become suggested strategy for remediation to unemployment and social vices in Nigeria. Femi (2010) reports that according to MDG (2006) report, over 70% of unemployment are youth and unskilled who are between the age limit of 13 – 25 years old. The National Policy on Education, (FRN, 2013) identified this age limit (13 – 25) years for secondary school students. Therefore, the need to engage this group of students in skill acquisition with entrepreneurship education as enshrined in National Policy on Education, (FRN, 2013) becomes highly imperative instead of focusing attention on graduates of tertiary institutions.

Femi (2010) observes that most science curricula attach much importance to student's acquisition of skills, despite the relevance of process skills, students' performance in science examinations are still low. According to Nwogbo (2009) a number of factors have been identified as contribution to the non-acquisition of skill by secondary school students which invariably lead to students' poor performance and students' restiveness. Infact, one out of the factors is teachers' inability to navigate through the use of varieties of teaching methods by considering hand–on activities. Fenton *et*.al, (2013) reported that despite awareness of project-based instructional strategy, lecture method remains the frequently used teaching method used by teachers even in a practical lesson. Okoli (2006) observed that teachers cannot teach effectively without employing the science process skills neither can students learn science effectively without acquiring such processes as well. Project-based instructional method is one of the early teaching approach for acquiring experience through the use of science process skills. Emphasis is not adequately given by teachers and students in acquiring meaningful skill, has instructions are over taken by lecture method. Lack of these skills has contributed to poor performance of

students interms of entrepreneurial skills. This research work therefore put up Project-based Approach as a means of teaching entrepreneurial skill acquisition in biology among secondary school students which requires teacher to navigate through other teaching methods so as to improve students performance in biology.

Nwagbo and Nnorom (2009) reported that secondary school biology students are not exposed to entrepreneurship training. This is due to the fact that the few topics that lend themselves to entrepreneurship training are not adequately developed into curriculum in terms of content and practical activities by both students and teachers of biology. Thus, biology concepts for entrepreneurship at secondary school level could not be identify and applied for an independent business enterprise or entrepreneurship education over the years. This research work will identify some entrepreneurial skills and entrepreneurship concepts in biology such as aquaculture, poultry, apiculture and floriculture which could be used for entrepreneurship training in secondary schools.

Apart from teaching methods, gender is also implicative to students' performance in some skills acquisition concepts in science (Okeke, 2007). The issue of gender disparity in terms of skills acquisition permeates every aspect of human endeavour (Okeke, Egbunonu & Ugbaja, 2009). Some skills are socially biased against one or the other, such as more females are into home economics while more males are into agriculture. Eventually, this distorts available job opportunities of some individual sex despite their talents for such skills. This study therefore, investigated students' ability level in area of entrepreneurial skills acquisition and its effect on students' performance and retention in biology.

## 1.3 Objectives of the Study

The following were the objectives of the study which are to:

i. find out the effect of Project-based approach on students' academic performance in Biology.

ii. find out the effect of Project-based approach on students' retention of Biology concepts.

iii. investigate the effects of Project-based approach on students' entrepreneurial skills acquisition on retention abilities.

iv. determine whether Project-based approach is gender friendly.

v. determine students' level of entrepreneurial skills acquisition using Project-based approach assessment tools .

## 1.4 Research Questions

The following research questions were advanced for the study:

i) What is the effect of Project-based approach on students' academic performance in Biology?

ii) What is the effect of Project-based approach on students' retention of Biology concepts?

iii) What is the effect of Project-based approach on students' retention ability to acquire entrepreneurial skills in Biology?

iv) Is there any difference in the performance mean scores of male and female students after exposure to Project-based approach in Biology?

v) What is the difference between levels of entrepreneurial skill acquired using Project-based Approach assessment tools (DATS and TFLE)?

## 1.5 Null Hypotheses

The following null hypotheses are formulated and tested at $P \leq 0.05$ significant levels.

$HO_1$: There is no significant difference between students' means scores in Biology taught using Project-based Approach and those taught using lecture method.

$HO_{2:}$ There is no significant difference between the retention mean scores of students taught Biology concepts using Project-based approach and those taught using lecture method.

$HO_{3:}$ There is no significant difference in students' acquisition of entrepreneurial skills when taught using Project-based approach and those taught using lecture method.

$HO_{4:}$ There is no significant difference in the mean scores of male and female students after exposure to Project-based approach in Biology.

$HO_{5:}$ There is no significant difference in students' ability levels in entrepreneurial skills acquisition using Project-based approach assessment tools (DATS and TFLE).

## 1.6 Significance of the Study

The research findings would hopefully benefit the following:

i. **Biology Students**: Provides training for career placement and development in education and instills in students technical skills and confidence for selecting appropriate entrepreneurial skills. It would provide a bench mark for students to financially assist their parents in solving some of their academic problems.

ii. **Biology Science Teachers:** Trained teachers in identifying and integrating some concept of biology for entrepreneurship development. Also, provide training for managing efficiency which is the hall mark of entrepreneur's enterprise.

iii. **School Administrators**: School administrators acquired personal, technical and managerial skills as they are involved in the implementation processes of every educational innovation. Therefore, they acquire more skills through assessing projects.

iv. **Curriculum Planners:** Serve as database for curriculum planners to develop new curriculum for entrepreneurship education. Specifically the production of Entrepreneurship-based Project-based approach Teaching Manuals on fishery,

poultry and floriculture, their respective syllabus as well as assessment tools (DATS, TFLE, and Entrepreneurship-based Project Approach check-list) will serve as a base for further research work and entrepreneurship development in biology.

v. **Researchers:** Serve as a foundation for further researches and development of innovative educational delivery that would enhance implementation of entrepreneurship in secondary schools.

vi. **Publishers:** Be used for designing teaching manual to guide activities in selecting skills. Therefore, publishers would have this opportunity to produce as much as possible manuals for every student to lay hands on.

vii. **Society:** Reduce chances of crime and youth restiveness among unemployed youth because of the pre-exposure to entrepreneurial skills before graduation from secondary schools. Entrepreneurial skills acquisition provides benefit to society, even beyond their application to business activity. It adds up to attitudinal changes or personal qualities of individual in aspect such as creativity and spirit of initiative. It raises the economic standard of a given society through self-reliance, self-productivity and self-employment.

## 1.7 Scope of the Study

The study investigated the effects of Project-based approach on entrepreneurial skills acquisitions, retention and performance in biology among secondary school students in Niger State. The study was limited to the seven Educational Zones in Niger State namely Bida, Kutigi, Minna, Suleja, Rijau, Kontagora and New Bussa. This study was carried out using only public Senior Secondary School (SS II) students. SSII classes were considered based on the following reasons; as they were pre–exposed to Biology from SSI; the nature of the curriculum that focused on some rudimentary concepts of biology for entrepreneurship; the use of Entrepreneurship/Trade study syllabus in Fishery and Poultry.

The Senior Secondary School Biology concepts for entrepreneurship used for this purpose were drawn from the senior secondary school Biology syllabus. They include the following topics: Reproduction in invertebrates, (zooplanktons and phytoplanktons), Reproduction in vertebrates (poultry and fishery), Nutrition in animals (poultry and fishery), Basic concepts in ecology for teaching fishery and poultry as concepts of entrepreneurship training.

## 1.8 Basic Assumptions

This study assumed that:

i. Schools in the education zones of Niger State run the same biology syllabus.

ii. Project-based approach effect could measure parameters required (entrepreneurial skills acquisition, retention and performance) for this study.

iii. The biology teachers were all trained and could handle the biology concepts used for the study.

# CHAPTER TWO

# REVIEW OF RELATED LITERATURE

## 2.1 Introduction

This chapter deals with review of related literature and was viewed under the following sub-headings:

2.2 Teaching and Learning of Biology at Senior Secondary School.

2.3 Science Teaching Methods and Process Skills

2.3.1 Project Teaching Approach and Performance in Science at the Secondary School Level.

2.4 Scientific Process Skills and Skills Acquisition in Biology.

2.5 Concepts of Entrepreneurship in Science.

2.5.1 Concept of Entrepreneurship and Process Skills in Biology.

2.5.2 Concept of Project-based Approach through Entrepreneurship Education.

2.5.3 Concept of Project-based Approach and Diagnostic Adaptive Testing Skills in Biology.

2.5.4 Project-based Approach and Students Performance in Biology.

2.5.5 Project-based Approach and Students Retention Ability in Biology.

2.6 Overview of Similar Studies.

2.7 Implications of Reviewed Literature for the Present Study.

## 2.2 Teaching and Learning of Biology at the Secondary School Level

It is acknowledged that the needs for education is derived from a larger goal of the society and to change such societal goals and aspirations change become imperative through educational process. Nnorom (2009) reported that science curriculum is dynamic and continue to change with changes in the society. It is through science that the aims and objectives of science education are achieved. These aims and objectives are ever changing which is subject to innovation through science and technology. In line with this, Omole (2007) noted that an effective curriculum is one that is dynamic and sensitise people's needs requirements so as to effectively participate in social development through developing entrepreneurial skills. Adikwu (2008) reported that Nigeria curriculum at all levels must be global in nature to address the current Sustainable Development Goals (SDGs) if Nigeria must not to be left behind in the world of globalization by the year 2020.

The need for a functional science curriculum in Nigeria has led to a number of curriculum changes with West African Examination Council (WAEC) and National Examination Council (NECO) as indicators for judging students performance for the suitability of the curriculum (Nnorom, 2009). Nnorom (2009) affirmed that any good science programme should be geared towards inculcating in the students the need for a clear understanding of the concepts in science and their capability to use science in solving simple problems for the good of man and the society at large. It is in view of this that government of Nigeria reviewed and updated the National Policy on Education FRN (2013) to focus on situating educational sector within the overall context of government reform agenda so as to meet up with SDGs and NEEDS requirement goals which include social and economic transformation, wealth creation, poverty reduction, employment generation and value re orientation.

For the actualization of the SDGs and NEEDS goals, for example article seven (7) items 2, 3, 4 of National Policy on Education (FRN, 2013) spelt out some specific goals to ensure the usage of Project-based Approach in teaching secondary schools students among others the goals are to: Ensure quality of education delivery at all levels; promote functional education for skill acquisition; job creation, and poverty reduction; ensuring periodic review, effectiveness and relevance of curriculum at all levels to meet the needs of society and the world of work. Thus, for the attainment of these specific goals in line with this context of entrepreneurial skill education, proactive measures need to be considered by ensuring that: Educational activities shall be learners-centred to maximized self-development and self-fulfillment; teaching shall be practical, activity–based, experiential and information technology supported; Education shall be related to overall community needs; the reason being that the education given will be meant to orient individual towards maintaining productive national values in acquisition of functional skills and competencies necessary for self-reliance right at secondary school.

More also, Section 3 sub-section 35 of National Policy on Education FRN (2013) identifies senior secondary school to be Post Basic Education and Career Development (PBECD) level. Education at these levels aimed at providing basic education and skills to graduates who are not proceeding to senior secondary schools or senior secondary school graduates that are not proceeding to tertiary level. The aim is to prepare individuals for the world of work, wealth creation and entrepreneurship education for life sustainability. Senior secondary school was considered to actualize the PBECD objectives which include to:

i. Provide the holders of post basic education certificate with the opportunity to advance education to a higher level;

ii. Offer diversified curriculum to cater for the differences in talents, disposition, opportunities and future roles;

iii. Provide skilled man power in the applied science at sub- professional grade so as to be functional at labour market;

iv. Provide entrepreneurial, technical and vocational job- specific skills for self–reliance and for the agricultural, industrial, commercial and economic development.

The attainment of the aforementioned objectives of PBECD, Section 3 sub-section 38.1 identified trade /entrepreneurship subject (as subjects that emphases skill acquisition) among others as compulsory cross-cutting subjects.

In view of this subject, (trade /entrepreneurship subjects) section 3 sub –section of 38.2.5 of National Policy on Education FRN (2013) out lined 34 fields of studies under trade/entrepreneurship subject while item 21(Animal Husbandry) and item 22 (Fishery) were selected as biology concept for entrepreneurship education among Secondary School students of which Project-based Approach could be applied. Section 3 sub-sections 39 of National Policy on Education, FRN (2013) stated the criteria for selecting subjects for WASCE and SSCE Students are expected to select one (1) field among the 34 fields of trade/entrepreneurship study. It is on this note that the researcher selected this study to develop suitable curriculum that would train students to be self- reliant right from secondary school using Project-based approach.

### 2.2.1 Biology Curriculum

Biology education exposes learners to biological nature, processes and attitudes and teachers with the professional skills of teaching biology (Nnorom, 2009). Biology curriculum remains one of the basic sciences taught at post basic education level with its curriculum that focuses on solving individual problems in relation to its environment based

on the four main objectives enshrined in the National Policy on Education, FRN (2013). The learners should be exposed to the;

i. Acquisition of adequate laboratory techniques/Field skills necessary to carryout and evaluate experimentation and project in biology

ii. Provision of meaningful and relevant knowledge that will be functional to the needs and aspiration of the society.

iii. Ability to apply scientific knowledge to everyday life on matters of personal and community health and agriculture.

iv. Reasonable and functional scientific attitude

Therefore, it is in accordance with the above stated objectives, that the content and context of biology syllabus placed emphasis on acquisition of activity-based field skills studies through Learner-centred guided discovery, for the development of reflective and conceptual thinking among biology students. This will develop in student the mindset of being self-reliant through entrepreneurial skills acquisition. Therefore, this study envisaged that Project-based approach would provide the gate way for the actualization of these objectives. This approach is regarded by scholars to be appropriate in teaching biology (Yunusa, 2002; Okeke, Egbunonu and Ugbaja, 2009; Nnorom, 2009 & Omomttee, 2011).

The approach encourages the entrepreneurship training which requires attitudinal changes in searching for opportunity where others hesitate. This therefore requires teacher's interest in using the right and varieties of methods for the attainment of set goals. Nnorom (2009) and Omomttee (2011) asserted that no any scientific method can be effectively taught without considering the teacher's reasonable and functional scientific attitude. The role of teacher becomes indispensable in teaching Project-based Approach.

### 2.2.2 Role of the Biology Teacher in Entrepreneurship Education

According to, Dike (2009) and Lawal (2009) Nnorom (2009) stated that the teacher of biology has a great role to play in impacting entrepreneurial skills in biology students. The roles are as follows:

i. The biology teacher should be able to identify concepts in biology that lends itself to entrepreneurial skill acquisition.

ii. The teacher of biology should be able to teach concept with a double aims of acquiring the knowledge as well as the demonstrating skills that can help open a way to productive opportunities.

iii. The biology teacher should practicalize the teaching, giving small group or individual project work that lead the learner to acquire relevant practical skills for self reliance.

iv. The biology teacher should link up with existing relevant industries for the students to get first hand information, industrial as well as practical experiences.

v. The biology teacher should make available enough information in form of pamphlets or teaching manuals carrying useful information on how to carry out the jobs.

vi. Adequate period must be given for intensive exposure of students to practical knowledge as well as skills.

vii. The teacher of biology should try as much as possible to create or invent the equipment or tools needed or improvise where the need arises.

viii. The teacher of biology should have a good mastery of subject matter and good use of effective instructional strategies which will enhance scientific and pedagogical skills.

ix. Teacher of biology should use authentic assessment methods for student as it has to do with performance-based and requires students to exhibit the extent of their learning in a real life situation through a demonstration of mastery skills.

It is in the view of the researcher that Project-based approach being a strategy in teaching some concepts of Biology using DATS and TLFE as form of assessment of students' performance and retention in biology can lead to skill acquisition. .

## 2.3 Science Teaching Methods and Process Skills

### Science Teaching Methods

Teaching methods are strategies displayed by a teacher in impacting knowledge to learners. Emphatically teaching is an enterprise being a cluster of activities a teacher may engaged in a classroom situation during a specific time period. There are several methods of teaching science and the choice of method is determined by the topic to be taught. Furthermore, there is hardly any method that can be used in isolation in a typical lesson rather requires interception of other methods. A skillful teacher may need the use of two or more methods that are relevant to enhance effective teaching and learning process (NTI, 2001; Nnaobi 2007& SMASE, 2010).

According to the report of SMASE baseline survey (2006) in Nigeria revealed that teaching method commonly used in Nigerian institutions are lecture and demonstration methods, which pave way for rote learning and discourages students inquiry and creative mindedness. Other teaching methods that are appropriately being used by science teachers include: Inquiry method, discovery method, problem solving method, discussion method, project method, constructive approach, team teaching, lecture method to mention but few. Nnaobi (2007) affirmed that there is no best method of teaching but, the effective scientific teaching should be laboratory-centred and activity-oriented rather than textbook or lecture dominated method which characterized teaching approach in Nigerian schools. It is on this note that this study uses Project-based approach that characterized the laboratory-centred and activity-based methods.

Researchers shows that teaching methods can said to be:

i. Organizational method

ii. Instructional or communication methods

i. Organizational method: This consists of: (i) class teaching method (involves a teacher teaching a large number of pupils in a class), (ii) Individual teaching method (involves one-on-one correspondence at individual pace), (iii) group teaching method (involves teaching pupils in a unit of 5 pupils). (ii) Organizational teaching method forms a stage on which instructional teaching methods operate while Project method is a component of organizational method of teaching entrepreneurship biology concepts through Project-based approach using DATS assessment strategy. Project method requires individual and group method of teaching to succeed. (NTI, 2001 & Akpomi, 2009).

ii. Communication or Instructional method of teaching: This encompasses lecture, discussion, demonstration, inquiry, discovery, problem-solving, to mention but few (NT1, 2001).

Lawal (2010) reported that some topics in science specifically in Biology prove to be too difficult for students to understand and thus students perform poorly in the examination. This makes it imperative for teachers of biology to possess the required skills or techniques in determining the appropriate methods to be used in achieving adequate instructional goal for such difficult concepts. It is on this note that Akpomi, (2009) and Lawal (2010) opined that the methods of instruction adopted by teachers are strong determinants to achievement in learning if creatively and skillfully selected. The following are some selected science teaching methods.

**Inquiry Method**

'Inquiry method', otherwise called 'investigation', or 'pseudo-experiment' refers to the technique of questioning, seeking knowledge or information or find out about

phenomena (Obeka, 2010). Using this method students learn not only concepts and principles but spirit of self-direction, responsibility and social communication. More also, in inquiry method, the learner learns the strategies for solving problems through the use of science process skills (Olajide, 2012).

**Inquiry Method and Process Skills:**

It is a highly interactive step by step approach which involves students at all levels of discussion putting in to play all science process skills for attaining scientific goals, (Obeka, 2010). In the same vein, Olajide and James (2009) and SMASE (2011) see inquiry method as a science process skill in the act of questioning, exploring and experimenting natural phenomena in order to confirm or reject predictions. This involves activities, skills which focus on active searching for knowledge or understanding by a learner, with minimum guidance in order to satisfy curiosity or discover solution to a problem. It is similar to problem- solving methods in some aspects (SMASE, 2011). Similarly, Akinsete (2006) stated that it is a method of teaching (inquiry) that encourages a child to solve problems by seeking and asking questions to gather information, interpret and analyse the gathered information in order to search and ascertained for profitable opportunity that would aid in solving the societal problems.

Inquiry method involves development of skills in scientific discovery about natural phenomena. The listed skills below represent psychometric and cognitive skills of an educational objectives on which science process skills serves as interface for the discharge of inquiry method.

**i.** Acquisition skills: Such as rewarding, comparing, contrasting, classifying, organizing among others.

**ii.** Manipulative skills: Such as using an instrument, demonstration, experimentation, repair, construction, collaborative among others.

**iii.** Communication skills: Involve asking question, discussion, explanation, reporting, writing, criticising, graphing and teaching (NTI, 2001; Olajide and James, 2009; Olajide, 2012). Olajide (2009) stated that inquiry method is an appropriate communication or instructional teaching method for teaching entrepreneurship education. Entrepreneurship education requires interactive medium through the use of acquisition, manipulative and communication skills. This study therefore uses these aforementioned skills to assess students' performance in skills acquisition in fishery and poultry among secondary school students.

**Discovery Method**

'Discovery' means to 'find out'. The method offers students with the opportunity to discover scientific facts, concepts, and principles for themselves rather than being told (NTI, 2001 & SMASE, 2010). Guided discovery is a student-centred activity oriented teaching strategies in which the teacher guides the students through problem solving approach to discover answers to instructional problem at hand (SMASE, 2010).

**Discovery Method and Process Skills**

Discovery implies induction in which students proceed from specific examples (precepts) to concepts and from concepts to a generalization or principles. These three basic words are predominant in discovering method. The three concepts are fundamental tools of science process skills use before conclusion is made about natural phenomenon. According to SMASE (2010) discovery method is a method that involves learners performing certain mental process skills (cognitive processes) such as observing, classifying, measuring, predicting, describing, inferring and to mention but few. As this method emphasized the understanding of concept of particular phenomena, thus, cognitive domain is highly emphatic in reaching a constructive generalization or principle.

The following skills are considered to this effect (discovery method) by SMASE (2010) outlined skills in discovery method as the integrated science process skills using Project-based approach for skill acquisition, which atre:

**i.** Comprehension skill**:** This is through observing, selecting, explaining, illustrating, interpreting, summarizing and indicating.

**ii.** Application skill: Through calculating, solving, constructing, showing, demonstrating, computing and to mention but few.

**iii.** Analytical skill: Through comparing, contrasting, separating, classify, differentiating and to mention but few.

**iv.** Synthetic skill: Through suggesting, relationship, generating, gathering data and to mention but few.

**v.** Evaluative skill: Defining, assessing, recalling, measuring and to mention but few.

Adeoye and Alayande (2009) summarized that discovery method makes activities enjoyable, accessible and promote students language and communication and entrepreneurial skills. Therefore discovery method remains bedrock for the students to discover their suitable area of profitable venture, discover resource from sources, discover opportunity from what others neglected, and discover suitable skills and strategy in teaching biology concepts for entrepreneurship in secondary schools. This study was able to identified significance of using the above mentioned skills (Comprehension skill**,** application skill, Analytical skill, Synthetic skill and Evaluative skills). Project-based approach uses these skills in integrated form to assess students' performance in skills acquisition in fishery and poultry among secondary school students.

**Problem Solving Method:**

This method is defined as an application of the unit idea (SMASE, 2010). It embraces a continuous, meaningful and well integrated activities beginning with a

problematical situation. It then ends when the problem has been solved, and the solution checked. The series of actions involved in the process constitute a unit of experience. In other words, problem solving method is a teaching- learning process in which the students work on solving a problem. They do this by using result of some analysed data. The data are collected from a proved solution rather than an assumed solution. Thus, in this method students are given a problem and required a proven solution to a problem (NTI, 2001, SMASE, 2010).

**Problem Solving Method and Process Skills**

This method requires the use of generalised data or the result of some analysed data so as to proffer solution to a related problem or make prediction about future occurrence. The data are collected from a proved solution rather than an assumed solution through science process skills so as to arrive at generalised conclusion.

There are three types of problem-solving approaches in acquiring skills. These include;

i. The guided approach;

ii. The modified approach

iii. The free approach

i. The guided approach: This is used when the students are inexperienced in the use of skills. The teacher takes control and directs the students in the areas of the lesson. Considering science process skills, the teacher initiates the topic, the hypothesis, the collection and the analysis of data. The teacher guides the students to arrive at a generalization. To this context the teacher group the students into groups of five to work in collaboration (Adebayo, 2009).

ii. The modified approach : This is used when the students are ‘catching up’ with the acquired skills. The students can handle some part of the procedure and the teacher

still serves as a resource person in the process of problem solving approach. Individual or group activity could be given to ascertain student(s) level of competency.

iii. The free approach: this is used when the students can handle the skills independently. They can formulate the topic and work to draw up generalizations (NTI, 2001). This stage requires the students to draw up a business plan that develop a full fledge productive policies. Two procedures are involved in using problem solving methods:

i. Inductive procedure which is to enable the students to establish generalizations (general principles) from observed cases.

ii. Deductive procedure which involves students given established rules. These rules are to be used to solve problem or to prove the correctness of the rules (NTI, 2001).

Problem-solving skill is synonymous to inquiry method that emphasize mainly on cognitive and psychomotor domain. Inquiry and problem-solving methods incorporate discovery approach as one of its elements. NTI (2001) reported that inquiry or problem-solving methods are natural extension of the discovery method. Therefore, inquiry and problem-solving method are better used in higher classes of secondary schools (Senior Secondary School) than lower classes (Junior Secondary School). These are main components of Project–based approach that assist the researcher in teaching and assessing learning progress as well as skills acquisition among secondary school students..

**Demonstration method:**

This is a method of science teaching that involves manipulation of certain scientific equipment to show or illustrate scientific principles or concepts(NTI, 2001 & Obeka, 2010). It is a teacher-centred method but could involve the students through rigorous demonstration. This method is employed when an instructional material is costly; difficult

to use; involves stimulating and direct thinking in inquiry manner of teaching. It can be used when handling and using new equipment or teaching demonstration concept. Therefore, it is a teaching strategy which requires or involves experimentation (NTI, 2001; Obeka, 2010 & Igboegwa, 2012).

Demonstration method involves continuous oral examination, with illustration to communicate processes, concepts and facts. Demonstration method has been shown to be superior to lecture method in aiding retention (Nwachukwu and Nwosu, 2007 & Obeka, 2010). Obeka (2010) asserted that Demonstration and Inquiry method can be combined for effective teaching but inquiry method is more effective and efficient than demonstration method in teaching science subjects.

**Demonstration Method and Process Skills**

Demonstration method deals with cognitive and psychomotor domain display of learning objectives. The following science process skills are required for attainment of the Project-based approach goal:

**i.** Acquisition skill: Such as rewarding, comparing, contrasting, classifying, organizing among others.

**ii.** Manipulative skill: Such as using an instrument, demonstration, experimentation, repair, construction, collaborative among others.

**iii**. Communicative skill: Such as asking question, discussion, explanation, reporting, writing, criticising, graphing and to mention but few (NTI, 2001).

**Lecture method**

Lecture method is the process whereby the teacher verbally delivers a preplanned body of knowledge to learners (NTI, 2001 & Olajide and James, 2009). Lecture method is regarded as a way of teaching in a situation where a large number of students or participants is involved. Lecture method is a conventional chalk-talk method in which the

instructor reads a prepared note to students and give explanations, illustration or demonstration where necessary to complement the information in the lecture (Usman, 2008). Students in this case are passive listener or sometime actively involved in jotting chalkboard summary.

Lecture method remains the conventional or prominent method of instruction over the years. It attracted the attention of scholars as a process of instruction that makes teaching and learning easier and faster. This method is regarded to be traditional method right from the period of the Greek philosophers, (Socrates) in 470-399 BC) and often used in upper classes of secondary schools and in post secondary institution (NTI, 2001).

Academic performance is the attainment of set objectives of instruction (Nnaobi, 2007). To this context, performance can be viewed from its academic performance in a particular skill by a learner. lghoegwu (2012) reported that studies have shown that the teaching of science in Nigerian secondary schools fall short of the standard expected of it with regards to performance. This is due to inappropriate and uninspiring use of teaching methods by teachers. Usman (2008) reported that lecture method does not give room for interactive mode of instruction. It encourages rote learning without understanding concepts, and it does not encourage student inquiry and creative mindedness; it does not cater for individual differences; listening skill is highly emphasized; students understanding are merely judged by assumption; active participation of students is avoided and neglected. Thus, the need to encourage learner-centred activity is highly imperative for effective delivery of functional biology. This can be achieved if teaching of biology is to be a profitable venture, Project -based approach could be used to this effect.

Olorukooba, Lawal and Jiya (2012) affirmed that different instructional strategies have relatively different effect on students' academic performance. Okoli (2006) indicated that an overwhelming majority of biology teachers prefer the lecture method of teaching

and therefore shy away from innovation, activity-oriented teaching method that emphases hand-on activity rather than heart-on-activity. Eventually this affect students' performance particularly in subject like biology that is said to be voluminous in content and has not been considered commercially significant due to inability to identify its entrepreneurial potentials. It is on this note that students lost interest which consequently make students' academic performance in Biology to deteriorate. Usman (2008) had separately observed that lecture method encourages rote learning without aiding understanding thereby resulting to poor performance in Biology. To ensure effective delivery and selection of profitable activity-oriented concept in Biology among secondary school, Project-based Approach needs to be employed to enhance students' academic achievements.

## 2.3 Teaching Biology Concepts Using Project Teaching Approach

Project teaching approach is an educational strategy in which students solve practical problems over a period of several lessons, days or weeks. In other words it is regarded as a process of learning carried out by learners in real life situation. This may be carried out individually or in group under the guidance of the teacher to achieve set objectives (NTI, 2001). In this type of situation student acquired skill of mind-on, hand-on and heart-on-activity, with hand-on-activity (psychomotor) having more emphasizes. Project–based approach in this regard engages students working under freedom and autonomy to decide on what and how to learn or acquire skill at their own pace. In this case the learner decides on the topic to work on, how to collect data, analyses data collected and draw conclusion under the guidance of the teacher through discussion, advice, counseling, conference or instruction be it in written or oral form. The Project-based approach provides the necessary tools in actualizing the topical nature of the objectives of biology (entrepreneurship) in our institutions. The concept of biology placed emphasis on acquisition of activity-based field skills studies through learner-centred and guided

discovery for the development of reflective and conceptual thinking among biology students. This will develop in learner the mindset of being self-reliant through entrepreneurial skills acquisition. Also biology aimed at providing individual with meaningful and relevant knowledge that will be functional to the needs and aspiration of the society; providing individual with adequate laboratory techniques and field skills to carryout and evaluate experimentation and project in biology. Project–based approach trains individual with the mind set of acquiring field skills and functional knowledge needed by the society to identify opportunities where others hesitate. Project-based approach could be in theoretical form or practical form depending on the type of project objective, practical activity, aesthetic type, problem type and the nature of the skill required (Yunusa, 2002 & SMASE, 2010).

### 2.3.1 Project Teaching Approach and Performance in Science at the Secondary School Level.

#### 2.3.1.1 Traditional Lecture Method and Project-based Approach

Traditional lecture method is a verbal presentation of content or subject matter formally organized and supported by other learning media, extending over protracted period of time (Yunusa, 2002 & Usman.2008). This method of teaching originated from Plato's method of teaching secondary school students. As Plato's method of teaching exposed the learner to precepts and beliefs in interpretations and encourage students urge to ask questions.

It could be seen that lecture method is limited in scope as compared to project approach. However, lecture method is still necessary, particularly during the introduction and the presentation aspect of some entrepreneurial ventures. Also it can enhance mobilization and sensitization of entrepreneurial enterprises (NTI, 2001; Yunusa, 2002). Olajide and James (2009) viewed that lecture method is mostly used by the majority of science teachers in teaching science across all levels and this strategy is mainly

authoritative. Nonetheless this method assist instructor to deliver a particular task in a short period of time especially during preparatory stage of project-based approach. Biology is regarded to be voluminous in content, therefore, need to be skimmed in presentation so as to enhance easy coverage of content over time. Lecture method can salvage presentation of voluminous content as well as assist in presenting introductory aspect of entrepreneurship activity. However, the success of every lesson depends on the selection of suitable method. Thus, Project-based approach and traditional lecture method can be compared considering some relevant aspects in teaching biology.

#### 2.3.1.2 Laboratory Practical Work and Project-based Approach

Laboratory practical work is an inquiry and hand-on activity which makes it possible to transfer knowledge on higher order of cognitive level and create curiosity in students (Fenton *et al.,* 2013). Practical work develops problem solving skills and a deeper understanding of the concepts and principles in biology students. Practical work prepares students for adult life by translating theory learned in the classroom into practical form in a laboratory. Contrary to Laboratory practical work, Project-based approach is regarded as a way of teaching through practical assignment but as an outdoor activity (Fenton *et al.,* 2013). Project-based approach is a learning approach that enables learners to appreciate their physical environment by identifying available resources as well as building on students' creativeness and innovativeness of changing source into resource. This approach offers the learner the required experience to freely explore and develop a functional skill in biology for life sustainability. Traditional laboratory practical work can be restrictive and may limit students investigation potential (Fenton *et al.,* 2013). It is possible to implement Project-based approach to develop problem solving skills in secondary school biology using Project-based approach. But most often it should not be a substitute to regular traditional laboratory practical methods but rather complement it. This is so because

practical activity as a complimentary approach to project-based approach requires the interplay of science process skills at all ramifications (Fenton *et al.* 2013).

Therefore, to be scientifically skillful, science process skills need to be put into play in entrepreneurship education. Entrepreneurship skills are occupational survival skills which require the ability to do something in functional and logical forms using all the required senses of hand-on, mind-on and heart-on. Laboratory teaching as the instructional mode of Project-based Approach is described by instructional theorist as a technique by which the learner studies scientific phenomena with the approach of the scientist and using scientific process skills such as observing, comparing classifying, experimenting, communicating, inferring and so on (Olajide, 2012).

## 2.4 Scientific Process Skills and Skills Acquisition in Biology.

The search for more effective approach for teaching and learning of biology enhance the acquisition of science process skills. This is because, acquisition of science process skills are the bases of scientific inquiry and the development of intellectual skills and attitudes needed to learn biological concepts. To actualized this assertion some programmes such as Science A Process Approach (SAPA) designed by American Association for the Advancement of Science (AAAS) aimed at improving in child the spirit of acquisition of needed skills through scientific processes. Science process skills are therefore regarded as the paths and strategies followed by scientist using senses of hand-on, heart-on and mind on in order to acquire scientific skills. Femi (2010) posited that most science curricula attach much importance to student's acquisition of skills, despite the relevance of process skills and the poor students' performance in science examinations. Essien, (2009) describe science process skills as abilities which can be developed by experience and which are used in carrying out mental operations and physical actions.

Okoli (2006) observed that teachers cannot teach effectively without employing the processes of science neither can students learn science effectively without acquiring such processes as well. Study by Okoli (2006) asserted that when some one acquires the science process skills of observing, measuring, questioning, designing experiments interpreting data, such a person becomes specially equipped with the tools required for scientific inquiry or problem solving as well as ability to use these skills in the laboratory for a variety of investigations.

Nigerian Education Research Council (NERC 1990) modified science process skills as observing; classifying; predicting; using numbers; questioning; defining operationally; hypothesizing; interpreting data; measuring; communicating; inferring; using space /time relationship; controlling variables; formulating models and designing experiment. Realising the significance of the science e process skills to problem solving, the Federal Government of Nigeria among other things states as one of the national goal of education in Nigeria that: education should aim at helping the child in the acquisition of appropriate skills; abilities and competencies, both mental and physical as equipment for individual to live in and contribute to the development of society (FRN 2004). Biology teachers should therefore, be creative, resourceful, and enthusiastic in their chosen profession by adopting measures that ensures that their students acquire the right scientific knowledge, skills and attitude while at the same time inculcating scientific literacy in these students. This would enable learners to change ideal or scientific literacy into profitable products (Okoli, 2006).

The need to use science process skills becomes highly important visa viz observation, classification, measurement, counting numbers, recording, communication, prediction, hypothesizes, inferring, experimentation, research, interpretation of data, controlling variable, generalization to mention but few. The use of these process skills over

a period of time lead to an accumulation of scientific knowledge in form of scientific law, principles, and theories, all of which put together constitutes the products of science.

Development of science process skills will lead to acquisition of the skills, that successful entrepreneur use to start a business venture., Some of the integrated science process skills inclined to entrepreneurial skills are: creative thinking, planning and research, decision making, organization, communication, team building, marketing, financial management, record keeping, goal setting and business management, (*http;//www,mvp.cfee,org/en/selfasssessmentskills ,html, 2009).* Ezekannagb and Moukebe (2009) outlined the following as entrepreneurial skills: observation, determination and interpretation of market, exhibition of knowledge and mastery of skills and ability to communicate. More also, Ezekannagb and Moukebe (2009) opined that integrated science process skills for the purpose of Entrepreneurship through Project-based approach to include: Personality skills, Managerial skills, Commercial skills and Technical skills. Ezekannagb and Ezekannagb and Moukebe (2009) further stressed that skills that are tacit can be exploited or acquired if the teacher can use varieties of teaching methods in attaining the needed goals. Project-based approach teaching method can be investigated as more appropriate in teaching that required entrepreneurial skills. It is on this note that this research work aimed at investigating the effects of Project-based approach in skills acquisition, retention and performance in biology among secondary school students.

**Science Process Skills and Academic Performance in Biology**

It has been observed that in science instructions for instance, if a learner accomplished a tax successfully and attains the specified goals for a particular learning experience, the learner is said to have achieved. Besides, the execution of a particular tax so as to attain a particular goal makes an individual to have performed. Thus, better performance is recognise when more work is accomplished by an individual in a very

limited time frame using less resource. The attainment of the goals of scientific education over a limited time using less resource is of major concern to education policy makers and some of such goals are: the inculcation of scientific literacy; inspiring students especially students of biology with a desire for self-achievement, self-improvement and self-reliance both at school and later in life, National Policy on Education, (FRN, 2013). It is on this note that entrepreneurship education through science process skills in biology become highly significant in current trend of educational reform.

According to Olorukooba, Lawal and Jiya (2012) stressed that biology is centred to science education which involved exposing students to several opportunities that can help them to be useful to the society as well as understand different type of concepts, principles and theories. Thus, biology remains prerequisite to the study of some professional course for instance medicine, pharmacy and agriculture. Thus, failure in biology, affect the study of these professional courses. Okoli (2006) reported that biology concepts can sometime be difficult particularly when describing ideas that are abstract or cannot be fully comprehended by learners for the first time. Therefore, research finding by WAEC (2006), Lakpini (2006), Lawal (2009) Lawrence, Ken, Patrick (2009) identified a number of concepts in biology to include evolution, genetics and ecology topics that pose difficulty for biology students to understand, which consequently leads to poor academic performance in biology. This invariably affects the admission of students into some professional course like medicine and pharmacy.

The success of any educational goal revolve on the selection and the use of appropriate methods of teaching. Failure to select appropriate method of teaching makes teaching and learning haphazard and consequently affects learners' performance particularly in biology. In view of these assertions, Fento, *et al.* (2013) affirmed that no single method is best for the teaching of science especially biology. Until variety of

integrated methods that would require the interplay of science process skills that employed student's active participation, cooperative learning is enhanced. Thus, the researcher felt to test the effect of project-based approach on students' performance and retention in Biology.

A number of teaching strategies such as lecture, discussion, inquiry, demonstration, concept-mapping and cooperative learning have been employed in teaching biology over the years but academic performance in secondary school certificate examination in biology continue to be poor. This raised doubt whether the scientific literacy level has inhibited the cognitive process skills of students in Biology due to other variable. This study set out to strengthen the use of science process skill through the use of Project-based approach in teaching biology for self-reliance that would emphasize psychomotor (hand-on-activities) among secondary school students so as to be useful after graduation. Also, DATS according to scholars will boost students' academic performance as well as retention in biology concurrently (Adeyemo, 2009; Akpomi, 2009 & Opatele, 2009).

According to Mbachu (2011) teacher is seen as an agent of innovation, creativity and the fulcrum on which the success or failure of any educational system rotates. Therefore, students' academic performance measures the effectiveness and the efficiency in the use of appropriate instructional strategies by the teacher. On this note Ayua (2009) asserted that teacher is the most indispensable factor in the school systems, without the effective teacher, even if all other things are provided, it would show no effect to the attainment of the desired goals. However no any social development rises above its education and no any educational system can rise above the quality of its teacher (Akinwumi, 2007). Therefore, there would be no qualitative and effective teachers without effective teacher education programme such as entrepreneurship education as it remains the topical issue to economic development or revitalization.

## 2.5 Concepts of Entrepreneurship in Science Education

Entrepreneurs according to Aminu (2008) originated from an Irish man called Cantillo in France in the early part of 18th century. Aminu (2008) further stated that the concept of entrepreneur stems from the French word "entrependre" meaning one who 'undertakes' or one who is a 'go-between' or 'between-taker' literally. Different people perceived entrepreneur in different ways which lead to controversies in literatures over the years. But the main reason which account for the many definition and role is due to the fact that entrepreneurship is studied in virtually all discipline ranging from social position to organisational theory. In view of these controversies, entrepreneur can be grouped into three broad areas:

i. Occupational definition: entrepreneurship is regarded as the provision of organized and manageable self-employment or as wage employment for life sustainability.

ii. Behavioural definition: entrepreneur is regarded as one who perceived opportunity; manage the risk involved for profitable purpose.

iii. Economic definition: entrepreneur is a person who controls all factors of production in order to establish profitable venture.

In view of this, Kajuru (2015) pointed out that an entrepreneur is a person who involve in innovation, development, recognition, seizing opportunities and converting available opportunities in to marketable idea and marketable idea into profitable venture. Thus, in scientific terms entrepreneur is a person who perceives opportunity, organizes resources using science process skills needed for exploiting opportunities for the purpose of' profit making while satisfying the needs of people (Evborokhai & Abubakar, 2011). Entrepreneur searches for change and responds to it. Entrepreneur is a risk taker that searches for opportunity where others considered insignificant and makes a valuable venture to the society. As an innovator entrepreneur possesses scientific skills of

converting a source into a resource, and a need achiever (Abubakar, 2011). It requires the application of energy and passion towards the creation of implementation of new ideas and creative solutions to the problems at hand. Associated with entrepreneurship is the concept of intrapreneurship.

**‘**Intrapreneur’: This is a person within a large cooperation who takes direct responsibility for turning an idea into a finished profitable product through an assertive risk taking and innovation. To this context intrapreneur is regarded to be a person working within the cooperation rather than outside the organisation. In contrast entrepreneur is a person who through his or her skills create a business and willingly take a manageable risk of accounting for any success or failure encountered, whereas intrapreneur is the person who utilizes his or her skills and innovations to manage or create something useful to an assisting business or someone else business. To further buttress this differences, Issa *et,al.* (2014) pointed out the following distinctions:

a. Entrepreneur provides spark of the business while intrapreneur keeps the flame.

b. Entrepreneur are found everywhere their work take them to, while intrapeneur work within the confinement of the organisation.

c. Entrepreneurs may find it difficult to get resources, intrapreneurs have their resources readily available to them.

d. Entrepreneurs know the business on a macro scale while intrapreneurs are highly skilled and specialised on business micro scale.

An enterprise is the business organization that is formed which provides goods and services, creates jobs, contributes to national income, exports and several economic developments (Evkorokhai & Abubakar, 2011). Entrepreneurship training is the rudimentary form of entrepreneurship. This form of education was supported by Plato (425-347BC) where he regarded the training as informal educational system that is more of

apprenticeship system. This type of learning does not give room for the learner to ask questions or be self- initiative, self-inventive, self-creative, self–explorative rather his or her taught is controlled within the confinement of the knowledge and way of life of their predecessors. Learners because of their adaptability and plasticity of youth have no capability for development beyond the level reached by their predecessors. Entrepreneurship training is the provision of occupational skills or practical skills and knowledge used in developing and recognisng opportunities for life sustainability. Entrepreneurship training is often based on personal experience rather than systematic approaches and it takes place outside school environment. Arogundade (2011) stressed that entrepreneurship can be informally learned thus, it can be formally taught.

There have been considerable controversies on a workable definition of what an entrepreneurship is. The term 'entrepreneurship education' is commonly used in the United States of America (USA) and in Canada but less commonly applied in Europe (Gibb, l993). The preferred term within the United Kingdom (UK) is 'Enterprise Education'. Essentially, Gibb(1995) made a clear distinction between enterprise education and entrepreneurship education, with the former focusing on the advancement of personal enterprising attributes and attitudes that prepare the individual for self-employment, while the latter relates to the development of functional management skills and abilities that train the individual to start, manage, and develop a business. Despite this distinction, the ultimate aim of both enterprise and entrepreneurship education is to encourage independent business creation.

Entrepreneurship education is formal educational system confine to school environment (Gidado, 2015). It is about initial expansion, subsequent expansion, factor innovation, production innovation and market innovation. Entrepreneurial education is often categorized into three teaching and learning approaches (Arogundade, 2011). Teaching "about" entrepreneurship means a content-laden and theoretical approach aiming

to give a general understanding of the phenomenon. Teaching "for" entrepreneurship means an occupationally oriented approach aiming at giving budding entrepreneurs the requisite knowledge and skills. Teaching "through" means a process based and often experiential approach where students go through an actual entrepreneurial learning process. The latter is the focus of this research work as well as entrepreneurship education. This approach is often termed action-based entrepreneurial education, which is in turn called 'Learning through Entrepreneurship' this is regarded as Project-based approach (Arogundade, 2011).

Entrepreneurship education to this context of Project Approach is defined by Arogundade, (2011) as a collection of formalized teaching that inform, trains and educates anyone interested in participating in socio-economy development through a project to promote entrepreneurship awareness. In a nut shell Entrepreneurship education is the process of assessing business opportunities by carrying out feasibility study in order to develop a workable business plan that will determine the success or failure of the business enterprise. Therefore the development of entrepreneurial skills in Science Technology and Mathematics education (STM) particularly in Biology as a life science is urgently required to provides opportunities to the growing unemployed graduates (Jongur, Kabutu, & Abba 2009).

According to Evkorokhai and Abubakar (2011) emphasized that the model used for entrepreneurship education has three phases:

a. **Stimulatory phase:** This phase involves planned publicity for opportunities, motivation, training and help/guidance in selection of profitable product or services. This is in agreement with the project approach stages out lined by NTI (2001). This is regarded as the planning and organization stages of project approach.

b. **Support phase:** This provides help in registration of units, management of finance as well as provides, land, shades, power, water, community centre and to mention but few, that will aid marketing of products. This stage conforms to the NTI (2001) implementation stage of project approach.

c. **Sustenance phase:** Once the enterprise is set up, with effective assessment, modification, modernization, diversification, additional financial investment would be achieved. This stage also conforms to NTI (2001) assessment stage of project approach. All the above phases are important in teaching and development of entrepreneurial spirit and skills in any given nation.

**Learning Skills for Entrepreneurship Education**

Entrepreneurship education is valuable to all students, including those who are taking courses other than business and management studies (Smith, Collins, & Harnio, 2006). Akpomi (2009) stressed that entrepreneurship should be taught to students in all disciplines of every institutions. It is not out of place to say that many business ideas emerge from non-business disciplines but are often waved aside or ignored because students are not sufficiently educated with the knowledge and skills to be acquired in the said discipline. Akpomi (2009) stressed that practical skills which can be required through entrepreneurship education programme can hasten the reduction of poverty in our society. Entrepreneur learns in the real world, through "Adaptive" learning (Gibb, 2008). They are therefore, action-oriented and much of their learning is experience-based (Rae and Carstwel, 2000 in Akpomi, 2009). They also learn by doing which encompasses activities like trial and error as well as problem solving and discovery methods (Yunusa, 2002; Adeyemo, 2009). According to Akpomi (2009) reported that learning is not an optional /extra, but is central to the entrepreneur process of changing its tacit idea to profitable goal which can be assessed using DATS (Apkomi, 2009).

According to Pleshette (2009) said that the process of acquisition and development of entrepreneurial skill is concerned with four stages that the learner must put in place and these are to;

i. objectively analysed and identify the current and foreseeable business needed skills in terms managerial, technical, commercial and leadership skills and their relevance. (Planning stage)
ii. identify entrepreneur's personal goals and objectives about the skill so as to accurately analyse and evaluate the skills and its required resources (Organisation stage).
iii. produced a realistic personal development plan for the potential entrepreneur (Implementation stage).
iv. monitor and evaluate on-going performance of the entrepreneur once the business has started, progress made and success achieved in developing new skills (Assessment state).

These stages conform to the outlined by NTI (2001) on the four stages involve in carrying out project-based approach The four stages in using Project-based Approach as outlined by NTI (2001) are:

i. Panning stage
ii. Class or site organization stage
iii. Project implementation stage
iv. Assessment stage

**Objectives of Entrepreneurship Education**

Entrepreneurship education according to Arogundade (2011) is structured to achieve the following objectives which are to:

i. offer functional education to youth that will enable them to be self- employed and self reliant.

ii. provide youth with adequate entrepreneurial training and competencies so as to have the spirit of creativity and innovativeness in identifying sustainable business opportunities.

iii. promote smooth transition of technology from traditional form to modern industrialized types.

iv. serve as catalyst to economic growth and development.

v train learners' mind to acquire the mind set in risk taking management.

vi foster wealth generation through job- specific creation.

vii imbibe the spirit of perseverance in youth that will enable them to persist in any venture they embark on, may be it is there the success lays.

viii discourage rural-urban migration.

alleviate poverty in the society.

ix bridged the gap between academic sphere and labour market terms of productivity.

x develop new skills from the resources considered not feasible by others to create profitable venture.

**Developing Entrepreneurial Competency**

The ultimate goal of entrepreneurship education is to provide youth with adequate entrepreneurial training and competencies so as to have the spirit of creativity and innovativeness in identifying sustainable business opportunities. Martin (2013) stressed that the development of entrepreneurial competencies among learners can be measured interms of Knowledge, Skills and Attitudes that affect the willingness and ability to perform the entrepreneurial job of new value creation. Entrepreneurial competencies can be measured directly and indirectly. Martin (2013) pointed out that frame work of learning by doing is based on the assessment of learners' competency interms of knowledge (cognitive), skills (conative or non-cognitive) and attitude (affection). The facilitating

frame work for assessing these components of competency forms the platform on which Entrepreneurship through Project-based Approach can be developed as seen below:

**Table 1: The Facilitating Frame Work for Assessing these Components of Competency are as follow:**

| Entrepreneurial | What are they? | How to develop? | How to assess? |
|---|---|---|---|
| .a)..Knowledge / …thought / …know-what / …cognition | Mental models, declarative knowledge | Lectures Reading literature | Summative tests Reports – oral/text |
| b) Skills / …action / …know-how / …conation | Marketing, strategy, resource acquisition, opportunity identification, learning, interpersonal skills | Lectures Reading literature Case based teaching Learning-by-doing | Summative tests Reports – oral/text Jobs taken / done |
| c) .Attitudes / …emotion / …know-why / …affection | Passion, self-efficacy, identity, proactiveness, perseverance, uncertainty tolerance | Learning-by-doing | Pre/post surveys |

Source, Martin (2013).

### 2.5.1 Concept of Entrepreneurship and Process Skills in Biology

Teaching science is a dynamic enterprise and revolves around three pivotal factors; the pupils, the teachers and the school environment. Therefore, the science teacher of the modern world needs to understand and appreciate the use of science process skills through entrepreneurial skills in their day to day science affair in and outside the classroom and the society at large. A science teacher will need a broad array of entrepreneurial skills by integrating all the required science process skills in order to fine tune the required skills if and only if he is to succeed in today's science education enterprise. Therefore, five basic skills must have to be effectively in function before a science teacher is regarded as an entrepreneur. Visa viz;

i. Commercial /Sales and Market Skills: this entails understanding the concept of marketing in changing the perception of their students towards concept of science

education as a big enterprise. The teacher should teach the learner the skill of generating or handling money.

ii. Technical Skill: Teacher needs a manipulation skill so as to manage resources through improvisation.

iii. Self-Motivation Skill: the teacher should be able to identify his needs, the needs of the learners and the needs of the society at large so as to be able to adjust to their requirements. To this array the teacher must have the extra drive and commitment to take a necessary step to make his dream a reality as a manager of enterprise.

iv. Managerial/Time Management Skill: the teacher should have the ability to manage time and prioritise goal targeted task particularly in school business enterprises.

**v.** Leadership/Administrative skills: Teacher of science should be able to process and control all the available human and material resources for the purpose of profitable venture. This study emphasized the use of technical, commercial, managerial skills in assessing acquisition of skills, retention and performance among students in biology concepts for entrepreneurial skills acquisition.

**Concept of Biology for Entrepreneurial Skills Acquisition**

Some concepts in Biology possess profitable entrepreneurial skill if carefully identified. Jongur, Kabutu and Abba (2009) reported that the SS3 Biology graduates should be able to acquire skills and undertake the production of the goods and services from the following concepts of biology on commercial scale for self- reliance and self-employment. Entrepreneurial skills drawn from some concepts of biology are as shown below:

i. Food and water quality control skills: for example pure water choose from the content of water and sanitation in Biology.

ii Food and beverages production skills: For example fermentation of beverages to make local wine, choose from the content of nutrition.

iii. Animal production skill: For example (a) fish farming or aquaculture (b) Rabbiting (c) Poultry production (d) Api culture (e) Animal fattening and production and to mention but few;

This could be extracted from biology content of reproduction in vertebrate and invertebrates.

i. Cross breeding skills: through artificial insemination from biology content of reproduction in farm animals.

ii. Identification and marketing of medicinal plants: from Economic Botany in Biology.

iii. Horticulture and Floricultural skill: Maintenance of vegetable garden as well as identification of ornamental plant. It can be obtained from the concept of flowering plants in Biology.

iv. Animal feed production skill: for example fish feed, poultry feed and soon Nutrition in biology can provide the content.

v. Instructional material production skill: for example production of models and chart as improvisation for effective teaching of biology can be obtained from concept of biological techniques.

vi. Hybridization of Seed Skill: Production of improved variety of seed can be extracted from Biology topic like Genetic and germination of seeds.

**Advantages of Entrepreneurship Education to Biology Students**

Entrepreneurship education has the following advantages:

a. Skill acquisition: it provides students of biology to form a base of knowledge about functions and operations of a business in accordance to the societal needs or technological changes.

b. Occupational knowledge**:** It serves as a complementary role in developing the occupational knowledge, job skills and work experience among teachers and students of biology.

c. Creation of employment: It offers opportunities to students for job experience, for earning, saving and investing money at an earlier stage of life.

d. It aids poverty alleviation through self-employment and self-reliance goal for student of Biology with entrepreneurial skills.

c. fosters effective utilization of local resources.

d. It enhances decentralization and diversification of business.

e. It promotes the actualization of objectives of science and technology as well as (MDGs)

f. It provides room for capital formation

g. Promotion of entrepreneurship culture is assured.

**Strategies for Developing Entrepreneurial Skills in Biology Education**

Based on the studies carried out by Jongur, Kabutu and Abba (2009) the following are some of the strategies that could be employed for encouraging or developing entrepreneurial skill among Biology students and teachers of secondary schools in Nigeria:

i. **Attitudinal development:** Building achievement motivation in teaching or learning situation so as to enhance students' success and expertise in new ventures.

ii. **Quality performance model:** Teaching of certain concept should not divorce reference or history of progressive success or failure of some entrepreneur. This will foster self-confidence and self-discipline in students.

iii. **Career Education**: Early prognosis on career guidance by biology teacher should be encouraged so as to foster learners' creativity and help in identifying honourable or profitable means of livelihood at all levels of education.

iv. **Training in management efficiency:** Teacher and learners of biology should be trained in management of resources so as to enhance management efficiency which is the hallmark of entrepreneur's enterprise.

v. **Research and innovations:** There should be more serious investment in research, in form of research grants, because it is through it that knowledge expands, innovations emerge and skills realized.

vi. **Technical skills and confidence:** There is the need to develop the teachers of biology with the technical skills and build in confidence in the system so as to promote effective transfer of skills into their students for productive economy. Based on the aforementioned strategies. this study stressed the development in students and teachers of biology the spirit of managerial, technical skills as well as career development strategy.

### 2.5.2 Concept of Project-based Approach through Entrepreneurship Education

Project-based approach through entrepreneurship means the functional process of teaching and learning that aim at bringing together creative and innovative ideas coupled with managerial and organizational skills in order to combine people, money and resources to meet an identified need and create wealth for livelihood (Arogundade, 2011). Project-based approach is a teaching and learning model which emphasise Student-centred instruction by assigning project or learning task to students so as to be constructive in knowledge and skill acquisition.

It is regarded as powerful pedagogical approach that aim at developing learner's deeper conceptual understanding and more applicable knowledge and skills in solving problem of its environment.

The characteristic of Project-based approach are :

The use of complex realistic and challenging problems that elicit in learners active and constructive process of knowledge and skill acquisition.

The inclusion of small group, collaborative work and ample opportunities for interaction communication and cooperation.

The encouragement of learners to set their own goals and provision of guidance for students in taking more responsibilities for their own learning activities in the processes.

Project is learning processed that is central to socio-constructivism and related to activity-based approach in which learner view opportunity and autonomously construct their own learning or proceed student-generated products that is worthwhile. It is on this note that entrepreneurship-based leaves is regarded to be an extension of project-based approach. Therefore this approach as indispensable as they are complementing approach.

**Main Features of Project Approach**

i. Are central to curriculum

ii. Long-term (more than a couple of class days and up to semester)

iii. Interdisciplinary

iv. Have a driving questions that is challenging and constructive.

v. Are students – centred.

vi. Are based on collaborative or cooperative group learning (small group of 4 or 5 students).

vii. Are integrated with real world issues and practices.

viii. Have productive outcomes.

ix. Have an impact on “life skill or real life situation” like self-management, group process and problem-solving skills.

And used cognitive tools usually technology based or psychomotor-based domain.

PBL makes school more engaging for students: Today's students, more than ever, often find school to be boring and meaningless. In PBL, students are active, not passive; a project engages their hearts and minds, and provides real-world relevance for learning. PBL improves learning: After completing a project, students understand content more deeply, remember what they learnt and retained it longer than is often the case with traditional instruction. Because of this, students who gained content knowledge with PBL would be better in performance of the acquired knowledge and be able to apply it to new situation. PBL helps address standards by emphasizing on real-world application of knowledge and skills, and the development of success skills such as critical thinking/problem solving, collaboration, communication in a variety of media. Thus, Project-based approach requires all processes of planning, organizing, implementing and assessing skills. Thus, Project-based approach can be viewed on the basis of the following frame work or model in science:

**Forms of Project-based Approach**

Project-based approach can be carried out in the following approaches or forms:

**(a) The Preparatory Approach /Form:** This involves preparing and preserving Biology specimens such as hearts, lungs, frogs, snails, fishes for practical studies pond liming, feeds and drugs. Beside it trains student of biology for entrepreneurship the skills of preparing and preserving end products like beverage and feeds fish) for sale at the required time and cost. (Ughaja, 2009).

**(b) The Constructive Approach/Form:** It involves training of individual students the skills of building, constructing models to aid instruction in biology. Or construction of fish ponds, for stocking fish or constructing animal husbandry for rearing animals or constructing animal facilities or construction of horticultural farm for production of vegetable and

medicinal plants. (Okeke, Eghunonu & Ughaja, 2009). The aforementioned approaches/forms can be carried out in the following stages:

**Stages in Using Project-based Approach**

There are four stages in using Project-based approach as outlined by NTI (2001). Therefore the teacher of Biology teaching entrepreneurship education needs to understand the characteristics of each stage as stated below:

a. Panning stage

b. Class or site organization stage

c. Project implementation stage

d. Assessment stage

**(a) Planning Stage**: At this stage the teacher needs to consider:

i. The overall interest of the course or skill to be acquired

ii. The quality and justification of the objective set by the students

iii. The alternative methods to teach the topic or theme, and justification for choosing the method.

iv. The available resources and space.

v. The activities planned for the project should be type that would sustain the students' interest as well as providing useful results.

vi. The result should be in line with course requirements.

vii. Time bond

**(b). Organization Stage:**

The teacher divides the students into group(group of four or five students) irrespective of their ability or differences.

Teacher should arrange the groups accordingly to avoid disturbances

The resource materials should be easily accessible by all the students

Teacher should be accessible to all students.

**(c). Project Implementation Stage**

i. The students should be aware of nature of the project by using hand bills, posters manual and so on.

ii. The students should have the freedom to conduct the project in an interactive form or independently.

iii. Teacher should have full control of the class to avoid indiscipline.

iv. Teacher should be a guide or resource person.

v. Students finding should be compiled and reported in the class.

vi. Resource materials used should be clean and returned to a required place at the end of the project.

**(d). Assessment Stage**

i. A review of the objectives: The collection, analysis of data and generalization drawn should be made after the project.

ii. Mistake made should be marked or recorded for correction.

Generalization drawn should be made known to the class.

iii, The findings should be accessible to the students for consultation or appreciation.

iv. Use check-list to assess student performance.

**Recording and Reporting of Project**

The work done by the students in the form of a project should be recorded and reported. They should maintain a complete record of the project work. While recording, the following points should be kept in mind-how the project was planned, what discussions took place, assigning duties, how it was carried out and evaluated. Also while reporting the following should be considered, background, rational for the design, purpose,

explanation of the basic concept, review of related literature, methodology, conclusion, recommendations and references.

The planning, organization and implementation stages are highly required for the successful usage of preparatory and constructive approach in a designing Project-based approach in teaching biology. While the last stage which is assessment stage requires the use of effective assessment tools to determine the extent of attaining the stated educational goals. The assessment of Project-based approach (using psychomotor domain) can be systematically carried out considering the following phases:

**Phases Involve in Assessing Project-based Approach**

Akpomi (2009) asserted that entrepreneurial skill learning through project-based approach can be assessed through three sequential organizational phases. He specified assessment weight to be 100% with (25%, 15%, 65% for phase I, II, III respectively). He reported that assessment of any project-based approach should put into consideration the following three assessment phases:

**a) Assessment Phase I**

**Group Presentation and Exhibition Assessment:** In groups of four or five, students should create business concepts and work on it to develop a business proposition or business proposal. The group presentation will provide an opportunity for students to present their ideas on market research and route to market, to a number of judges who will be invited on the exhibition day.

**b). Assessment Phase II**

**Individual Business Proposition Assessment:** After the group presentation, students will be expected to work individually and developed a full-fledged business proposition.

**c). Assessment Phase III**

**Business Plan:** the student develops at his pace new business plan from the acquired skill for future entrepreneur. Project-based approach is often based on personal experience as well as systematic approaches (Fayolle and Gailly,2008 and Akpomi, 2009), and is often centered around letting students create a business plan (Honig, 2004).

**Application of Project-Based Approach in Teaching and Learning**

Some research findings carried out by some constructivist such as Katz and Chard (2000) reported that Project-based approach has three phases: Planning, Creating and Processing. Thus, each phase requires collaborative learning and cognitive apprenticeship.

**First phase:** During the initial Planning stage individual acquired the spirit of Identifying Opportunities from worthwhile things. At this stage the teacher selects the topics of study, learners collaboratively choose a project, set goals and identity necessary resources. The teacher also brainstorms using his/her own experiences, knowledge ideas and represent them in a topic web. The teacher discusses the topic with the learners experiences the learners have had and what they already know about it. (Burnerfeld *et al*., 2000).

**Second Phase:** The second phase was Creating Opportunities. This involves collecting data, and other relevant information for the project teacher and the learners, provide resources to help the learners with investigation, real object, books and other research materials are gathered. Each learner is involved in representing what he or she had learned and each learner can work at his/her own pace in terms of basic skills, construction, drawing and dramatic play. The teacher enables the learner to be aware of all the different work and being done through class or group discussion and display. The topic web designed earlier provides a shorthand means of documenting the progress of the project.

The **third phase i**ncludes the Product of the project and evaluation of the product, by the learners and the teacher. The learners reflect on their own projects, assess how well

they have accomplished the goals set during the planning phase and revise any goals if they used the teacher arranges a culminating event through which the learners share with others what they have learned. Learners share their products and or achievement with other members of the class and reflect on the learning process and the product through dialogue and feedback. The learners may sometimes need help in telling the story of their project. In short this is regarded as report writing. The teacher helps the learners to select the materials to share and in doing so, involves them meaningfully in reviewing and evaluating the whole project. This also offers the learners imaginative ways of personalizing their new knowledge through reflective thinking, by designing art, stories, or drama. Finally the teacher uses learner's ideas and interest to make a meaningful transition between the conclusion of the project and the topic of study in the project.

**Assessment Involve in Project-based Learning Approach**

Assessment is a complex field that help teachers develop more complex relationships with their students when receiving feedback when students planned steps of project (Melic, 2003). The following are the three common phases of assessing of Project–based approach:

1. Formative Assessment (DATS) is designed to provide feedback while the students are still working on the project. This allows both the students and teacher to make mid project corrections. The teacher may use some of the formative evaluation information via final assessment, but may choose not to do so.

2. Summative Assessment (TFLE) is carried out after the project is completed. A teacher might decide to base the project assessment purely on information gathered in the summative evaluation phase. However, a final assessment might also give considerable weight to the process carried out in the project, such as accomplishing a project milestone on time and the quality of intermediate products.

3. Portfolio Assessment is collections of worked samples. The students and the teacher work together to decide which work samples will go into the student portfolio. During the school year, a large number of items may be collected for use in the school year portfolio. Then some of them will be added to student's long term portfolio.

Authentic assessment is one of the components of PBL Assessment activities not only capture the students' understanding of concepts and subject matter, but they also document and promote the development of real world skills which students need outside the classroom and beyond the school environment. Assessment reflects student's learning over time, and not just achievement on a piece of work or a final examination. Project-based approach assessment takes place in a context familiar to the students. Project-based approach Assessment as constructivist feedback helps in building real mastery of a subject matter by allowing students to revise their work and incorporate new understanding. Assessment of activities also require students to articulate and explain subjects matter, take decision, develop initiative on worthwhile phenomenon (Melic, 2003).

Project-based Approach considering cognitive assessment in relation to students' 'academic performance and retention in biology, makes the use of DATS imperative. Therefore Diagnostic Adaptive Testing Skill (DATS) is a formative assessment used instead of summative Traditional Fix Length Examination (TFLE) for the purpose of this research work.

### 2.5.3 Concept of Project-based Approach and Diagnostic Adaptive Testing Skill (DATS)

It is pertinent to emphasize the need to look inward to utilize assessment or testing strategies in order to foster maximum understanding of scientific concepts and processes with the view to producing effective learning outcome in schools (Opateye, 2009). DATS becomes an instrumental strategy for assessing Project approach in order to provide

effective understanding of scientific process and skills. According to Okoye (2009) pointed out DIAGNOSTIC as entrepreneurial skill or science process skill needed by teacher of biology in identifying the nature of problem in order to find solution to the problem. DATS is considered as a form of need assessment conducted to investigate or identify learner's area of weakness and strength so as to intermittently proffer solutions to these effects. This is done by conducting pre-test in adaptive form (Opateye, 2009). Opateye (2009) stated that Adaptive test is one in which different sets of questions (items) are administered to different individuals depending on each individual's status or traits being measured in real life situation. Adaptive test has also been referred to as tailored, response contingent, individualized test and sequential testing strategy. It is a psychometric test that tailors to the ability of the test taker (student) (Opateye, 2009). Gibb (1995) stated that entrepreneurs learn in the real world through "ADAPTIVE" learning. In a nutshell DATS refers to as sequential measuring skills for identifying the nature of a problem in a real life situation so as to find their solutions.

**Diagnostic Adaptive Testing Skills (DATS) As Assessment Tool**

The quality of any educational assessment program is determined by the quality of the assessment instrument especially how the instrument is developed (Oduleke, 2012). He further asserted that the achievement of national goals through education is better enhanced in the development of educational assessment instrument.

The role of assessment in evaluating student's learning outcome should be given rightful place during classroom teaching or learning process. Summative evaluation determines the mastery of the course objectives at the end of a unit or course. This is accompanied by Traditional Fixed Length Examination (TFLE) which presents teach least-taker (student), without considering how well the student is doing in examination. While formative evaluation (DATS) uses an evaluation made intermittently or during the course

of learning that provided evidence of the effectiveness of the learning process so as to diagnose the appropriate areas that require immediate attention (Falayayo, 2004 & Opateye, 2009). Thus, DATS assessment made for the purpose of this research is based on formative assessment that would foster maximum assimilation at self-pacing mode and provide immediate feedback that will enhance students in selecting their profitable career from the available concepts of biology for entrepreneurial development in secondary school before graduation.

**a. Benefit of DATS to Concepts of Biology for Entrepreneurship**

According to Opateye (2009), identified six benefits of using DATS as assessment mode visa viz:

i. Test are given on demand and scores are available immediately.
ii. Ease responsibility for test administrators.
iii. Test is individually paced so that an examinee does not have to wait for others to finish before going to the next section.
iv. Increase in test security.
v. Potential to accommodate a wider range or wider spectrum of item types across subject areas.
vi. Accurate scores are provided over a wide range of abilities of the examinees.

**b. Applications of Diagnostic Adaptive Testing**

i. Adaptive testing improves efficiency and measures precision of test items. The most efficient strategy in term of providing equal or precise measurement is the maximum information strategy using manuals combined with maximum like hood scoring form.

ii. Adaptive tests can also generally show higher reliabilities at very short test lengths, with reliabilities equal to those of peaked convectional tests with two or more times the number of items.

iii. Diagnostic adaptive testing enhances efficiency of measurement to improve test efficiency with the kinds of item pools found in conventional tests.

iv. Diagnostic Adaptive Testing is also applicable for classification and mastery decisions. The problem in testing is one of the classification that is determining whether an individual is below or above a specified cut-off value.

v. Adaptive test as it measures individual change in real life situation. The measurement of individual change is sure; each individual trait can be measured to pre-specified degree of precision at a given point in time.

**c. Steps in Constructing Diagnostic Adaptive Testing Skills**

The following steps were adopted from Opateye (2009):

i. Identification of concept of Biology for entrepreneurship.

ii. Creation of appropriate blue print (table of specification).

iii. Generating stems, correct items and item distracters.

iv. Discrimination indices.

v. Item standardization (administration, instructions, time limits and scoring).

vi. Ascertaining validity and reliability of the test items.

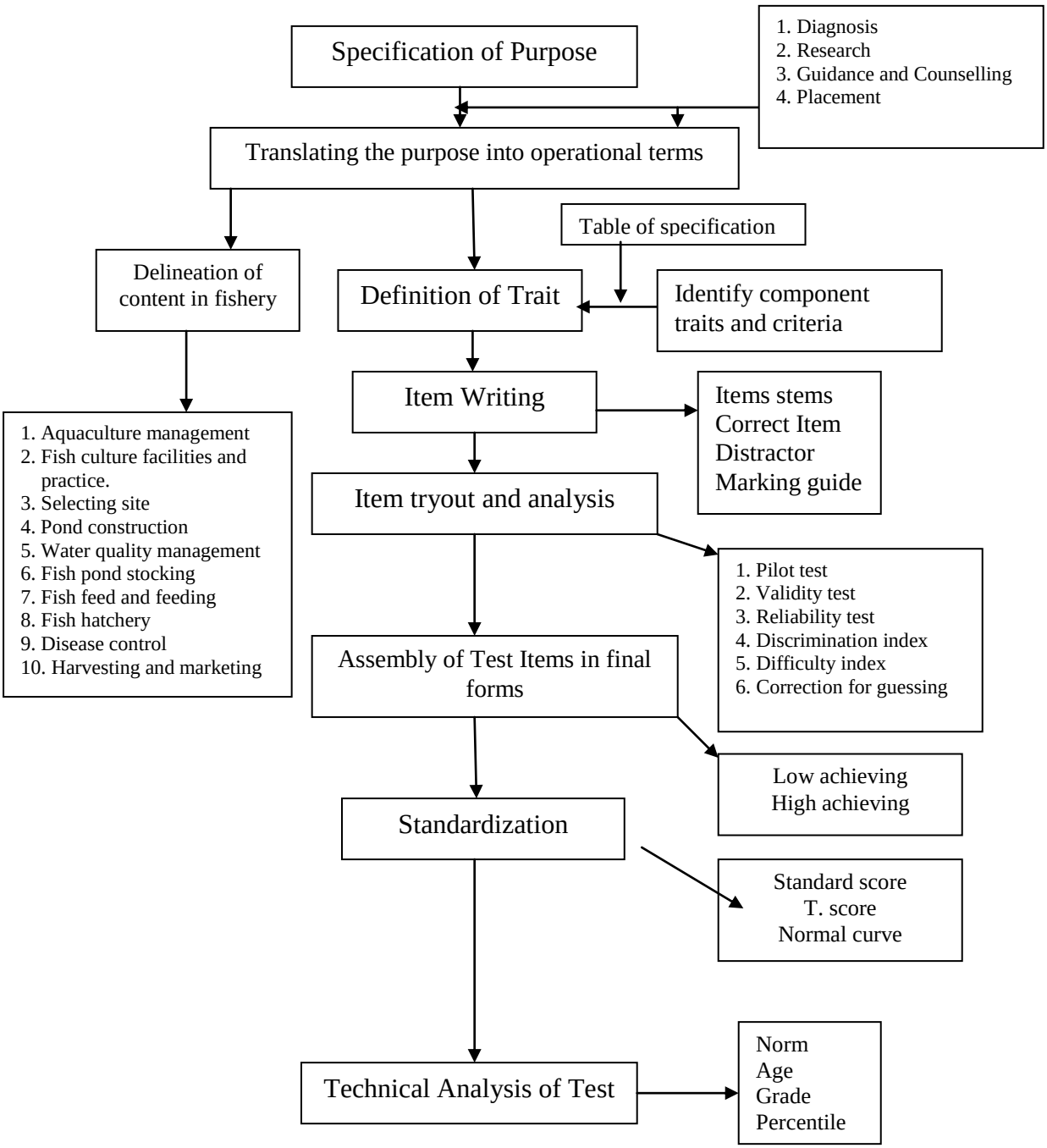



**Fig. 2.1: Flowchart of DATS Construction and Testing Skill Development in Concept Fishery for Entrepreneurship** Source**:** (Opateye, 2009).

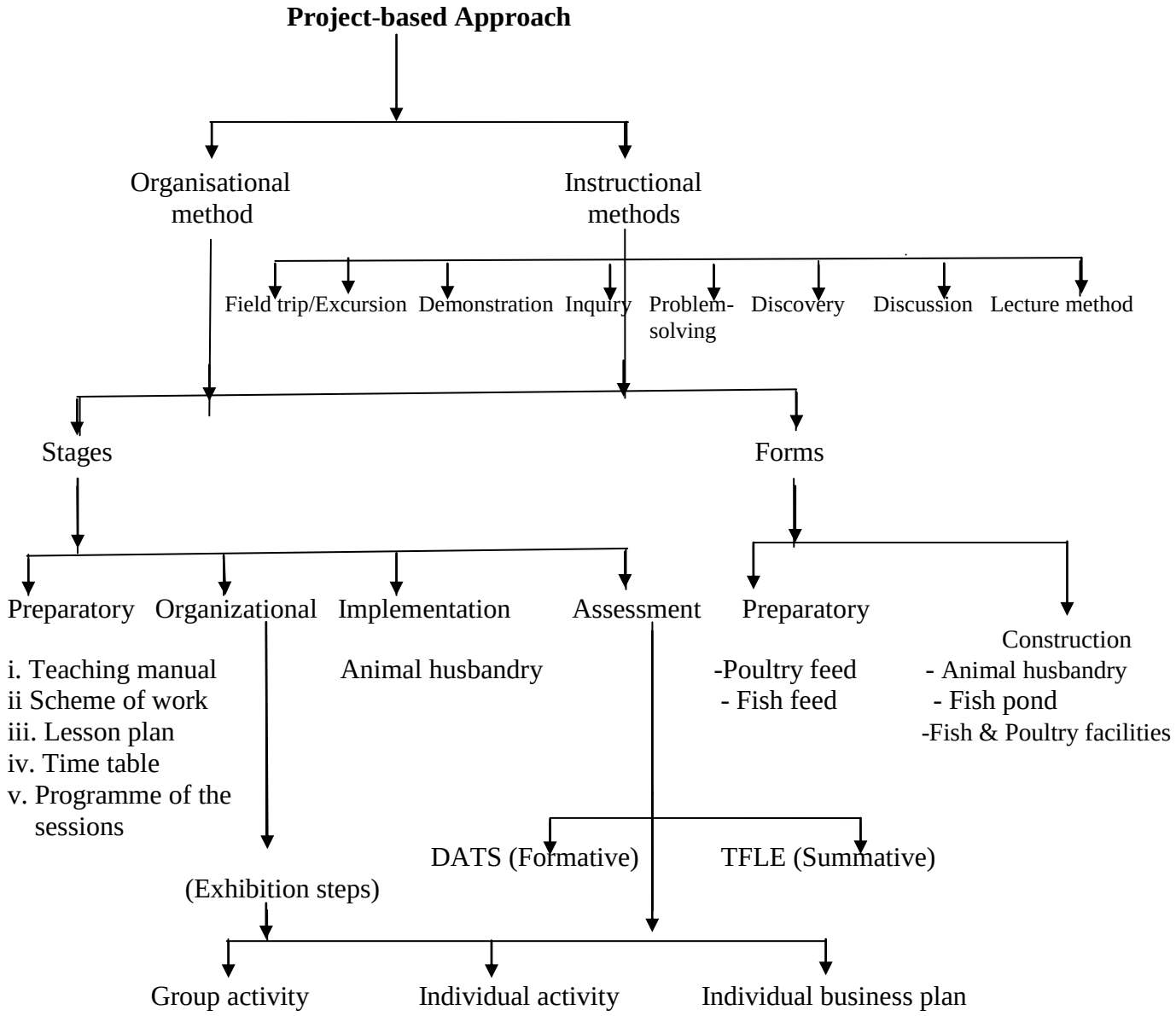



**Fig. 2.2 Flowchart of Project-based Approach** Source **:** (NTI, 2001 & SMASE, 2010).

### 2.5.4 Project-based Approach and Students' Performance in Biology.

Performance as teaching/learning process is concern with the attainment of set objectives over a limited time using less resources (Nnaobi, 2007). Students' performance can be observed by considering the ability level of the learner, sex of the learner as well as the retention level of the learner. This can be discussed as follows:

Project-based Method and Academic Performance:

Agbenyeku (2010) reported that not only the downward trend in the performance in science particularly biology, but also the results getting worse and the recipients getting progressively unscientific in their thought pattern and approach in solving problems. Also the fear of failure has shift interest of structures away from studying biology. Project based approach is motivating as it encourages students to select project of their choice and produce at the pace. Thus, it can minimize the fear of what science is.

Okafor (2000) reported that classroom size is also a contributory factor to poor performance of students in Biology. This is because all students irrespective of field of interest must write biology as a compulsory subject. Consequently, lead to massive failure because of large class size. It is in view of this that project-based approach that is characterized with grouping of students and dividing of concept into sub-theme or topics enhance performance in biology. Therefore, Project-based Approach is employed and deem fit for teaching biology concepts for entrepreneurship by the researcher.

Performance of students in science (particularly in Biology) is sometime influenced by human resource factors. Agbenyeku (2010) stressed that the fear or dislike of subject teacher leads to failure to recall the knowledge acquired. This couples with the inability to use variety of teaching methods, for students to be able to perform effectively as well as exhibit their tacit knowledge, it is necessary for teacher to navigate among variety of teaching methods. Project-based approach among others provides students the means of

learning at individual pace with little guidance from the teacher. This would salvage the fear and dislike of a particular teacher. Also, Hillea (2002) said that academic achievement depended most heavily on students' personal conviction of being in charged of their own fate in the learning situation.

Project-based Approach and Ability Level Grouping:

This is one of method of the teaching where the teacher is faced with larger number of students or larger content to cover at a particular time. Project-based approach that has been widely used over the years is to place students in a sort of homogeneous grouping. This is done by placing students with basically the same cognitive ability level into the same group. This present research work, adopted the strategy where by students were tested for their academic equivalence before treatment is being administered. Therefore, the schools that show no significant difference were taken for the study(Kadala,2014).

In view of this Okeke, Egbunonu and Ugbaja (2009) examined in their study the entrepreneurship skills acquisition of biology education students through designed project. Therefore, students participation in entrepreneurship skill acquisition in some biology concepts were rated based on the following levels: four point rating scales of High skill (HS), Moderate Skill (MS), Low Skill (LS) and No Skill (NS). For data collecting the following boundary score limits were used:

High skill (HS), = (75%-100%)

Moderate Skill (MS) = (50%-74%)

Low Skill (LS) = (25%-49%)

No Skill (NS) = (0%-24%)

Therefore, this study adopted this performance rating scale of Okeke, Egbunonu and Ugbaja (2009) to investigate the effects of Project-based approach on students ability level in biology skill acquisition.

Project-based Approach and Gender Difference:

Some studies revealed that male students have a head start advantages over female students in opting for science related career (Eta, 2002). He observed that female participation both in science and education in general have been observed to decline drastically through primary to secondary levels. This differential participation according to Lakpini (2006) broadens with maturity on the same vein, studies have revealed that female students are more prone to exhibiting fret (worry) and anxiety than male students in carrying out some science related task (Lakpini, 2006).Who also reported that sex-type extra curricula activities among male and female students influence their career choice in science which influence their academic achievement in science. Lakpini (2006) reported that boys perform better than girls on physical science questions and high-level questions (application analysis and synthesis) whereas girls do better than boys on question in biological science lower-level (knowledge, recall, comprehension) questions.

Kajuru (2010) reported difference in gender performance among students in secondary schools. The study discovered that the difference was due to gender sterotyped choice. However, it was found that the only science subjects in which female students achieved majority of passes was Biology. This implies that male students performed better than female students in all science subjects except in Biology. It is on this note that Biology is chosen for this purpose so as to ascertained academic equivalence in testing process skills in entrepreneurship. The general argument was that boys dominate classrooms discussion and take over the teacher's attention than girls (Kajuru, 2010). This lowered girls' self-esteem while teaching topics on mental reasoning. Kajuru (2010) further reported that male performed significantly better than female counterpart in mental reasoning concepts. He concluded that sex differences are factors that affect performance in an achievement test. It is widely believed that there are some inherent capabilities

especially for boys or girls, and that boys excel in the areas that involve mental reasoning. It is in view of this that this research work aimed at determining whether Project-based approach is gender related on acquisition of skills, retention and students' performance in biology. Even though many researchers reported gender differences in science, there are some conflicting reports to this effect. For example, Lakpini (2006) on the other hand reported that there is no significant difference in achievement between boys and girls in science. Okeke, Egbunonu and Ugbaja (2009) affirmed that gender has no significant effect on the extent of entrepreneurship skill acquisition using a designed project approach. Therefore, it is on the basis of these that this research work aimed to find out the effects of Project-based approach on male and female level of skills acquisition in some biology concepts for entrepreneurship.

Isah (1992 in Agbenyeku 2010) reported that male students and girls exposed to more practical activities do not differ significantly which implies that gender does not affect students academic achievement when exposed to intensive practical activities in integrated science. Uhmuavbi, Oriahi and Olusi (2003) cited by Agbenyeku (2010) showed that sex plays no significant role in performance and achievement in science particularly biology. Ogunboyede (2003) on the study of sex difference and student achievement and performance at primary school level indicated that boys are not better than girls in terms of educational achievement. Nacteri, Abdullahi, Aizan, Sharir, Kumar (2009) examined age, creativity and gender as predictors of academic achievement. Participants (N – 150, 105 = male and 48 = female). Completed creativity test. Cumulative grade point average (CGPA) was used to select the participants. A multiple regression analysis revealed that creativity, age and gender explained 0.143 of the variance in academic achievement. The significance level was indicated by the F-value of 8.294, multiple regression analysis showed interaction effects between creativity, age and gender as low predictors of academic

achievement. The findings also show a lower correlation of CGPA and the independence variable of this study. No significant difference between CGPA and gender was observed.

Research carried out by Abdullahi (2014) reported that the extent to which cooperative learning in mathematics curriculum will have any differential effect on boys and girls. The samples consist of two hundred and eighty nine boys and two hundred and eighty three girls from six secondary schools. They used AGO project model (The Acronym AGO stand for the Dutch equivalent of Adaptive Instruction and Cooperative Learning). The study compared the AGO model with traditional instructional method. The outcomes of the study showed that the aptitude scores of boys and after the experiment were higher than scores for girls. Students in both conditions (experimental and control) were comparable in aptitude at the beginning of the experiment. Boys performed better than girls and AGO students scored higher on post-test achievement than students in the control group.

### 2.5.5 Project-based Approach and Retention in Biology

Retention is the ability to hold on to things experienced or learned (Lakpini, 2006). Research studies have shown that improved instructional strategies improve students' achievement and retention. A study on analysis of score according to ability level revealed that high ability students were significantly better in retention of learned materials than the average ability level, which in turn retained more of the learned biology concepts than the low ability students (Lakpini, 2006). Oyedokun (1998) reported from her study on the effect of a conceptual change model on students' achievement, retention and attitude to biology concepts, affirmed that experimental group was significantly better than the control group in retention of learned material. This study aspired to investigate the retention level in biology after exposure to Project-based approach

Retention level in relation to age has been investigated by some researchers among which Cross 1974 in Agbenyeku (2010) cited that retention increases from infancy through teenage years, by slow recession in middle age to old age. This implies that project-based approach should be encouraged particularly at teenage and old age as project-base approach is a practical base pedagogy. Small class size also leads to high grade retention. The division of large class in the groups of 5 students enhance retention of knowledge and skills among students. Ahmed (2016) reported most human beings retain an average of seven items of information at a time in short term memory. Therefore, long term memory on the other hand is not only unlimited in capacity but also capable of retaining all the experience a person had during his life time information in long term memory and may not be forgotten easily (Net, 2008).

Ahmed (2012) reported that retention of materials is the cardinal point of every teacher, but student learnt the material, take a test; but forget the learnt material after a while. Therefore, it is important to use a pedagogy that would consider the significance of knowledge retention when evaluating learning strategies. One of the strategies is distribution of learning (spread practice). This procedure involves total study time held constant, but the content is spread across multiple study seasons. However, if students solve all problem on the same day or period it would be considered mass practice. Therefore study had showed that at longer retention intervals, spread/distributed practice produced better retention concepts than mass practice. Therefore, it is in view of that project based approach is divided in phases so as to enhance longer retention of acquired skills, experiences and knowledge. Retention interval is the time elapse between a test of original learning and that of a retention test. Thus, knowledge retention by student after specific retention interval, if not in use gets decay. The three main principles of knowledge retention are.

Firstly, knowledge retention generally falls to 75-89% of its original level after a relatively short period of time i.e. an interval of 2 weeks. Secondly, retention rate decreases over time. Third, all performance regardless of their individual levels of achievement have similar knowledge retention rates. The aforementioned principles guided the utilization of project-based approach in retaining skills and knowledge acquisition. It is on this note that Bichi (2000) reported that it is widely accepted that the longer the period of retained material not in use, the greater the probability of decay. The factors that account for skill decay include; task type, high amount of learning task, (over learning), instructional strategies used, length of retention interval, learning interference (Bichi, 2000 and Obeka 2010).

Ahmed (2012) reported that quantity is important in retention of learning task. Individual with retention task of 50 words in 5 minutes and recall 20 words is better in retention than the individual with 20 words retention task in 5 minute but can recall 10 words. The implication of this study to the present study is that project-based approach in acquisition of entrepreneurial skills in biology possess a larger table to be accomplished with a given period. At group level, individual will retain some concepts, but at individual level, the concepts to be retained would be greater.

In addition Maikano 2010 made comparism between outdoor and indoor laboratory teaching strategies on secondary school students academic achievement and retention in ecology in Kaduna State. The result of the study revealed that the experimental group taught ecological concepts using the outdoor laboratory approach achieved retention significantly higher than the control group taught the same concepts using in door laboratory. Project-based approach is more or less outdoor laboratory in its approach. Therefore, Project-based approach can enhance performance and retention as well. It is on

this note that the researcher selected this approach as suitable for teaching biology concepts for entrepreneurship.

## 2.6 Overview of Similar Studies

This study focus on observing some related studies on Project-based Approach, students performance in entrepreneurial skills acquisition and retention of Biology concepts that relate to entrepreneurship studies among senior secondary school students in Niger state.

Duch (2002) carried out an experimental study investigating the effect of project based, inquiry, and lecture-demonstration teaching method on students learning outcomes in Biology. Duch (2002) reported have used 177 high school students of University of Delaware (98 boys and 79 girls) from four different schools. Students were exposed to treatment for 10 weeks in three experimental and one control group using intact classroom setting respectively. The instruments used for data collection were duly validated and certified reliable by the researcher who adopted a 4 x 2 x 2 matrix for data analysis using Analysis of Covariance (ANCOVA). The result of the findings revealed that; there was significant main effects of treatment on student's cognitive achievement, practical skills and attitude towards ecology; the three experiment groups recorded higher cognitive achievement than the control group; project-based strategy enhanced cognitive achievement more than other strategies while combined strategy facilitated practiced skills acquisition and more positive attitude to ecology than other strategies. This present study investigated retention of acquired skills, as it promotes students performance in biology Learning becomes meaningful if learner would be able to recall learnt knowledge or experiences.

Kolawole (2003) examined the effects of project, inquiry and lecture demonstration teaching methods on senior secondary school students achievement in separation of

mixtures in practical chemistry test in Lagos. This study assessed and compared the relative effectiveness of three methods for teaching and conducting experiments in separation of mixture-in chemistry. A pre-test; post-test experimental design with a control group was used. The findings of this study revealed that lecture- demonstration method, inquiry method and project method can be used for teaching and learning depending upon the topic. Project method was recorded to be more effective because it affords the students to study on their own at their pace. This current study considered acquisition of skills, its retention and its effect on students' performance in Biology. Gender performance was not investigated for their significant difference in the study carried out by Kolawale (2003).

Seron and Silbey (2004) found that group work in project based teaching strategy in science and engineering courses did not improve the performance of students. Females often "develop a culture of shared learning and interdependence" while learning to make explicit connections to real world. Seron and Silbey's work also suggests that a project-based approach with emphasis on group work can have detrimental effects. For examples student got frustrated because of varied abilities with tools and technology which often prevents equal sharing of workloads between men and women. This present research work correct this assertion, as the work is divided in phases as suggested by benedict (2015). Also the use of DATS assessment tool checked out non performance among students.

Some researchers such as Ozdener and Ozcoban (2004) have researched into the effectiveness of project-based teaching model on computer courses and multiple intelligence theory. The results indicated that PBTs increased students' achievement.

Kibelt and Kathuri (2005) carried out a study to find out the effects of project based instructional strategies used singly and in combination with lecture teaching method on students learning outcomes in first engineering undergraduates mathematics in . The quasi-experimental design using four randomly selected groups, randomly assigned to three

experimental and control groups. Total of 109 students in intact classes were involved. The adopted 4 x 2 x 2 (instruction at four levels, cognitive styles at two levels and gender at two levels) non-randomized control group, pre-test, post-test design using analysis of variance (ANOVA) and t-test to analyzed data gathered using various instruments which they validated and confirmed reliable statistically. The results of the findings is as follows: post-test mean scores of the groups exposed to project based, lecture method separately and in combination were significantly higher than those of the control group. Post-test mean scores in achievement and attitude of students exposed to a combination of instructional strategy were significantly higher than those exposed either to project-based or lecture method separately. However, this present study did not consider attitude but retention as not intact class was used instead randomly sampled subjects were considered.

Okeke, Egbunonu, Ugbaja (2009) worked on the entrepreneurship skills acquisition on biology education students through a designed project in Anambra State, Nigeria. The population of 75 third year NCE students was used for the research. A descriptive survey design was adopted. Two research questions and one hypothesis guided the study. The instrument used for data collection was structured Biology Student Entrepreneurship Skill Acquisition Questionnaire (BSESAQ). The data collected were analysed using t-test for testing hypothesis at alpha 0.05 level of significance. This revealed that the extent of entrepreneurship skills acquisition of biology education students through designed project is moderate. The result also revealed that gender has no significant difference on the extent of entrepreneurship skills acquisition using designed project. Recommendation was made by using a designed project approach to enhance the acquisition of entrepreneurship skills of the biology education students. Similarly, this present research work adopted the use of Project-based approach among senior secondary school students instead of using

Entrepreneurship education as a means of skill acquisition in biology among students in tertiary institutions as used by Okeke, Egbunonu, Ugbaja (2009).

Okoye (2009) investigated the assessment of resources for developing entrepreneurial skill in biology through Science, Technology and Mathematics Education (STME) among secondary school students in Anambra State, Nigeria. A descriptive survey design was used to this effect. The samples consisted of 15 secondary schools principals, 30 biology teachers and 360 students. The instrument used was questionnaire. The data were analyzed using descriptive statistics for the research questions. While the hypotheses were tested at alpha $P \leq 0.05$ significance level using the Analysis of Variance (ANOVA). The findings revealed lack of entrepreneurial skills competencies on the part of Biology teachers and lack of materials resources for developing the needed skills revealed the main constraint. This present study used Project-based approach to determine its effect on entrepreneurial skill acquisition among secondary school students in biology and quasi experimental design was used instead of the descriptive survey design used by Achufusi, Umeh and Okoye (2009).

Nwagbo and Chekelu (2011) investigated the effects of biology practical activities on secondary school students' process skill acquisition in Abuja Municipal Area Council. The design of the study was quasi-experimental using a sample of one hundred and eleven senior secondary one (SS 1) biology students who were randomly selected from two co-educational schools. Two research questions and two null hypotheses guided the study. An instrument known as Science Process Skill Acquisition Test (SPSAT) was used for data collection and analyzed using mean, standard deviation and Analysis of covariance (ANCOVA) at $P \leq 0.05$ level of significance. The results revealed that practical activity method was more effective in fostering students' acquisition of science process skills than the lecture method. Their study used practical activities in enhancing skills acquisition

while this study used Project-based approach to attain the same. Retention of acquired skills was tested to ascertain its effect on students' performance in biology.

Mohammed (2015) investigated teachers' and learners' attitude towards entrepreneurship–based project approach as a substitute to laboratory practical activity in teaching biology among secondary students in Niger state Nigeria. A total of 245 public senior secondary schools were used as the population. Three schools were purposively sampled form seven educational zone. Sixty students and twenty teachers were drawn from each sampled school given a total of two hundred and seventy subjects. A survey research design was conducted. Entrepreneurship-based Project Approach Questionnaires (EPAQ) and Laboratory Practical Activity Questionnaires (LPAQ) were the instruments used for collecting data. Three research questions were advanced, while two hypotheses were sought to find the significance difference at $P \leq 0.05$ level of significance. The hypothesis stated was there is no significant effects in using entrepreneurship –based project approach as an alternative to laboratory practical activity in teaching biology among secondary school students. Also another hypothesis states that there exists no effects of entrepreneurship-based project approach on gender in terms of skill acquisition in biology. The result revealed that there are no significant effects in using entrepreneurship –based project approach as an alternative to laboratory practical activity in teaching biology among secondary school students. Also there exists no difference between male and female interms of skills acquisition using project approach. Therefore, it is recommended that entrepreneurship–based project approach should not be used as a substitute but as a compliment to laboratory practical activity in teaching biology among secondary school students. The present study uses quasi experimental instead of survey research design. Also this present research investigated the effects of Project-based approach on acquisition

of entrepreneurial skills and retention of biology concepts for entrepreneurship among secondary school biology students in Niger state.

Olatoye, and Adekoya, (2010) carried out an investigation on the effect of three teaching strategies, Project-based, demonstration and lecture method of teaching on students achievements on pasture and forage crops which is an aspect of agricultural science. A 3 x 2 x 2 pre test post test experimental design with a control group was used in the hundred and fifty randomly selected senior secondary school two (SS2). Agricultural science students were drawn from the three schools. The data obtained was analysed using the ANCOVA and Scheffe Post Hoc test analysis. The stated hypotheses were analysed using collected data from the findings of this study and revealed that there is significant main effect of treatment on students achievement in an aspect of agricultural science (pasture and forage crop) with value of ( $F=20.860$ at $p<0.05$). Also, students performed significantly different at different levels in the three groups. Thus, there is no significant intervention effect of treatment and gender on students achievement in an aspect agricultural science, (pasture and forage crop) with ($F=0.494$, $p> 0.05$). It was recommended that Project based, demonstration strategies of teaching are potent in raising students achievement, thus in service training in form of workshop seminars and symposia should be organised for teachers regularly to update their knowledge and enhanced their adoption of appropriate teaching strategies. This present research work differs from the work of Olatoye and Adekoya (2010) because it was a work carried out on biology concepts for entrepreneurship instead of Agricultural science. Retention of acquired skills were tested for significant difference when using the teaching approaches, but the work carried out by Olatoye and Adekoya (2010) did not considered retention ability of acquired skills among students.

Agbayaku (2012) carried out a study on the Effect of Advance Organisers on Performance and Retention of Ecology Concepts among Senior Secondary School students in Giwa Educational Zone of Kaduna state. The study was conducted using 145 students from two sampled schools using an intact class. Quasi experimental of non equivalent control group of pre-test, post test, post post test design was used. The sampled schools were assigned to one experimental and one control group. Ecology Concepts Achievement Test (ECAT) was used for data collection. Four null hypotheses were formulated at $P \leq 0.05$ level of significance. The result revealed that there was significant difference in the retention level of students taught using lecture method only. Also the advance organizers favoured female students than male students. Female students retained ecological concepts more than male students. Since advance organizer is an element that fosters creativity in skill acquisition, thus this present study aim at investigating the effect of Project-based Approach on students' retention ability on skills acquisition in biology instead of using an element of cognitive domain (advance organiser) to test for retention. Also considering the above study, the present research aim at determining whether Project-based approach is gender related on students' performance in biology.

Cakici, and Turkmen, (2013) examined the effect of project-based learning activities on the fifth grade children's science achievement and their attitude towards science course for the unit on 'sound ` and to compare the effectiveness of project-based learning over more traditional teaching methods. The pre test post test control group of quasi experimental research design was used. The study was carried out with 44 fifth grade students at a public primary school in the north western part of Turkey during the spring term of the 2011/2012 academic year. Students were randomly divided into two groups as Control Group (CG, n=22) and experimental group (EG, n=22). Initially, pre test on (an Achievement test and an Attitude scale) were applied to both CG and EG. Following the

four weeks, the EG was taught using the project-based practices while the CG was taught using more traditional teaching practices. Children in the EG carried out three science projects for the science unit on ‘sound`: bite and hear, making music with glass bottles, and designing a house with sound insulation. Then the post tests were carried out in order to determine the effect of a project based learning approach on children’s learning. Data were collected through the use of two instruments, an Achievement test and an Attitude scale. The reliability coefficient of this test was determined by KR20 method with coefficient of test was .92. t-test was used to compare the mean score of the two groups on a given variables. The research findings revealed that children’s science achievement significantly improved with the project based activities, but their attitudes toward science did not change. From this finding it was recommended that science teachers should be encouraged and supported to practice inquiry-based approaches, especially project based science teaching to improve success of reform effort at schools. This present study identifies the need to use senior secondary school instead of primary school pupils so as to enhance performance in biology. Attitude was not considered in the present study because even the work carried out by Cakici and Turkmen (2013), attitude was considered. The finding shows that achievement was improved with the use of Project–based approach, but their attitude towards science did not change.

Kadala (2014) investigated the Effect of Concept–Mapping and Project-based Instructional Strategies on JSS students’ Performance and Attitude Towards Geometry in Adamawa state Nigeria. A quasi- experimental with pre- test post- test control group design was adopted. The 3 x 2 factorial analyses were employed for variable matching using three levels of instructional strategies and two levels of gender. The sample size consisted of 381 government junior secondary school two (JSS2) students made of 195 male and 186 female students. The research instruments used were; Geometry Performance

Test (GPT) and Students Geometry Attitude Questionnaire (SGAQ).They were validated and reliability coefficients estimated as r= 0.86 and r= 0.78 respectively. The hypotheses were tested and analysed using t-test, Analysis of variance (ANOVA), Analysis of covariance (ANCOVA) and Kruskal Wallis test. Post Hoc Scheffe test was used to detect the sources of the magnitude and direction of such significant variation. All hypotheses were tested at $P\leq 0.05$ level of significance. The findings showed that: (i) there was significant difference among three groups of students when exposed to concept mapping, project- based instructional strategies and lecture method. (ii) There was significant mean performance difference between male and female students when exposed to concept mapping , project-based instructional strategies and lecture method.(iii) significant difference existed among the three groups in mean attitude scores towards geometry when exposed to concept mapping, project- based instructional strategies and lecture method. Based on this finding the following recommendations were made: it is recommended that concept mapping, project- based instructional strategies could serve as viable alternative to the lecture method in teaching difficult/abstract geometry concepts as it produced higher mean performance among the JSS students. This present research advanced findings to senior secondary school students instead of junior secondary school. This research could not design suitable instrument for measuring skills acquisition in biology concept for entrepreneurship. This makes this present research work designed suitable instrument to measure entrepreneurial skills acquisition among biology SS2 students.

Obialor, Osuafor and Nnadi (2017) investigated the effect of students project work on secondary school science process skills acquisition in biology. The study was carried out in Owerri North Local Area of Imo state Nigeria. Three research questions guided the study and three null hypotheses were postulated and tested at $P\leq 0.05$ level of significance. The design of the study was quasi experimental design: specially pre-test post-test non-

equivalent control group design. The sample consisted of one hundred and thirty four (134) SS2 biology students. A science process skills acquisition test (SPSAT) was used for data collection. The instruments were validated by experts and the reliability coefficient obtained was 0.87 using the test retest method in conjunction with the Pearson Product Moment Correlation analysis. The data collected were analysed using mean and standard deviation for the research questions and Analysis of Covariance (ANCOVA) at $P \leq 0.05$ level of significance for the hypotheses. The result revealed that students' project work had a significant effect on science process skill acquisition in biology. Based on the findings of this study, it was recommended among others that workshops and conferences should be organised to update teachers' knowledge on the use of students' project work as an instructional strategy for enhancement of students' acquisition of science process skills in biology. Ability to recall prior knowledge makes learning meaningful. Therefore, retention was considered in this present research work to test for the meaningfulness of this study.

Isah (2012) investigated the effects of constructivist instructional strategy on the academic achievement, retention and attitude to physics among science secondary school students of varied ability level in Kano State. Pre-test post-test experimental design was used for the study. A simple random sampling technique was used to select 4 schools out of 7 science secondary school in Kano State. 160 out of 1559 SSII Physic students were used for the study. Physic Achievement Test (PAT) & Physics attitude questionnaires (PAQ) were used to collect data. The reliability of PAT was calculated using Pearson's Product Moment Correlation coefficient to be 0.86. Six null hypotheses were tested at $P \leq 0.05$ level of significance using t-test, one way ANOVA, and Mann Whitney U test statistics. The finding reveals that students exposed to constructivist instructional strategies achieved and retained the learnt concepts and developed more positive attitude to physics than their counterparts exposed to conventional lecture method. There was no significant difference

in students' achievement with reference to gender. It was recommended that incorporation of 5E constructivist instructional strategies would enhance retention and achievement among secondary school students. The present work also emphasized constructivist idea but did not consider attitude. Varied ability level require standard assessment tool like DATS and TFLE as stressed by this present work, but was not considered by the work carried out by Isah.

Enohuean (2013) investigated effect of instructional materials on the academic performance and retention of SS II biology students in Ika area of Delta state. The study sample consist of 141 SSII biology students randomly selected from a population of 5,626 students drawn from 18 public schools in Ika Delta state. An instrument designed and developed from pass WEAC questions by researcher known as BAT and was validated by some biology teachers in Delta state. The instrument used was tested and certified to be reliable at 0.646 coefficients. The selected sampled were categorized into 2 experimental and control group The experimental group were subjected to treatment using instructional materials but the control group was taught without any instructional material. Four null hypotheses were tested using t-test statistics. The following major findings were made. There is a significant different between the mean academic achievement scores of students using instructional materials (EG) and those taught without the use of instructional materials (CG). There is no significant different in the mean achievement score of the male and female students taught biology concepts using instructional materials even though there was slight difference in the their mean retention scores of students taught with instructional materials and those taught without instructional materials. There is no significant difference in the retention ability of male and female students exposed to the used of instructional materials. It is on the basis of these findings that some recommendations were advanced one of which is teachers should make use of instructional

materials to facilitate teaching biology. The use of Instructional materials is one of the cardinal points of project method. However, this present study focused on skills acquisition using instructional materials and how it affects students' performance in biology using Project-based instructional approach.

Olarewaju (2012) worked on the effect of cooperative learning strategy with model on academic achievement and retention of some Biology concepts among pre ND students in Kaduna State. A randomly selected sample of 100 students from the four Federal Mono-technical College in Kaduna State made up the subjects for the study. These subjects were divided into four groups. The three experimental and one control groups. A pre-test administered to the subjects established their equivalents ability. Quasi experimental control design was adopted. The instrument used for data collection was Biology Achievement Test (BAT). BAT was validated by experts and reliability was called at r=089. Six research questions were raised and six hypotheses were formulated and test using t-test at $P \leq 0.05$ level of significance. The major findings included the following: The experimental group achieved higher and retained more of Biology concepts than the control group which is in favour of the experimental groups. The recommendation was that lecturers should encourage the use of models along with cooperative learning strategies in the teaching of Biology concepts in tertiary institutions. Skill acquisition by learners was not stressed by this work but the present work emphasized the use of self constructivist skill acquisition through project based approach. The present research work focused on SS II students instead of pre-ND students. Gender performance was not investigated for their significant difference in the study carried out by Olarewaju (2012) on the use of cooperative learning strategy on pre ND biology students.

Therefore the use of Project-based approach promotes the students performance and retention of Entrepreneurial skills acquisition in Biology among senior secondary school student.

## 2.7 Implications of Reviewed Literature for the Present Study

Project-based approach as an instructional strategy that engages students in acquiring skills and knowledge through an extended inquiry, and discovery processes structured around learner designing its own learning tasks in order to produce a meaningful product. Studies have shown the effectiveness of this teaching approach on students' performance in biology and science in general.

However, it is interesting as noted above on the researches carried out above, that most of the studies have been carried out in subject areas considering knowledge acquisition but with little or no emphasis on skills acquisition in poultry and fishery, using project-based approach as instructional strategies in secondary schools in Niger State. Also studies have been carried out considering attitude and knowledge base as its affects performance in biology using project-based teaching strategies. This current study make it flexible to be replicated in biology considering the significance of retention of knowledge and skills as it affects performance in biology among secondary school students.

Project-based approach as instructional Strategies emphasise on practical skills assignment that promote cognitive achievements, entrepreneurial skills acquisition and positive attitude among students. It has been reported by Duch(2002); Kibelf and Kathuri (2005); Cakici and Turkmen, (2013); Obialor, Osunfor and Nnadi(2017) that there is Significant difference on students performance when using project based approach over Concept-Mapping, Inquiry, and Lecture Method in Science-based subjects and Mathematics, particularly when project based approach is used independently in teaching entrepreneurial skills.

Lecture method of teaching (which is the traditional method commonly used in schools) is inadequate for improving students' acquisition of skills, retention and performance in biology among secondary school students (Enoiyeju 2010, Kadala 2014). Therefore, this underscores need to shift from the use of lecture method of teaching and embrace some instructional strategies that have been found to have facilitative effect in promoting students active participation in entrepreneurial skills acquisition through project–based approach. This can influence skills acquisition, retention and performance of students as it is designed in phases and students learn at their pace in real life situation.

In all the investigations carried out, assessment of tools for evaluating skills, retention and academic performance was not emphasised, but this present research work adopted diagnostic evaluation or assessment tool (DATS) from the work of Opetale (2009) that was carried out among secondary school chemistry students. This was employed to determine the strength and weakness of students prior to the study so as to facilitate students' placement to a particular career of entrepreneurial skills inclination.

All the aforementioned research works were developed using descriptive survey design where retention and students' performance were not emphasized, but this present work emphasises quasi experimental design to determine practical activities in enhancing skills acquisition which is part of Project-based approach. This research work stressed the use of retention and students' performance on entrepreneurial skills acquisition to enhance students' performance in biology among secondary school students.

# CHAPTER THREE

# METHODOLOGY

## 3.1 Introduction

The main purpose of this research study was to determine the Effects of Project-based Approach on Entrepreneurial Skills Acquisition on Retention and Performance in Biology among Secondary School Students in Niger State. This, chapter will be discussed under the following headings.


3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sample Techniques

3.5 Instrumentation

3.51 Validity of the Instruments

3.6 Pilot Testing

3.6.1 Reliability of the Instruments

3.6.2 Item Analysis

3.7 Administration of Treatment

3.8 Data Collection Procedure

3.9 Procedure for Data Analysis

### 3.2 Research Design

The research design adopted for this study was quasi experimental design of two experimental groups ($EG_1$ & $EG_2$) and one Control group (CG) involving Pre-test, Post-test, Post-post test. The research work investigates the Effects of Project-based Approach in Acquisition of Skills, on Retention and Performance in Biology among Secondary School Students in Niger State.

The Design is Illustrated in Fig. 3.1

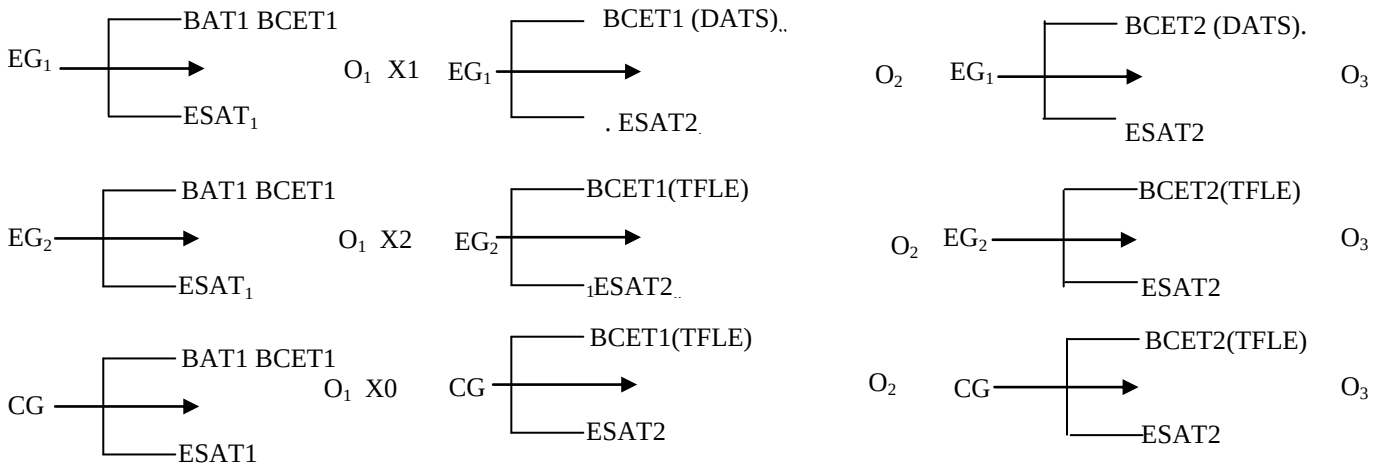



**Fig. 3.1 Research Design**

Key

EG1 Experimental Group 1

EG2 Experimental Group 2

CG Control Group

$X_1$= PA = Project-based Approach Using Training Manual in Fishery and Poultry (DATS).

$X_2$ = PA = Project-based Approach Using Training Manual in Fishery & Poultry (TFLE).

$X_0$ = TLM = Traditional Lecture Method Using Training Manual in Fishery & Poultry (TFLE).

O1 = Pre-test using BAT1, BCET1 and SAT1.

O2 = Post-test using BCET2 (DATS); BCET2 (TFLE) and SAT2.

O3 = Post post-test using BCET2 (DATS); BCET2 (TFLE) and SAT2.

BAT1 = Biology Achievement Test 1

BCET1 = Biology Concepts for EntrepreneurshipTest1 (poultry and fishery)

BCET2= Biology Concepts for Entrepreneurship Test 2 (poultry and fishery)

DATS = Diagnostic Adaptive Testing Skill

TFLE=Traditional Fix Length Examination

ESAT1 = Skill Acquisition Test 1

ESAT2 = Skill Acquisition Test 2

### 3.3 Population of the Study

The population of this study consisted of all public senior secondary school students (SS2) in Niger state with the total of 149,290 students from 245 schools in the seven educational zones of the state as shown in the Table 3.1.

**Table 3.1: Sample Schools from Educational Zones**

| S/N. | Sample Schools | Educational Zone | Male Enrolment | Female Enrolment | Total Enrolment |
|---|---|---|---|---|---|
| 1. | Eyagi Day Secondary School Bida | Bida | 183 | 131 | 314 |
| 2. | Day Secondary School Kutigi | Kutigi * | 137 | 119 | 256 |
| 3. | Day Secondary School Suleja | Suleja | 132 | 111 | 243 |
| 4. | Day Secondary School Paikoro | Minna * | 221 | 199 | 420 |
| 5. | Government Science Secondary School Kagara | Rijau | 120 | - | 120 |
| 6. | Government Secondary School Wushishi | Kontagora* | 102 | 87 | 189 |
| 7. | Government Secondary School New Busa | Borgu | 112 | 91 | 203 |
| | **TOTAL ENROLMENT** | | **1,007** | **738** | **1,745** |

**Source:** Planning, Research and Statistics (PRS), Ministry of Education (MOE) Minna, (2016).

### 3.4 Sample and Sampling Techniques

The sample for this study was drawn from public senior secondary schools (SSII biology students) in Niger State. This is because SSII students were exposed to biology concepts for entrepreneurship right from SSI. The nature of the curriculum of SSII also provides means for successful implementation of skill acquisition and finally they will not be distracted by their final examinations (WAEC or NECO).

Thus, for the purpose of this study one Senior Secondary School was purposively sampled from each of the seven educational zones of Niger State. This is because not all the schools are mix. Also cost implication of project-based approach was considered.

BAT1 was conducted to the seven sampled schools to test for academic equivalence. Six schools showed no significant difference and were considered, but one school showed significant difference and another school from the educational zone was selected for another test of academic equivalence. The result of the sampled school revealed that there is no significant difference and thus considered for further sampling. the seven senior secondary schools sampled undergone a sampling technique by balloting where three senior secondary schools were sampled for the study and then assigned to two treatment groups (EG1 and EG2) and one control group (CG). To assign the schools to treatment and control groups, simple random sampling technique by hat draw method without replacement was used. The first sampled school chosen was assigned to control group, the second and third samples chosen were the experimental group one and two (EG1 and EG2 respectively.

Selection of the sample subjects were carried out by simple random sampling technique by balloting using inscription of S(Sampled) and NS(Not Sampled) for selection of sample size without replacement where 50 subjects (25 male and 25female students) were selected from each sampled school. This is considered appropriate for an experimental research of this nature. This is in line with the recommendation of central limit theorem (Tuckman, 1975; Frankler & Waller, 2009). The fifty sampled respondents from each school were given pre-test on Skill Acquisition Test1 (SAT1) to determine level of skills acquired. The subjects were grouped into groups of 5 subjects for skill acquisition in Poultry and Fishery.

**Table 3.2: Sample Schools for the Study**

| A | Sampled Schools | Experimental Group | SSII School Enrolment | Male sample | Female Sample | Total |
|---|---|---|---|---|---|---|
| 1. | Day Secondary School Kutigi | $EG_1$ | 265 | 25 | 25 | 50 |
| 2. | Government Secondary School Paikoro | $EG_2$ | 420 | 25 | 25 | 50 |
| 3. | Government Secondary School Wushishi | CG | 189 | 25 | 25 | 50 |
| | **Total** | | **874** | **75** | **75** | **150** |

## 3.5 Instrumentation

The research instruments used for the purpose of this research are:

(i) Biology Achievement Test (BAT)

(ii) Biology Concepts for Entrepreneurship Test (BCET) using Diagnostic Adaptive Testing Skills (DATS).

(iii) Biology Concepts for Entrepreneurship Test (BCET).using Traditional Fix Length Examination (TFLE).

(iv) Entrepreneurial Skills Acquisition Test (ESAT)

### 3.5.1 Biology Achievement Test (BAT)

This is one of the research instruments used for the collection of data on students' performance. BAT contains 60 items of multiple choices questions, subjected to an all steps of item analysis specifically called facility index. Each item had four options (A-D) that is distracters which the students were expected to select a correct answer. All the items were drawn from the Biology Syllabus and Scheme of Work of SSS 1 as well as past WAEC questions (2012 to 2016). BAT was used to test for academic equivalence between the sample schools.

**Table 3.3 Table of Specification Test BAT**

| | Content | Weight % | Knowledge | Compreh. | Application | Analysis | Synthesis | Evaluation | Total % |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Nutrition in animals | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| 2 | Ecological concepts and functions of Ecosystems | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| 3 | Relevance of biology to agriculture | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| 4 | Toward a better Health | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| 5. | Reproduction Vertebrates | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| 6. | Classification of vertebrates and invertebrates | 10 | 3 | 1 | 1 | 2 | 1 | 2 | 10 |
| | **TOTAL** | **60** | **18** | **6** | **6** | **12** | **6** | **12** | **60** |

### 3.5.2 Biology Concepts for Entrepreneurship Test (BCET).

This is a cognitive or psychometric test designed to determine the academic performance of the biology students in the study. BCET consist of 100 items multiple choice questions drawn from Project-based Approach Training Manual (PATM) in fishery and poultry, with four distracters (a, b, c, d) to each item. This was administered using two different assessment models. Thus:

(i) Diagnostic Adaptive Testing Skills (DATS)

(ii) Traditional fix Length Examination (TFLE):

**I. Biology Concepts for Entrepreneurship Test (BCET) Using Diagnostic Adaptive Testing Skills (DATS):** The Diagnostic Adaptive Testing Skills (DATS) was used as a model of assessment of BCET instrument. The instrument consist of 100 multiple choice test items. The model divides the test instrument (BCET) into 4 sections of 25 items. BCET (DATS) was separated into BCET1 (DATS) comprising of 2 sections with 25 items each. Likewise BCET2 (DATS). BCET2 (DATS) was used as post-post test after the reshufflement of BCET1 (DATS)

items. The BCET using DATS was administered to students individually, intermittently and immediately. It was marked using Adapted Researcher Marking Scheme to generate the data. In designing BCET using DATS, the researcher had to bring teaching professional skills into play. These include the skills in preparing effective Project-based approach scheme of work in poultry and fishery; lesson plan; generation of test items with their psychometric properties; preparation of making guides and grading system (see Appendices VI-XVIII ). The following are the steps involve in preparing BCET using DATS in biology classroom as adopted from the work of (Opateye, 2009).

**Step 1:** Integrate the related topics in the curriculum and divide them into modules unit, week and content, to form scheme of work to be used for a term. See Appendices XXI.

**Step 2:** Develop weekly lesson plan on each module (See Appendix XIX for sample of lesson plan).

**Step 3:** Generate at least one hundred (100) multiple choice test items on the modules with making guide or scheme.(See Appendix IX, XI, XIII, XV, XVII).

**Step 4:** Pre-test the items to students from other schools to ascertain its psychometric properties of the test items. That is conduct item analysis (facility index, difficulty index, and discrimination index and reliability coefficient).

**Step 5:** Sort items on the modules into low and high difficulty level using this categorization process:

Low-difficulty indices ranges from 0.50 – 0.99 to be labeled Higher achievers

High-difficulty indices ranges from 0.00 – 0.49 to be labeled Lower Achievers

**Step 6:** Categorize the students into their respective groups of interest.

**Step 7:** Teach two modules in two (2) periods per week. Administer DATS items to students after the completion of five modules during the fifth week.

**Step 8:** Mark and review BCET (DATS) questions with the students (use marking scheme).

**Step 9:** Use weekend to prepare a project.

**Step 10:** Report the project using Designed Project-based Plan Report Format at the end of a designed activity / project as seen in Appendix: II.

The school EG1 was assigned and assessed using BCET (DATS) to test the effect of DATS in assessing students' performance in entrepreneurial skills acquisition.

**II. Traditional Fix Length Examination (TFLE):** Students performance assessment was considered at the end of the project exercise using BCET (TFLE) model of assessment used. The BCET (TFLE) was an instrument of 100 items multiple choice questions used. To this effect a school as EG2 was assigned and assessed using BCET (TFLE) to ascertain the effect of the assessment tool for entrepreneurial skills acquisition in teaching biology concept for entrepreneurship among secondary schools students. All the items were drawn from the syllabus and scheme of work of SSS 1 biology concepts that have relationship with entrepreneurship. The test was administered using the under listed topics in accordance to Bloom Taxonomy:

**Table 3.4 Table of Specification Test BCET**

| | Content | Weight % | Knowledge | Compreh. | Application | Analysis | Synthesis | Evaluation | Total % |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Management Practice in poultry/fishery). | 20 | 2 | 2 | 8 | 2 | 4 | 2 | 20 |
| 2. | Production Management(poultry/ fishery). | 20 | 2 | 2 | 8 | 2 | 4 | 2 | 20 |
| 3. | Nutrition in animals (poultry/fishery). | 20 | 2 | 2 | 8 | 2 | 4 | 2 | 20 |
| 4. | Health Management (poultry/fishery) | 20 | 2 | 2 | 8 | 2 | 4 | 2 | 20 |
| 5. | Product processing storage and record keeping. | 20 | 2 | 2 | 8 | 2 | 4 | 2 | 20 |
| | **TOTAL** | **100** | **10** | **10** | **40** | **10** | **20** | **10** | **100** |

### 3.5.3: Entrepreneurial Skill Acquisition Test (ESAT)

Entrepreneurial Skill Acquisition Test (ESAT) is an instrument designed to ascertain the level of entrepreneurial skills a student might have acquired before exposure to the new entrepreneurial skills in the school. Also ESAT1 provides platform for student placement to a suitable venture (enterprise for life sustainability right in school). ESAT1 contains 9 items and a flow chart. This was administered to students as pre-test before receiving treatment on entrepreneurial skills acquisition in some biology concept for entrepreneurship. ESAT1 was used to assess students' ability level of performance in entrepreneurial skills acquisition in poultry and fishery using Project-based approach work book. This observational assessment instrument according to Razzaq and Ajayi (2000) is an instrument that requires watching and recording happening of event or it study behavioral pattern in setting interest. The instrument was designed based on the following headings: test instruction; Project-based procedure; inference; observational rating scale designed on the numerical rating scale of 5,4,3,2,1 in order to determine the strength of students' degree of response and participations in the project under study. See Appendix II The overall score (100 scores) was rated based on the following levels of four point rating

scales of High skill (HS), Moderate Skill (MS), Low Skill (LS) and No Skill (NS). Thus the following boundary score limits were used:

| | | |
|---|---|---|
| High skill (HS), | = | (75%-100%) |
| Moderate Skill (MS) | = | (50%-74%) |
| Low Skill (LS) | = | (25%-49%) |
| No Skill (NS) | = | (0%-24%) |

ESAT2 was Administered as post-test to determine the effect of Project –based Approach on acquisition of skills among secondary school students. See Appendix II show the format of reporting and assessing Project-based activity as used in the study. Therefore, this study adopted this performance rating scale of Okeke, Egbunonu and Ugbaja (2009) in order to investigate the effects of Project-based approach on students ability level of skills acquisition in biology.

### 3.6 Validity of Instruments

The three instruments were validated by two (2) Senior Lecturers with Ph.D qualification from A.B.U. Zaria. Also a senior staff from biology education with a minimum of first degree in biology and working experience of not less than 20 years was used to validate the instruments from the schools. BCET, ESAT and BAT instruments were validated using content validity because the instruments were administered considering specific content areas and behaviourally stated instructional objectives. BCET Instrument was validated considering content validity. Table of specification by Bloom was used to assess weight mark for each content. ESAT instrument was validated and time allotted to each item was adjusted to meet the content converge. Also Emphasis was much more on application. BAT Content Validity was used to correct area coverage and questions with much emphasis on Knowledge acquisition.

### 3.7 Pilot Testing

Pilot study was conducted using three Senior Secondary Schools in Niger state. Two schools were used as experimental groups for administering research instruments for testing their reliability. The remaining one was used as control. The researcher organized several meetings with the Principal and the Biology teacher. During the meetings, the researcher discussed the objectives and procedure of the research to the (Biology teacher). One of the biology teachers was used as research assistant to help the researcher in monitoring and controlling the project activities. The researcher prepared the study manual and lesson plan on Project-based approach in fishery and poultry. The researcher explained the use of BAT, BCET using TFLE and DATS, ESAT and Design Project-based Approach work book in Poultry and Fishery to the Biology teacher. Time Table was designed for effective implementation along with the Biology teacher. Twenty sampled students were involved from each sampled schools. BAT items were tested for reliability using facility index and Pearson Product Moment Correlation Coefficient (PPMC) statistical tools at $P \leq 0.05$ level of significance. Also BCET (DATS) and ESAT items analysis were tested for reliability using discrimination and difficulty indices. The results obtained from the use of the instruments were tested for their reliability using Pearson Product Moment Correlation Coefficient at $P \leq 0.05$ level of significance. The research for pilot testing was for research instruments to determine:

i. The characteristics of the research instruments (BAT; BCET using TFLE, DATS; ESAT) items through item analysis.
ii. The reliability of the research instruments.
iii. The appropriateness of the length of item required to conduct the test.
iv. Final refining of the multiple choice questions (Yusuf, 2006).

### 3.7.1 Reliability of the Instruments

**(i) Reliability of BAT**

Reliability involves investigating the consistency of the test instrument. Therefore, to determine the reliability of the treatments Test - retest method were employed. The first test (BAT) was given to students of different institutions after two weeks interval, the second test was administered. This is in line with the Tuckman (1975) recommendation for the use of two weeks interval between the test retest procedures. The result obtained was subjected to statistical analysis using Pearson Product Moment Correlation Coefficient at $p \leq 0.05$ and was $r = 0.68$.

**(ii) Reliability of BCET**

Also to test for reliability of BCET requires the use of Test - retest reliability test during pilot testing. This is to maintain the internal consistency of the test items. Pearson Product Moment Correlation Coefficient at $P \leq 0.05$ was used to analyse the reliability coefficient recorded during pilot testing. The result obtained was $r = 0.71$. Therefore BCET instrument was considered reliable and was used for this study.

**Reliability of ESAT**

The reliability of ESAT instrument requires the use of Test - retest reliability test. Pearson Product Moment Correlation Coefficient at $P \leq 0.05$ was used to analyse the reliability coefficient recorded during pilot testing. The result obtained was $r = 0.78$. Thus, the SAT instrument was considered reliable and was used for this study.

### 3.7.2 Item Analysis

Item analysis for BAT 50 items multiple choice questions was conducted using facility index.

**(i) Facility Index:** According to Yusuf (2006) facility index of an item is regarded to be the percentage of the entire candidates that responded correctly to the item

compared with total number of candidates that attempted the item. Thus, the facility index of BAT will be calculated using the formula below.

$$P = R/T$$

Where

p =facility index

r =total number of candidates that responded correctly

T =total number of candidates that attempted the item.

The range above 30% to 70% is usually recommended for use (Wood, 1990) that is the range from 0% - 30% renders the item to be too difficult, while the range above 70% – 100% renders the item too simple. Thus, all the items were tested with ten of the items tested to be too simple and were then modified while six of them were considered too difficult and were reconstructed. (See appendices xxii).

**(ii) Discrimination Index for BCET:**

The ability to discriminate between high and low achievers in a test as a whole is called discrimination index of that test. Therefore item analysis for BCET 100 Multiple Choice Test was conducted using discrimination index. The calculation was done by finding the difference of the two percentages (one for the Higher Achiever group and the other for Lower Achiever group). Then the formula is

$$D = R_H - R_L$$

Where D =Discrimination index.

$R_H$ = Number among Higher Achiever that scored an item correctly.

$R_L$ = Number among Lower Achiever that scored an item incorrectly.

$$D = \frac{\text{Who got item right (RH)-who got item right (RL)}}{\text{Total number in any of the group (1/2T)}} \times \frac{100}{1}$$

Given $\frac{RH - RL}{1/2T} \times \frac{100}{1}$

Discrimination index ranging from 0.49-0.58 were considered moderately positive value while those above 0.59 to 0.70 were highly positive value. More so, those values between 0.30 to 0.48 and below had low positive values. The values above 0.70 were considered too simple for the students. Also the items with the value below 0.30 were considered too difficult for the students. Therefore, the items that are too easy or too difficult were of no use for educational testing of academic attainment to know the good and bad performers are recommended by (Yusuf, 2006). Two of the items that do not meet up to the requirement or the criterion for selection were discarded and other items were reconstructed. Therefore, strictly the discrimination index between 0.30 to 0.70 (30% - 70%) was used for BCET items during the study.

**(iii) Difficulty Index for BCET**

This index was used to identify high and low achieving students using BCET instrument. According to James (2000) the following formular for computing difficulty index of a test instrument can be used

Given $\frac{Ru - RL}{^{1/2}N}$

Where

D = difficulty index

Ru = Number among upper 27 percentage of respondents who scored item correctly

RL = Number among lower 27 percentage of respondents who scored item correctly.

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

According to James (2000) item with the difficulty index ranging between 0.3-0.49 are considered moderately positive achievers. Those difficulty indices above 0.49 are high positive achiever. Considering the percentages difficulty after the analysis of this work, revealed that all the items with difficulty indices below 20% were discarded for being too difficult, while those items with indices between 20% to 30% were selected as the final

items for BCET instruments with some modification or reframing. Items with indices between 30% to 70% were selected without any modification, while those indices above 70%were modified and accepted. Therefore, for this study, BCET1 (poultry) with 50 items , 44 items were selected without modification while items selected with modification were 5items. Only 1 item was discarded and reconstructed to this effect. Also BCET2 with 50 items, revealed that 43 items were selected without modification while 7 items were selected with modification. BECT1 (fishery) revealed that 47 items were selected without modification while 3 items were selected with modification. BECT 2 (fishery) revealed that 49 items were selected without modification while only 1 item was modified (See appendices).

Finally result obtained from BCET instrument was retested and computed using Pearson Product Moment Correlation Coefficient (PPMCC) at $P \leq 0.05$ to determine correlation between the tests. Also Cronbach's alpha was computed for the tests to determine the standard error or consistence level of the instrument.

**(iv) Difficulty Index for ESAT**

Difficulty index was computed for ESAT instrument considering the above procedure. The result revealed that out of 50 items, 46 items were selected without modifications while 3 items were selected with modification. Only 1 item was discarded and reconstructed to this effect.

The homogeneity of the instruments was at tested at $P \leq 0.05$ and revealed that they were not significant. (See Appendix XXIV).

### 3.8 Administration of Treatment

The Project-based approach has the following stages: preparatory, organizational, Implementation, and assessment stages**.** The latter is further divided into three phases for the purpose of this research work which conforms with the work of (Akpomi, 2009).

Benedict (2015) reaffirmed that in an event that an experiment is planned to cover a longer period of time, then it should be carried out in phases to protect threats to experimental design study. Akpomi (2009) reported that assessment of any Project-based Approach should put into consideration the following three assessment phases with assessment weight of 100 %: (25%, 15%, and 65% for phases I, II and III respectively). This study was designed on the following assessment phases so as to facilitate administration of the instruments of this study:

**Assessment Phase I**

Group Presentation and Exhibition Assessment**:**

- Students were in groups of five,
- Students created Project-based concepts and work on it to develop a project proposition or project proposal.
- The group presentation: this provides an opportunity for students to present their ideas on project research and route to project skills,
- Projects exhibition for assessment or judgment by researchers were invited on the exhibition day.
- Weight percentage assessment is 25%.

**Assessment Phase II**

Individual Project-based Proposition Assessment:

- After the group presentation, students worked individually and developed a full-fledged Project-based proposition at their own pace.
- Weight percentage assessment is 15%.

**Assessment Phase III**

Individual Project-based Plan:

- The student develops at his or her pace new Project-based plan from the acquired skill as a future entrepreneur.
- Individual Action plan was designed using Project-based Approach work book.
- Project was reported using a designed using Project-based Approach report format
- Student entrepreneurial competence in skill acquisition was measured
- Weight percentage assessment is 65%.

It is on the basis of this assessment phases along with stages of Project-based approach (Preparatory, Organizational, Implementation, and Assessment stage)**,** that this research pre- test, post-test, and post post-test was designed.

**Pre-test ($0_1$):**

**Group Activity:**

**Preparatory and Organizational Stage**

During pre-test ($0_1$), BAT1 (Biology Achievement Test 1) was administered to the sampled subjects before exposure to the full treatments. This was to find out if the three groups (EG1, EG2 and CG) were equivalent in their performance ability levels before exposure to treatment (Sambo, 2005; Ifidons, 2007 & Obeka, 2011). Entrepreneurial Skill Acquisition Test (ESAT1) was conducted to determine level of skills acquired by students in the areas of poultry and fishery management.

**Post-Test ($O_2$):**

**(a) Group Activity: Organizational and Implementation Stage**

After the administration of pre-test, post-test ($O_2$) was administered to the two randomly sampled experimental groups (EG1 and EG2). Project-based Approach Training Manual in Poultry and Fishery (PATMP and F) using Project-based Approach (PA) was

used as treatment to this effect. The remaining sampled school which is the control group (CG) also used Project-based Approach Training Manual in Poultry and Fishery (PATMP and F) but Traditional Lecture Method (TLM) was used as a form of treatment. This is to determine the effects of Project-based Approach in acquisition of entrepreneurial skills, retention and performance in Biology among secondary school students over the use of Traditional Lecture Method.

**(b) Group Activity: Assessment Stage**:

Furthermore, BCET1 (DATS) as a formative assessment tool was used to assess, experimental group EG1, while BCET1 (TFLE) as a summative assessment form was conducted to assess EG2. The two experimental schools used Project-based Approach as treatment. Control Group (CG) using TFLE used Traditional Lecture Method as a treatment to this effect. This was to determine the use of DATS over TFLE in assessing the use of Project-based Approach in teaching biology concepts for entrepreneurship among senior secondary school students.

**Post-Post Test ($O_3$): Individual Organizational and Implementation Stage**

Post-post test ($O_3$) as individualized implementation form, Project-based Approach (PA) treatment using PATMP and F was administered to the two sampled schools (EG1 and EG2). While CG used TLM as treatment using Project-based Approach Training Manual in Poultry and Fishery PATMP and F as a tool. ESAT2 was conducted to experimental and control groups too. This is to determine the effects of Project-based approach on students' performance in skills acquisition. BCET2 was administered to every individual in order to determine retention levels of students in biology.

**Period Allocation**

The period of two (2) weeks was used during the pre-test covering the periods of : first week for the administration of BAT1 and conduct of entrepreneurial skills acquisition

as introductory session, while the second week for the administering of ESAT1. Therefore, post-test covered a period of six weeks; Post post-test was administered after the period of four weeks. This gave a total of twelve (12) weeks for the purpose of this study. This is in accordance with the work of, as Adopted from the work of Akpomi (2009) entrepreneurship learning skills.

### 3.9 Procedure for Data Collection

Data collection was done using BAT. BAT was used for the collecting data on students' academic performance, academic equivalence of the sampled subjects under study. The BAT that is psychometric research instrument with four distracters (a, b, c, d) to each item was administered to students in a written form. BAT1 was used during pre-test to generate data so as to determine level of equivalence of the subjects and lasted for two weeks. ESAT1 was conducted during pre-test to students in EG1, EG2 and CG to determine level of entrepreneurial skills acquired. Also ESAT2 was conducted after treatment during Post-test to determine the significant difference between levels of entrepreneurial skills acquisition before and after treatment (ESAT1 and ESAT2).

BECT using DATS cognitive or psychometric research instrument was drawn from PATM in fishery and poultry, with four distracters (a, b, c, d) to each item. BCET (DATS) was administered to students individually and immediately marked using adapted researcher marking scheme so as to generate data. BCET (DATS) was administered to EG1 at post test and post post test to generate data that determines students' level of retention on biology concepts for entrepreneurship. Moreso, BCET using TFLE was conducted to EG2. The data generated from EG1 and EG2 were compared for their significance in carrying out Project-based Approach in acquiring skills. Also BCET2 was administered during Post post-test treatment. Data obtained from BCET2 was compared with BCETT1 so as to

determine the effects of Project-based Approach on students' performance and retention in entrepreneurial skills acquired in some biology concepts for entrepreneurship.

ESAT observational research instrument was Administered personally by the researcher to the students in group and individually using test with a five points rating scale of 5, 4, 3, 2, 1, to generate data. ESAT was administered during post-test to a group work and to individual work. This is to assess students' non cognitive skills ability level and participation in acquisition of entrepreneurial skills.

In administering treatment to different groups, the following parameters need to be considered:

(i) The choice of mix research group( male and female students ) among others;

(ii) Ensuring the capability of the research group;

(iii) Ensure that different schools are used to avoid contamination (Experimental and control group might meet to exchange ideas or notes) and

(iv) Each school will be ensured to be a school where biology is compulsorily taught among senior secondary school students (Yusuf, 2006).

### 3.10 Procedure for Data Analysis

The data collected were analyzed using descriptive statistic among which were mean, percentage mean, mean deviation, standard deviation and standard error to answer the research questions while inferential statistics was used to test the stated null hypotheses.

**Null Hypotheses**

The following null hypotheses were formulated and tested at $P \leq 0.05$ significant levels.

$HO_1$: There is no significant difference in students' means scores in Biology taught using Project-based approach and their counterparts taught using lecture method.

ANOVA statistics was used for this hypothesis

($HO_1$) at $P \leq 0.05$ to check the level of significance among the variables under test.

$HO_{2:}$ There is no significant difference between the retention mean scores of students taught Biology concepts using Project-based approach and those taught using lecture method.

ANOVA statistics and Post-Hoc Scheffe's test were used for this hypothesis ($HO_{2:}$) at $P \leq 0.05$ to check the level of significance difference.

$HO_{3:}$ There is no significant difference in students' acquisition of skills when taught using Project-based approach and their counterparts taught using lecture method.

ANOVA statistics (Univariate Analysis of Variance) test and Post-Hoc Scheffe's test were used for this hypothesis at($HO_{3:}$) $P \leq 0.05$ to check the level of significance.

$HO_{4:}$ There is no significant difference in the mean scores of male and female students after exposure to Project-based approach in Biology.

ANOVA (Univariate Analysis of Variance) statistics and ANCOVA statistics were used for this hypothesis ($HO_{4:}$) at $P \leq 0.05$ to check the level of significance.

$HO_{5:}$ There is no significant difference in students' ability levels in skills acquisition using Project-based approach assessment tools (DATS and TFLE).

ANOVA statistics and Post-Hoc Scheffe's test were used for this hypothesis ($HO_5$) at $P \leq 0.05$ to check the level of significance among the variables under test.

# CHAPTER FOUR

# DATA ANALYSIS, RESULTS AND DISCUSSIONS

## 4.1 Introduction

This chapter focused on data analysis, presentation and discussion of results obtained from the study respondents. Data on level of skill acquisition were collected using SAT instrument, while data on academic performance and retention were collected using BCET instrument. BAT instrument was used to collect data on students' academic equivalence and retention.

## 4.2 Data Analyses and Results Presentation

The results and analyses of data obtained are presented under the following:

4.2.1 Answering Research Questions

4.2.2 Testing Null Hypotheses

4.3 Summary of Findings

4.4 Discussion

### 4.2.1 Answering Research Questions

The mean performance scores and standard deviation of Project-based approach using DATS was used as EG1 while Project-based approach using TFLE was used as EG2. The data from the two aforementioned approaches were compared with the Lecture Method as Control Group (CG). The data obtained from each stated research question was presented below in the following tabl

**Research Question 1**

(i) What is the effect of Project-based Approach on students' academic performance in Biology?

**Table 4.1: Mean Scores among SS2 Students Taught using Project-based Approach and those Expose to Lecture Method.**

| Group | N | Mean | SD | SE |
|---|---|---|---|---|
| Experimental Group 1 (EG1) | 50 | 53.72 | 16.76 | 3.36 |
| Experimental Group 2 (EG2) | 50 | 38.74 | 10.43 | 2.09 |
| Control Group (CG) | 50 | 34.79 | 9.83 | 1.96 |

Table 4.1 reveals the performance mean scores, standard deviation and standard error of post-test. The mean performance scores of students from EG1 using Project-based Approach (DATS) was 53.72 while the mean performance scores of students in EG2 using Project-based Approach (TFLE) was 38.74 and Control Group (CG) using Lecture Method was 34.79. The results from Table 4.1 shows that the performance mean score of students exposed to Project-based Approach using DATS (EG1) was higher than those exposed to Project-based Approach using TFLE(EG2) and in turn higher than those taught using Lecture Method (CG).

**Research Question 2:**

(ii)What is the effect of Project-based Approach on students' retention of Biology concept?

**Table 4.2: Comparing Retention Mean Scores among SS2 Students Taught using Project-based Approach and those Expose to Lecture Method.**

| **Group** | **N** | **Mean** | **SD** | **SE** |
|---|---|---|---|---|
| EG I | 50 | 66.02 | 10.27 | 2.05 |
| EG2 | 50 | 50.20 | 8.76 | 1.75 |
| CG | 50 | 41.68 | 9.01 | 1.81 |

Table. 4.2 shows that the mean scores of students' retention of biology concepts when exposed to Project–based approach (EG1&EG2) and those taught using Lecture

Method (CG) were 66.02,50.20 and 41.68 respectively. Thus, the mean score of the experimental Group 1 (EG1) students' retention of biology concepts for entrepreneurship was higher than Experimental Group2 (EG2). Moreso, the Control Group (CG) had the least retention mean score of retention of biology concepts.

**Research Question 3**

(iii) What is the effect of Project-based approach on students' retention ability to acquired skills in Biology?

**Table 4.3 Students' Retention Ability Skill Mean Scores When Exposed to Project-based Approach in Teaching Biology Concepts for Entrepreneurial Skills.**

| Group | N | Mean | SD | SE | Remark |
|---|---|---|---|---|---|
| EG1 | 50 | 81.54 | 10.07 | 1.48 | High skill |
| EG1 | 50 | 64.26 | 11.94 | 1.48 | Moderate skill |
| CG | 50 | 49.54 | 12.37 | 1.48 | Low skill |

Data from Table 4.3 reveals that students retention ability level when exposed to Project-based approach using DATS has the mean retention ability score of 81.54 and acquired High Skills which is higher than students exposed to Project–based approach using TFLE(EG2) with retention mean ability score of 64.26 and acquired moderate skills. Moreso, it was observed from Table 4.3 that students taught using Lecture Method (CG) s achieved lowest mean retention ability score of 49.54 and acquired Lower Skills.

**Research Question 4:**

Is there any difference in the performance mean scores of male and female students after exposure to Project -based approach in Biology?

**Table 4.4 Mean Scores of Male and Female Students after Exposure to Project-based Approach in Biology.**

| Method | N | Sex | Mean | SD | SE |
|---|---|---|---|---|---|
| EG1 | 25 | Male | 52.80 | 17.58 | 1.772 |
| | 25 | Female | 56.48 | 14.29 | 1.772 |
| EG2 | 25 | Male | 44.08 | 12.01 | 1.772 |
| | 25 | Female | 36.96 | 9.90 | 1.772 |
| CG | 25 | Male | 34.28 | 9.289 | 1.772 |
| | 25 | Female | 34.96 | 10.02 | 1.772 |
| TOTAL | 75 | Male | 43.72 | 15.236 | 1.45 |
| | 75 | Female | 42.60 | 15.035 | 1.45 |
| | 150 | Total | 43.26 | 15.106 | 1.45 |

Table 4.4 shows the mean performance scores of male and female students in EGI to be 52.80 and 56.48 respectively. The result indicated that the female mean performance score was higher than male mean performance score. From Table 4.4 it was observed that students in EG2 with the mean performance scores of male and female students were 44.08 and 36.96 respectively, showed that the male mean performance score was higher than female mean performance score. More so, in Table 4.4 above shows that in CG the mean performance scores of male and female students were 34.28 and 34.96 respectively, with the female mean performance score was higher than male mean performance score. Finally data in Table 4.3 revealed that the total performance mean score between male and female students were 43.7and 42.60 respectively and was slightly higher in favour of male students.

**Research Question 5:**

What is the difference between levels of skill acquired using DATS and TFLE as assessment tools for Project-based approach?

**Table 4.5. Mean Scores after Exposure to DATS and TFLE Assessment Tools on Acquisition of Skills among SS 2 Students of Biology.**

| Group | N | Mean | SD | SE | Remark |
|---|---|---|---|---|---|
| EG1 | 50 | 64.68 | 10.78 | 1.407 | MS |
| EG2 | 50 | 56.63 | 11.22 | 1.410 | MS |
| CG | 50 | 46.99 | 12.08 | 1.403 | LS |

The data from Table 4.5 reveals that in EG1, the Mean Score was 64.68 after exposure of students to Project-based approach using DATS as assessment tool ( formative) in evaluating the level of skills acquisition and shows that students acquired Moderate skills. While in EG2 the Mean Score was 56.63 after exposure of students to Project-based Approach using TFLE as assessment tool (summative) in evaluating the level of skills acquisition and shows that students acquired Moderate skills. Thus, the students from EG1 recorded the higher mean score than the students from EG2 with mean in entrepreneurial acquisition of skills in biology. The control group (CG) remains the least with the mean score of 46.99 and the students acquired Low Skills.

### 4.2.2 Results of Testing of Null Hypotheses

**$HO_1$:** There is no significant difference between students' mean scores in Biology taught using Project- based approach and those taught using Lecture Method.

**Table 4.6: ANOVA on Mean Performance Scores among SSII Biology Students.**

| Group (EG1, EG2, CG) | SS | Df | MS | F | Sig. | Remark |
|---|---|---|---|---|---|---|
| Between groups | 1058.08 | 2 | 5291.54 | 33.22 | .000 | S* |
| Within groups | 23415.78 | 147 | 159.291 | | | |
| Total | 33998.86 | 149 | | | | |

* Significant at P≤ 0.05

Table 4.6 shows that P=.000 at P≤ 0.05 level of significance. Thus, significant difference in performance mean scores in Biology exist among students when taught using Project-based approach (EG1&EG2) and those taught using lecture method (CG). The null hypothesis which states that there is no significant difference in students' means scores in biology taught using Project-based approach and their counterpart taught using lecture method is rejected. This implies that the treatment has a significant main effect on students in biology.

**$HO_2$**: There is no significant difference between the retention mean scores of students taught Biology concepts using Project-based approach and those taught using Lecture Method.

**Table 4.7: ANOVA Test on the Difference in Retention Mean Scores in Biology among SSII Students.**

| EG1, EG2, CG Group | SS | Df | MS | F | Sig | Remark |
|---|---|---|---|---|---|---|
| Between Groups | 152554.973 | 2 | 7627.487 | 85.008 | .000 | S* |
| Within Groups | 13189.860 | 147 | 89.727 | | | |
| Total | 28444.833 | 149 | | | | |

* Significant at P≤ 0.05

Table 4.7: reveals that there is significant difference in retention level of biology concepts between students taught using Project-based approach (EG1 & EG2) and those students

taught using lecture method (CG). The calculated P-value of 0.000 which is less than P<0.05 alpha level of significance when compared between EG1 and EG2 with CG groups. To identify the cause of the effect for the significant difference, Post -hoc Scheffe Test was conducted as shown in the Table 4.8 below. However, based on the statistical evidence that the p calculated was lower than the alpha level of 0.05, the null hypothesis which states that there was no significant differences between retention mean scores of students taught biology using project based approach and those taught using lecture method is rejected.

**Table 4.8: Post-Hoc Scheffe Test on the difference in Retention Mean Scores in Biology among SSII Students.**

| Methods Group (1) | Group J | MD (1-J) | SE | P. Value | Remark |
|---|---|---|---|---|---|
| Scheffe | EG2 | 15.820 | 1.894 | .000 | S* |
| EG1 | CG | 24.340 | 1.894 | .000 | S* |
| EG2 | EG1 | -15.820 | 1.894 | .000 | S* |
| | CG | 8.520 | 1.894 | .000 | S* |
| CG | EG1 | -24.340 | 1.894 | .000 | S* |
| | EG2 | -8.520 | 1.894 | .000 | S* |

* Significant at P≤ 0.05.

Table 4.8 shows that the retention mean Scores between students exposed to Project-based approach using DATS (EG1) and Project-based approach using TFLE (EG2) is statistically significant showing that the calculated P value of 0.00 which is less than 0.05 alpha value of significance. Thus, the retention mean scores between students taught using Project-based approach (EG1) using DAT was compared with these students taught using lecture method (CG). The result reveals that the calculated (P) value of 0.00 is less than 0.05 alpha value of significance. However, there is significant difference in retention mean scores between students exposed to Project-based approach using TFLE (EG2) and students taught using lecture method (CG) and has the calculated (P) value of 0.00 which is

less than 0.05 alpha value of significance, vice versa. The above findings showed significance difference therefore the stated null hypothesis is rejected.

**$H_{O3:}$** There is no significant difference in students' means scores on retention in acquisition of skills when expose to Project-based approach and their counterparts taught using lecture method.

Therefore, to test the significant difference, univariate test was conducted to ascertain that contrasting characteristics of the significant difference. This is shown in the Table 4.9 below.

**Table 4.9 Univariate Test of the Retention Ability Mean Scores of the Three Groups (EG1,EG2&CG)of Students on Acquired Skills.**

| EG1, EG2, CG Group | SS | Df | MS | F | Sig. | Remark |
|---|---|---|---|---|---|---|
| Contrast | 25654.613 | 2 | 12827.309 | 117.503 | .000 | S* |
| Error | 15719.920 | 144 | 109.166 | | | |

* Significant at P≤ 0.05

Table 4.9: shows that there is significant difference in the students retention ability based on the mean scores of the three groups EG1, EG2 and CG. Showing the calculated F value of 117.503 at P≤ 0.05 level of significance. The calculated P value is 0.000 at P≤ 0.05 level of significance. This shows that retention ability differs among the students in the three groups EG1, EG2 and CG. Thus, the use of two by two pairwise comparison to find out the causes in the difference between the groups is indicated in Table 4.10.

**Table 4.10 Post Hoc Scheffe Test on Retention Ability to Acquired Skills in Biology.**

| Method I | Method J | MD (I-J) | SE | Sig | Remark |
|---|---|---|---|---|---|
| Scheffe | EG2 | 17.280 | 2.090 | .000 | S* |
| EG1 | CG | 32.000 | 2.090 | .000 | S* |
| EG2 | EG1 | -17.280 | 2.090 | .000 | S* |
| | CG | 14.720 | 2.090 | .000 | S* |
| CG | EG1 | -32.000 | 2.090 | .000 | S* |
| | EG2 | -14.720 | 2.090 | .000 | S* |

* Significant at $P \leq 0.05$

Table 4.10 reveals that there is significance difference among the three groups (EG1, EG2& CG) given the calculated P value of 0.00 at $P \leq 0.05$ level of significance. The retention mean difference scores between EG1 and EG2 is 17.280 in favour of EG1. Therefore, EG1 significantly enhanced acquisition of skills better than EG2. Also the retention mean difference scores between EG1 and CG is 32.000 which is in favour of EG1. Thus, EG1 was better used to acquire entrepreneurial skills than CG. Moreso, between EG2 and CG the retention means difference scores of 14.720 is in favour of EG2. Therefore, EG2 can enhance acquisition of skills better than CG. Thus, EG1 is significantly better and enhanced retention ability than EG2, while EG2 enhanced retention ability than CG among SS2 students in acquiring skills in biology.

**$HO_4$**: There is no significant difference between the mean scores of male and female students after exposure to Project-based approach in Biology.

**Table 4.11 Univariate Test on Performance Mean Scores of Male and Female Students after Exposure to Project-based Approach in Biology.**

| Male & Female Group | SS | Df | MS | F | Sig. | Remark |
|---|---|---|---|---|---|---|
| Contrast | 31.740 | | 31.740 | .202 | .654 | NS* |
| Error | 22607.040 | 144 | 156.993 | | | |

* Significant at P≤ 0.05

Table 4.11 reveals that there is no significant difference on the performance mean scores between male and female students with calculated p value of 0.654 which is considered greater than P≤ 0.05 level of significance. Therefore, the stated null hypothesis is thereby retained. This implies that gender has no significant effect on performance in biology when exposed to Project-based approach. Table 4.11 shows the interception effect of methods used and gender on students' performance in biology'

**Table 4.12: ANCOVA Test on Post Test Performance Mean Scores of Students and Gender after Exposure to Project-based Approach in Biology.**

| Source | sum of square | Df | MS | F | Sig | Remark |
|---|---|---|---|---|---|---|
| Corrected model | 1139.820 | 5 | 2278.364 | 14.512 | .000 | S* |
| Intercept | 280714.140 | 1 | 280714.140 | 1788.064 | .000 | S* |
| Method | 10583.080 | 2 | 5291.340 | 33.706 | .000 | S* |
| Sex | 31.740 | 1 | 31.740 | .202 | .654 | NS |
| Method and sex | 777.000 | 2 | 388.500 | 2.415 | .088 | NS |
| Error | 22607.040 | 144 | 156.993 | | | |
| Total | 314713.000 | 144 | | | | |
| Corrected total | 33998.860 | 149 | | | | |

* Significant at P≤ 0.05

Table 4.12 reveals the performance of students using the three approaches of teaching Biology Concepts for Entrepreneurship showed significant difference in

performance among students with the calculated P value of 0.000 less than P≤ 0.05 level of significance. Beside, students' performance in Biology Concepts for Entrepreneurship showed no significance interception difference when considering gender with the calculated P value of 0.654 at P≤ 0.05 level of significance. Also, considering students' performance using the three difference approaches of teaching Biology Concepts for Entrepreneurship alongside with gender showed no significance difference with p value of 0.088 at at P≤ 0.05 level of significance. This implies that the use of the three different teaching approaches has no interception effect on gender difference in terms of students' performance in Biology Concepts for Entrepreneurship.

**$HO_5$:** There is no significant difference in students' ability levels in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tools of Project-based approach.

**Table 4.13: Two-way ANOVA on Mean Scores Difference after Exposure to DATS and TFLE (Assessment Tools on acquisition of Skills).**

| EG1, EG2, CG Group | SS | Df | MS | F | P | Remark |
|---|---|---|---|---|---|---|
| Between Groups | 8434.120 | 2 | 4217.080 | 30.993 | .000 | S* |
| Within Groups | 20001.380 | 147 | 136.064 | | | |
| Total | 28435.500 | 149 | | | | |

* Significant at P≤ 0.05

Table 14.13 reveals that there is significant difference between students ability level in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tool of Project-based approach with F value of 30.993 and calculated P value of 0.00 at P≤ 0.05 level of significance. Therefore, the hypothesis which states that there is no significant difference in students ability level in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tool of Project-based approach is

rejected. To identify the direction of significance difference between the approaches, Table 4.14 below indicated the direction of the difference.

**Table 4.14: Post-Hoc Scheffe Test on Mean/Scores of students after Exposure to DATS and TFLE (Assessment Tools on Acquisition of Skills).**

| Method I | Method J | MD (I-J) | SE | Sig | Remark |
|---|---|---|---|---|---|
| Scheffe | EG2 | 8.053 | 2.001 | .000 | S* |
| EG1 | CG | 17.695 | 1.986 | .000 | S* |
| EG2 | EG1 | -8.053 | 2.001 | .000 | S* |
| | CG | 9.642 | 1.992 | .000 | S* |
| CG | EG1 | -17.695 | 1.986 | .000 | S* |
| | EG2 | -9.642 | 1.992 | .000 | S* |

* Significant at $P \leq 0.05$

Table 4.14 reveals that there is significance difference with calculated P value of 0.00 at $P \leq 0.05$ among the three groups (EG1, EG2& CG). The mean difference scores between EG1 and EG2 was 8.052 in favour of EG1. Therefore, EG1 enhanced students' ability level higher than EG2. Also, the mean difference scores between EG1 and CG was 17.695 which is in favour of EG1. Thus, EG1 is better used to enhance students' ability level than CG. Moreso, between EG2 and CG the mean difference scores of 9.642 was in favour of EG2. Therefore, EG2 enhanced students' ability level higher than CG. Thus, EG1 is significantly better to enhance students ability level than EG2 while EG2 enhanced students ability level in skills acquisition than CG among SSII students in biology. Therefore the null hypothesis that states there is no significant difference in students' ability levels in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tools of Project-based approach is hereby rejected. It was Therefore, investigated that there was significant difference between students' ability levels in skills

acquisition using DATS as assessment tool and those exposed to TFLE as assessment tools of Project-based approach.

### 4.3 Summary of Findings

1. There was significant difference in students' means scores in Biology taught using Project-based approach and their counterparts taught using Lecture Method. This was in favour of Experimental Groups (Project-based Approach {DATS}& Project-based Approach {TFLE}) over (Control Group) Lecture Method. The finding of this study reveals that Project-based approach is effective in enhancing students' performance in biology. Therefore, the stated null hypothesis is hereby rejected.
2. There was significant difference between the retention mean scores of students taught Biology concepts using Project-based approach and those taught using Lecture Method. This was in favour of Experimental Groups (Project-based approach {DATS}& Project-based approach {TFLE}) over (Control Group) Lecture Method. The finding of this study reveals that Project-based Approach is effective in promoting students retention ability in biology. Therefore, the stated null hypothesis is hereby rejected.
3. There was significant difference between students' means scores on retention ability in acquisition of skills when expose to using Project-based approach and those taught using Lecture Method. Therefore, the stated null hypothesis is hereby rejected
4. There was no significant difference between the mean scores of male and female students after exposure to Project-based Approach in Biology. Therefore, the stated null hypothesis is hereby retained

5. There was significant difference between students' ability levels in skills acquisition using DATS as assessment tool and those exposed to TFLE as assessment tools of Project-based approach. Therefore, the stated null hypothesis is hereby rejected

## 4.4 Discussion

The stated hypotheses of this study are discussed as follows:

Results from Table 4.1 of this study shows that the performance mean score of students in EG1 is higher than EG2 and in turn higher than CG. Meaning that the students exposed to Project-based approach using DATS (EG1), performed better than students taught using Project-based approach using TFLE (EG2) while students exposed to Lecture Method possess the least performance. This finding agreed with the findings of Olatoye and Adekoye (2010), Cakici and Tuckmen (2013) and Kadala (2014) which stressed that students' performance significantly improved with Project-based activities. Therefore, the results in Table 4.6 answered the research question with the stated null hypothesis which states that, there is no significant difference between students' means scores in Biology taught using Project-based approach and those taught using Lecture Method . The results in Table 4.6 revealed that there exist significant difference between students' means scores in Biology taught using Project-based approach and those taught using Lecture Method. Therefore null was rejected.

The findings of this study disagreed with the findings of Yunusa (2010), Mohammed (2015) who asserted that there was no significant difference in the use of Project-based instructional strategies when compared with the students exposed to lecture method. Beside, the findings of this study agreed with the earlier findings of the studies carried out by Kibett and Kuthuri (2005), Olatoye (2010), Olarewaju (2012), Idoko (2014) Kadala (2014), and Abialor, Osuafor and Nnadi (2017) who reported that there was

significant difference in favour of students' taught using Project-based approach cooperative learning and lecture-demonstration strategies over their counterpart taught using lecture method. This study lend support to the works of Okeke, Egbunonu & Ugbaja (2009) and Ezeliora (2009) who stressed that students' performance mean scores in biology through the use of Project-based approach over lecture method could be attributed to its characteristics nature of activity–based oriented method that is product or practical result oriented. Kadala (2014), and Abialor, Osuafor and Nnadi (2017) further supported that the investigative procedures of Project-based pack, enables students gain valuable academic knowledge, practical skills, develop ability to solve problems in real life situation and promote motivation as they work together as a team.

The results from Table.4.2 shows that the retention mean scores of students exposed to Project–based approach (EG1&EG2) in biology was higher than those taught using Lecture Method (CG). This finding concord with work of Maikano (2010) and Agbayaku (2012), that the experimental group taught ecological concepts using Project-based approach and Outdoor Laboratory Approach retained and achieve significantly higher than those exposed to Lecture Method. This is buttressed by Dewey (1956) assertion that learners acquired learnt experiences and retained more concepts when exposed to direct concrete real world experiences or projects in real-life situation. This help learner to connect learning to their world and set function for abstract notions. The results from ANOVA test obtained from Table 4.7 of this work was to test significant difference of the null hypothesis which stated that there is no significant difference between the retention means scores of students taught Biology concepts using Project-based approach and those taught using lecture method. Thus, the null hypothesis based on the present study maintained that significant difference exist between all experimental groups (EG1,EG2) with control group(CG) in terms of retention ability level of biology students. In Table 4.8

the results from Post Hoc Scheffe's test, two by two pairwise comparison shows the direction of the significance and reveals that EG1 and EG2 shows significant difference in favour of EG1 while EG2 and CG shows significant difference in favour of EG2. However, the result of the finding accords with the findings by Agbayaku (2012), Isah (2012), Olarewaju (2012), Kadala (2014) that retention of Biology concepts requires the interplay of activity-based strategies which required the interception of both mental, conceptual and physical approach In view of this Von Glassefied (1983) Usman (2008) affirmed the shift in instructional strategies to involve the use of psychomotor domain more than cognitive domain considering already learnt experience makes learning constructive and meaningful. Mangal (2011) ascertained that retention of learned material can be improve through association of ideas, connection and systematic thinking to recall already learnt task. Agbayaku (2012), affirmed from their findings on retention of ecological concepts that there was significant difference between those expose to experimental treatment (advance organiser) by retaining more ecological concepts in biology than those expose to lecture method.

The result of the findings in Table 4.8 shows that significant difference existed among the experimental groups the with mean scores than the control group interms of retention of biology concepts. This finding also accords with the study carried out by Lawal (2009), Agbayaku (2012) Kadala (2014) on the effectiveness of conceptual change instructional strategy and traditional instructional strategy in remediating the misconceptions in genetic concept of senior secondary school. The results of the finding confirmed that students exposed to conceptual change instructional strategy retained more knowledge of genetic than the students exposed to traditional instructional strategy. This finding agreed with the finding of Oyedokun (1998) whose finding contrastly shows that there exist significance differences between the retention mean scores of students taught

using conceptual change model in teaching Biology concepts and those taught using lecture method. She affirmed that the experimental group was significantly better than the control group in retention of learned materials.

Result from Table 4.3 reveals that students retention ability level in acquisition of skill when exposed to Project-based approach using DATS has the highest mean retention ability score and acquired high Skills than those exposed to lecture method which acquired Low Skills. This study agreed with findings of Okeke, Egbunonu and Ugbaja(2009) which stressed that the extent of entrepreneurship skill acquisition in biology through designed project approach was moderate, while those exposed lecture method acquired low skill. Therefore, the results in Table 4.9 answered the research question with the stated the null hypothesis which to this effect states that there is no significant difference in students means score on retention of acquired skills when taught using Project-based approach and their counterpart taught using lecture method. The ANOVA results from Table 4.9 shows that there was significant difference in the students' retention ability mean scores among the three groups EG1, EG2 and CG. Scheffe test results from Table 4.10 reveals that there was significance difference among the three groups (EG1, EG2& CG). Thus, EG1 is significantly better and enhanced retention ability than EG2, while EG2 enhanced retention ability than CG among SS2 students in acquiring skills in biology. This shows that the stated null hypothesis was hereby rejected. This finding agreed with the findings by Agbayaku (2012) Isah (2012), Olarewaju (2012), Kadala (2014) on the Effect of Advance Organisers on Performance and Retention of Ecology Concepts among Senior Secondary School students. The results revealed that there was significant difference in the retention level of students taught using lecture method only. This work agreed with the work carried out by Kadala (2014) on the existence of significant difference in retention mean score among student which was in favour of Project-based strategy when exposed to three

strategies (Project-based strategies, demonstration and lecture instructional strategies) . This agreed with the finding of Honig (2004) and Fayole and Gucly (2008) who asserted that Project-based approach is often based on personal experience of retained skills/knowledge as well as system approach which is often centered around allowing students create a planned skill or knowledge.

Result of the study in Table from 4.3 revealed that students in EG1 and EG2 achieved more skills thereby acquired high and moderate ability level of skills respectively. While CG achieved low skills thereby acquired Low ability level of skills. This concord with the findings of Lakpini (2006) who investigated the effect of conceptual change instructional strategies on achievement, retention and attitude among secondary school students. The study reveals that high ability students were significantly better in retention of learned materials than the average ability students which in turn retained more of the learnt biology concepts than low ability students. Retention eventually promotes students' performance in Biology. Therefore, meaningful learning improves retention while confusion or interference decreases the speed and efficiency of learning and accelerates forgetting of concepts. Isah (2012), Mouneme, Obeka, Usman, (2015) stressed that studies on retention and instructional strategies seem to agree with selection of suitable instructional strategies that are characterized by active learning or actions that are activity-based such as project-based approach yields permanent and meaningful learning that is readily retained and remembered at will by the learner.

The results from Table 4.4 reveals that the total mean performance scores of male students is higher than the total mean performance scores of female students after exposure to Project-based approach in biology. This could be attributed to characteristic features observed by Kajuru (2010) in his research work and reported that male perform significantly better than female counterparts in mental reasoning concepts and concluded

that sex difference are factors that affect performance in an achievement test and that boys dominate classrooms discussion and take over the lion share of teacher's attention while girls ego is being mask over. This lowered girls' self-esteem while teaching mental reasoning subjects. The results in Table 4.11 agreed with the null hypothesis that states that there is no significant difference in the performance mean score between male and female students when exposed to project-based approach, thereby retained . This disagreed with the findings of Rasha *et al.*,(2007) and Akinbola (2008) whose findings show that there exist significant difference between male and female performance using concept-mapping and project-based instructional strategies in favour of male students. This study disagreed with work of the following authorities such as Maikano, (2007), Kajuru(2010) Mari (2010,) Usman (2010) , Isah (2012) Kadala (2014), Enohuean (2013) who in their separate studies in various discipline found out that the application of instructional treatment on a mixed gender school improves the academic achievement of students irrespective of gender. Also stressed that there existed significant difference between male and female students when exposed to project-based approach, concept mapping, outdoor laboratory instructional strategy and demonstration method.

From the results in Table 4.11 ANOVA results reveals that there is no significant difference on the performance mean score between male and female students after exposure to Project-based Approach in Biology. This finding agreed with the work carried out by Okeke, Egbunonu, Ugbaja (2009), Olatoye and Adekoye(2010), Isah (2012), Mohammed(2015) on the entrepreneurship skills acquisition on biology education students through designed project. The result revealed that gender has no significant difference on the extent of entrepreneurship skills acquisition using designed project and demonstration method. Thus, The hypothesis to this effect stated that there is no significant difference in

the mean scores of male and female students after exposure to Project-based approach in Biology is hereby retained.

The results Table 4.12, ANCOVA test reveals that students' performance in biology concepts for entrepreneurship shows no significance interception difference when considering gender. Also, considering students' performance using the three difference methods of teaching biology concepts for entrepreneurship alongside with gender shows no significant difference. This implies that the use of the three different teaching approaches had no interactive effect on sex difference in terms of students' performance in biology concepts for entrepreneurship. This study agreed with work of the following authorities such as Maikano, (2007), Mari 2010, Olatoye and Adekoye (2010), Usman (2010) who in their separate studies in various discipline found that the application of instructional treatment on a mixed gender school improves the academic achievement of students irrespective of gender. Maikano (2007) found no significant difference in the academic achievement between male and female students taught ecological concepts using outdoor laboratory instructional strategy. In addition, Usman (2010), opines that outdoor laboratory method enhances academic achievement of studies in spite of their gender differences. Ghodi and Laleye (2006) reported that there was no significant gender difference in mean performance of students in the experimental and control group.

To identify the cause of the effect for the significant difference, Table 4.12 revealed that there is no significant difference in the mean scores of male and female students after exposure to, Project-based approach in biology. The null hypothesis was hereby retained.

The results from Table 4.5 reveals that in EG1 the mean score of students after exposure to DATS as assessment tool (formative) in evaluating the level of skills acquisition is higher than those students exposed to TFLE and shows that students acquired Moderate Skills. This research work agreed with the finding of Okeke, Egbunonu, Ugbaja

(2009) who worked on the entrepreneurship skills acquisition on biology education students through designed project. The results obtained from their work revealed that the extent of entrepreneurship skills acquisition of biology education students through designed project was moderate.

Table 4.13 Results on ANOVA reveals that there is significant difference in students ability level in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tool of Project-based approach .The null hypothesis states that there is no significant difference in students' ability levels in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tools of Project-based approach. The null hypothesis was hereby rejected. The results of this study maintained that there is significant difference in students' ability levels in skills acquisition using DATS as assessment tool and those expose to TFLE as assessment tools of Project-based Approach.

The Post Hoc Scheffe test results from Table 4.14 reveals that there is significance difference among the three groups with, EG1 significantly better in enhancing students ability level than EG2 , while EG2 enhanced students ability level in skills acquisition than CG among SS2 students in biology. Therefore the use of Project-based approach using DATS as assessment tool showed significant difference in students' ability levels in skills acquisition better than TFLE as assessment tools of Project-based approach. This is supported by the work carried out by Oduleke (2002), affirmed that the achievement of national goal through education is better enhanced with good development of educational assessment tool which appeals for intermittent evaluation of learning points. Nwagbo and Chekelu (2011) investigated the effects of biology practical activities on secondary school students' process skill acquisition in Abuja Municipal Area Council. The results revealed that practical activity method was more effective in fostering students' acquisition of science process skills than the lecture method. Also, buttressed by Cakici and Turkmen

(2013),from their research findings revealed that children's science achievement significantly improved with the project based activities.

# CHAPTER FIVE

## SUMMARY, CONCLUSION AND RECOMMENDATION

### 5.1 Introduction

The main objective of this study was to find out the effect of Project-based approach in acquisition of entrepreneurial skills, retention and performance in biology among secondary school students in Niger state. The methodology employed for the collection of data and summary of findings are briefly outlined. The conclusion emanating from the findings and subsequent recommendations are also discussed in this chapter.

### 5.2 Summary

In chapter one, this study focused on conceptual definitions of Project-based Approach and the relationship between Project-based approach with some of biology concepts that lend themselves with entrepreneurship education. The theoretical frame work centred upon the individual ability to construct new knowledge in adaptive form (real life situation) through acquired experience. The statement of problem of this study centred on secondary school biology students are not exposed to entrepreneurship training and poor performance recorded over the years in biology despite its relevant as a subject area that is pre-requisite to professional courses. This brought out the objectives of this study to include investigating the effect of Project-based approach on students' performance and retention of biology concepts. It also aimed at determining whether Project-based approach is gender related interms of students' performance in biology and acquired skills. Thus, it is through this that some research questions were advanced and hypotheses were developed to answer the stated research questions. This study was carried out within the scope of SS II students.

Chapter two: this chapter deals with the review of related literatures based on conceptual frame of Project-based Approach , science teaching methods, entrepreneurship

education and forms of assessing Project-based Approach using DATS and TFLE. The empirical frame work focused on some investigated related studies and inferences. This provided baseline for constructive criticism and pave way for further studies so as to bridge the gap between current study and existing studies for academic excellence.

Chapter three: the research design adopted for this study was quasi-experimental design of two experimental Groups (EG1 & EG2) and one Control Group (CG). The population of this study comprised of 149,290 students all from 245 public secondary schools in Niger state. From the population, 150 (75 male & 75 female students) SSII students were purposively sampled. Experimental instruments ESAT1, ESAT2, BCET1, and BCET2, BAT were developed. All items were tested for their validity and reliability through pilot study. Item difficulty index and discrimination index were also determined. The data obtained from the administered instruments were used to answer the stated research questions considering their mean, standard deviation and standard error. Null hypotheses to this effect were tested using inferential statistics of t-test, Scheffe test, ANOVA and ANCOVA. The data were analysed using statistical package for Social Sciences (SPSS) version 20.1.

Chapter four: Results from the research questions were analysed for their mean, standard deviation and standard error. Decisions were taken and conclusions were made. Moreso, stated null hypotheses 1to 5 were tested using t-test, Scheffe test, ANOVA and ANCOVA. The results obtained from the data were presented in their respective tables. Discussion in respect of each stated research question were made, so also null hypothesis were presented and discussion were made based on their significant difference at $P \leq 0.05$.

The following are the results of the null hypotheses:

**$HO_1$:** There wass significant difference between students' means scores in Biology taught using Project-based Approach and those taught using Lecture Method. This was in favour of Experimental Groups (Project-based Approach ) over Control Group (Lecture Method). Therefore, the stated null hypothesis is hereby rejected.

**$HO_2$:** There was significant difference between the retention mean scores of students taught Biology concepts using Project-based Approach and those taught using Lecture Method. This was in favour of Experimental Groups (Project-based Approach ) over Control Group (Lecture Method). Therefore, the stated null hypothesis is hereby rejected.

**$HO_3$:** There was significant difference between students' means scores on retention ability in acquisition of skills when expose to using Project-based approach and those taught using Lecture Method. Therefore, the stated null hypothesis is hereby rejected

**$HO_4$:** There was no significant difference between the mean scores of male and female students after exposure to Project-based Approach in Biology. Therefore, the stated null hypothesis is hereby retained

**$HO_5$:** There was significant difference in students' ability levels in skills acquisition using DATS as assessment tool and those exposed to TFLE as assessment tools of Project-based approach. Therefore, the stated null hypothesis is hereby rejected

## 5.3 Conclusion

Based on the findings of this research work the following conclusions were made:

1. Project-based approach is effective in enhancing students' performance in biology.
2. Project-based approach is effective in promoting students retention ability in biology.
3. Students' retention ability in acquisition of skills is enhanced when exposed to Project-based approach.

**4.** Gender is not a factor that influenced students' performance in Biology when exposed to Project–based approach.

**5.** Students' ability levels in entrepreneurial skills acquisition using DATS as assessment tool was better than those exposed to TFLE as assessment tools of Project-based Approach.

## 5.4 Contribution to Knowledge

The study was able to establish that:

1. The use of Project-based approach using Diagnostic Adaptive Testing Skill (DATS) promotes students' academic performance in biology. This is because it is product or practical-based result oriented, therefore would serve as reference point for further researches.
2. The use of Diagnostic Adaptive Testing Skills (DATS) and Traditional Fix Length Examination (TFLE) were effective in promoting students retention of biology concepts.
3. The use of Diagnostic Adaptive Testing Skills (DATS) and Traditional Fix Length Examination (TFLE) were effective in enhancing students' acquisition of Biology entrepreneurial skills

## 5.5 Recommendations

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

1. Project-based approach using diagnostic adaptive testing skill (DATS) should be adopted in the teaching of biology concepts for entrepreneurship among SSII students.

2. Project-based approach is effective in promoting students retention ability in biology. Therefore it should be encouraged in teaching of biology concepts for entrepreneurship among SSII students.
3. The lecture method which is widely used by teachers in subjects delivery has been found in this study to be relatively inferior with respect to performance and retention in learning of biology concepts and skills. Thus, science teachers should therefore be mindful of the usage of lecture method so as to avoid a situation where under achievement would unknowingly overcome the whole learning processes.
4. It was discovered in this study that gender play a significant role in skills acquisition, retention and performance in biology, where female students performed better in skills acquisition than male. A common curriculum should be developed to maximize equity on students' participation in acquisition of meaningful knowledge, skills and attitude.
5. It is recommended that the text book publishers should develop suitable training manuals and work books that will enhance effective delivery of biology concept for entrepreneurship through Project-based Approach using DATS among secondary school students. .
6. Project exhibition of finished products should be encouraged in schools as it develops in students occupational knowledge, job skills, work experience, and this makes self-employment and business ownership a viable and appealing goals for today's students.

## 5.6 Limitations of the study

This study had some limitations which include the following:

1. The performance in biology using Project-based Approach focused on some biology concepts that have inclinations with entrepreneurship training so as to enhance skills

acquisition and retention of some biology concepts. Thus, not all concepts in biology can be used for Project-based Approach, and even those concepts that apart from being unwieldy to identify their entrepreneurial potentials/characteristics are manage in a research of this kind, may be too expensive to conduct by an individual researcher.

2. The time for teaching biology concepts for entrepreneurship among SSII secondary school students, the nature of the selected topics, students, school administrators, classroom conditions, workshops and laboratories were some of the limitations encountered during the course of the study.
3. Infact only 150 biology students were sampled for this study. It might increase confidence level and precision if number of the sampled subjects used is large enough.

### 5.7 Suggestions for Further Studies

Considering the available literatures, it is obvious that not much work have been done in the area of Project-based approach using DATS as an assessment form of entrepreneurship skills acquisition in biology. Thus, in concluding this study, the following were suggested for further studies on Project-based approach in biology:

1. A similar study should be carried out focusing on biology concepts for entrepreneurship other than fishery and poultry as well as other subject areas in science.
2. This study investigated the effects of Project-based approach on skills acquisition, retention, and performance in biology concepts among secondary school students, but when measuring entrepreneurial skills competencies, knowledge, skills, and attitudes were the parameters involved. Therefore, attitude should be investigated along with other parameters so as to determine their interceptional significance.

3. This study can be stepped down to JSS students as the current curriculum emphasized entrepreneurship training across all educational levels.
4. A study can be carried out on the impact of Practical Laboratory-based approach and Project-based approach on students' performance in teaching biology for entrepreneurship education so as to enhance performance across all biology concepts.

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## APPENDIX I

## Skill Acquisition Test 1 (SAT1)

**Fill in the Appropriate Skill of Your Interest into the Spaces Provided. ID No,_____**

1. _____ is the entrepreneurial skill I wish to practice for self reliance.
   (a) Aquaculture (b) Floriculture (c) Poultry keeping (d) Apiculture (Bee keeping) (e) Rabbit keeping

2. Choose from the options a-e the skill have you acquired before?
   (a) Aquaculture (b) Floriculture (c) Poultry keeping (d) Apiculture (Bee keeping) (e) Rabbit keeping.

3. For how long have you been practicing the selected skill? _____
   (a) 1 year-5 years (b) 5 years – 10 years (c) 10years – 15 years (d) 15years-20 years
4. What is the level of your production from the acquired skill? _____
   a) Substantial level or (b) Commercial level
5. At what level do you wish to operate on the current entrepreneurial skill?
   (a) Substantial level (b) Commercial level
6. Do the acquired skill shows a different dimension other than the interested option selected in question 4 above?
   (a) yes (b) No
7. Is the venture profitable?
   (a) yes (b) No

Fill in the provided space with the following options (A) or (B)

8. Do you wish to _____ the acquired skill
   (a) Change (b) Continue with

9(a) what were your constraints when the enterprise was at lost?
   (i) _____
   (ii) _____
   (iii) _____
   (iv) _____

9.(b) what were your constraints when the enterprise was profitable?
   (i) _____
   (ii) _____
   (iii) _____
   (iv) _____

.

10. If you have ever ventured into Business enterprise of any acquired skill, fill in the business flow chart:

**Project-based Approah Cash FlowChart** **Student ID No._____**

| A. | In what month do I…? | Jan. | Feb. | April | May | June | July | August | September | October | November | December | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Have the most cash | | | | | | | | | | | | |
| 2. | Have the least cash | | | | | | | | | | | | |
| 3. | Have the most expenses(costs) | | | | | | | | | | | | |
| 4. | Have the least expenses(loss) | | | | | | | | | | | | |
| 5. | Borrow excesss money? | | | | | | | | | | | | |
| 6. | Borrow least money? | | | | | | | | | | | | |
| B. | In what Month are …? | | | | | | | | | | | | |
| 1. | Market prices highest | | | | | | | | | | | | |
| 2. | Market prices lowest | | | | | | | | | | | | |
| 3. | Input costs highest | | | | | | | | | | | | |
| 4. | Input lowest | | | | | | | | | | | | |
| C. | Which is the best month(s)for me to …? | | | | | | | | | | | | |
| 1. | Purchase inputs inventory | | | | | | | | | | | | |
| 2. | Start production | | | | | | | | | | | | |
| 3. | Sell product | | | | | | | | | | | | |
| 4. | Borrow money | | | | | | | | | | | | |

Adopted: USAID (October, 2007) Nigeria Agricultural Enterprise, Producer work Book Prop.com ADFIOD Foundation Pp. 10.

# APPENDIX II

**A Format of Project -based Approach Skill Acquisition Skill (SAT)Reporting and Assessment Tool**

**Chapter 1: Introduction**

i. Background

ii. Rationale for the design/purpose

iii. Explanation of the basic concept

**Chapter 2: Review of related literature**

i. Conceptual frame work

ii. Review of related study

**Chapter 3: Methodology**

## FORMAT OF REPORTING AND ASSESSING SAT

| S/No. | Test Instruction; activity | Project-based Procedure; and Assessment Tools | Inference | Rating Scale 5.4,3,2,1. |
|---|---|---|---|---|
| 1 | Draw and Construct and wooden fish pond. | 1. Workability<br>2. Use of appropriate materials.<br>3. Accurate measurements & features<br>4. Time bound.<br>5. Precaution. | Wooden pond construction | 5<br>4<br>4<br><br>4<br>3 =20/25marks |
| 2 | Prepare fish pond fertilization | 1. Workability<br>2. Use of appropriate materials.<br>3. Accurate measurements & features<br>4. Time bound.<br>5. Precaution. | | |
| 3 | Demonstrate the stocking of fish in a new pond | 1. Workability<br>2. Use of appropriate materials.<br>3. Accurate measurements & features<br>4. Time bound.<br>5. Precaution. | | |
| 4 | Construct any fish harvesting facility of your choice | 1. Workability<br>2. Use of appropriate materials.<br>3. Accurate measurements & features<br>4. Time bound.<br>5. Precaution. | | |
| 5 | Illustrate fish feed formulation | 1. Workability<br>2. Use of appropriate materials.<br>3. Accurate measurements & features<br>4. Time bound.<br>5. Precaution. | | |

(1) High skill (HS), = (75%-100%) (2) Moderate Skill (MS) = (50%-74%)

(2) Low Skill (LS) = (25%-49%) (4) No Skill (NS) = (0%-24%)

Recommendation

i. Summary/Conclusion

ii. References -source (Egbunonu and Ugbaja, (2009) FCE, Umunze Anambra State.

## APPENDIX III

**BIOLOGY ACHIEVEMENT TEST 1 (BAT 1) QUESTIONS Student No,_____**

**Instruction: Answer all Questions Provided. (1hr: 30min.)**

1. The vessel that carries blood from the heart to the lungs is called an artery because it
(a) Contains oxygenated blood (b) Contains more blood than the other vessels (c) carries blood away from the heart (d) has thick inelastic wall

2. Turgor pressure occurs in a cell when the
(a) Volume of its cell sap increase (b) Cell loses water to its environment (c) Volume of cell decreases (d) Cell is put in an isotonic solution

3. Terrestrial plants exchange gases through the following except
(a) Chloroplast (b) Stomata (c) lenticels (d) root-cells

4. Which of the following is not a function of the liver in mammals?
(a) storage of some vitamins (b) conversion of glycogen into glucose
(c) deamination of excess nitrogenous substances (d) filtration of urea from the blood

5. Iodine is needed by a patient suffering from a malfunctioning of the
(a)Salivary gland (b) thyroid gland (c) adrenal gland (d) sebaceous gland

6. In water culture experiments the culture solutions are protected from sunlight in order to
(a)control the temperature of the culture solution (b)Prevent algae from growing in the solution (c) prevent the minerals in the solution from being destroyed (d) allow the minerals to be used up at room temperature

7. The importance of a balance diet is to
(a) Maintain constant size of an animal (b) provide good taste in the food (c) increase the effectiveness of digestion (d) provide good health for an individual

8. Which of the statements is true?
(a) ptyalin acts on proteins to give amino acid (b)lactase acts on maltose to give amino acid (c) pepsin acts on proteins to give peptide (d) peptide acts on starch to give maltose

9. Which of the following is not a biotic factor?
(a) parasites (b) predators (c)grazers (d) pressure

10. Which of the following organisms can be found in fresh water habitat
(a)sargassum and dog fish (b) red mangrove and pond skater (c)sargassum and red mangrove (d)spirogyra and pond skater

11. Desert plants are usually called
(a)hydrophytes (b) mesophytes (c)xerophytes (d) sporophytes

12. Soil factors in an ecosystem are referred to as
(a) topographic (b)climatic (c)biotic (d) edaphic

13. A known weight of soil sample was oven-dried to obtain a constant weight. The loss in weight was due to loss of
(a) organic matter only (b) water only (c)water and organic matter (d) inorganic matter and water

14. Carbon is added to the atmosphere by the following processes except
(a)respiration (b) burning (c) photosynthesis (d) volcanic eruption

15. A situation whereby some mammals remain inactive through out dry and hot seasons is known as
(a) aestivation (b) dormancy (c)burrowing (d) incubation

16. Which of the following factors may not affect living organisms in an aquatic habitat?
(a) turbidity (b) temperature (c) humidity (d) light

17. Which of the following parasites is a flatworm?
(a)Plasmodium (b) Trypanosome (c) Ascaris (d) Schistosoma

18. During prolonged exercises, glucose in the muscle is converted to
(a)pyruvic acid (b) lactic acid (c) co-enzyme (d) ethanol

19. Which of the following is renewable natural resources?
(a) air (b) Timber (c) soil (d) Mineral

20. Which of the following resources is competed for by organisms in the desert?
(a) light (b) temperature (c) oxygen (d) water

21. Which of the following statements about sex determination is correct? At fertility
(a) the probability of male to female offspring is ½ (b)the Y chromosome of the father decreases the probability of having a male child to ¾ (c) the XX chromosome of the mother decreases the probability of having a female child ¾ (d) the vigour of either parents determines the sex of the offspring.

22. The genotypic ratio 1:2:1 in the offspring of a hybrid cross illustrates the law of
(a) Use and discuss (b) dominance (c) segregation (d) linkage

23. In fishes, the brooders return to their parent mouth for
(a) feeding (b) respiration (c) breeding (d) protection

24. In which of the following organism is ammonia excreted as a waste product?
(a) man (b) Bird (c) Amoeba (d) Spirogyra

25. The following are the functions of supporting tissues in plants except
(a) rigidity (b) flexibility (c) strengthening (d) secretory

26. Which of the following organism has the largest surface area to volume ratio?
(a) man (b) earthwarm (c) amoeba (d) grasshopper

27. Which of the following conditions will cause a decrease in body temperature?
(a) increased metabolism (b) shivering (c) vasoconstriction of capillaries of the skin (d) relaxation of the erector muscles

28. The organs constantly in touch with the liver are
(a) pancrease, colon and caecum (b) duodenum and stomach (c) ileum, stomach and colon (d) stomach and gall bladder

29. Which of the following is responsible for the increased heart beat of a boy who saw a python? Increased production of
(a) adrenalin (b) insulin (c)pitutrin (d) thyroxin

30. The nerves that arise from the brain are known as
(a) spinal nerves (b)sacral nerves (c)cranial nerves (d) optic nerves

31. The neurone that relay the message of effector organs are called
(a) efferent neurons (b) intermediate neurons (c) afferent neurones (d) spinal nerves

32. Each neurone consists of the following structures except
(a)cell body (b)dendrites (c)axon (d) white matter

33. The simplest form of nerves pathway which links receptors with reffectors is known as
(a) relay neuron (b) reflex arc (c) motor nerves (d) sensory nerves

34. Which of the following parts of the eye is sensitive to light?
(a) Retina (b) cornea (c) choroids layer (d) optic nerves

35. What happens to an ovule of flower, after fertilization? It
(a) becomes a fruit (b) withers away (c) becomes a seed (d) forms a cotyledons

36. Which of the following is not a dry indehiscent fruit?
(a) legume (b)cypsele (c)samara (d) caryopsis

37. Which of the following groups consist of only micro-nutrients?
(a) Molybdenum, sulphur and copper (b) Boron, Zinc and calcium (c)Manganese, molybdenum and zinc (d) magnesium, phosphours and manganese

38. The first stable product of photosynthesis is
(a) starch (b) glucose (c)oxygen (d) water

39. Which of the following statements about nitrogen is not correct? Nitrogen is needed for
(a) protein synthesis (b) activating certain enzymes (c) the synthesis of chlorophyll (d) vegetative growth of plants

40. A very poor growth in plants and discolouration of leaves signifies the deficiency of
(a) calcium (b) magnesium (c)potassium (d) manganese

41. Vitamin C which is water soluble is
(a) cabalamine (b) pyridoxine (c)ascorbic acid (d)riboflavine

42. Vitamin C deficiency results in
(a) ricket (b) beri-beri (c)scurvy (d) pellagra

43. Members of the vitamin B complex are
(a) water soluble (b) fat-soluble (c)water insoluble (d) generally insoluble

44. Which of the following statements about phosphorus is not correct?
(a) helps to regulate the acid-base balance of the body (b)regulates the metabolism of proteins, fats and carbohydrates (c) required in many chemical reactions occurring in the body (d) phosphorus is a major constituent of bones and teeth

45. Vitamin E is concerned with
(a) bone formation (b) reproduction (c)normal growth (d)formation of red blood cell

46. A balanced meal for an adult person may consist of
(a) two pieces of chicken, four balls of bean cake, two eggs and two cups of tea with milk (b) four slices of bread, one bowl of pap, two oranges and two bananas (c)four slices of yam and stew, two pieces of beef, one cup of tea with milk and two oranges (d) a plate of beans, two pieces of meat, two eggs, one cup of tea with milk and two oranges

47. Which of the following food substances turns bright red when warmed with sudden III solution?
(a) starch (b) reducing fat (c) protein (d) fat

48. Mammals require a relatively high amount of carbohydrates because
(a) they maintain the weight of the body (b) they are required for growth (c)they initiate enzyme production (d) they yield energy for activities

49. All the available places on earth which support life constitute the
(a) lithosphere (b) atmosphere (c) biosphere (d) hydrosphere

50. The biotic factor which determines the depth of which light penetrates in a pond is
(a) current (b) turbidity (c) wind (d) salinity

51. Which organ removes the largest quantity of water from the blood?
(a)lung (b) intestine (c) kidney (d) skin

52. A flowering plant having both the male and female flowers on the same plant, is said to be
(a) regular (b) monoecious (c) irregular (d) dioecious

53. Good quality food will perform the following function in human except
(a) supplying energy (b) providing resistance against malaria (c)sustaining growth (d) maintaining health

54. Ecology is best defined as the study of
(a) the characteristics of an environment (b) the inter-relationship between living organisms and the environment (c) living organisms in a particular area (d)the habitats and wildlife

55. Which of the following environmental factors is not considered in a terrestrial habitat
(a) temperature (b) sunlight (c) humidity (d) turbidity

56. The gas produced during decomposition of matter is
(a) hydrogen sulphide (b) carbon monoxide (c)chlorine (d) oxygen

57. Fish cannot survive on land because it has
(a) a body covered with scale (b)a streamlined body (c) no lungs (d) no walking appendages

58. Competition among individuals of a population increases the
(a) number of organisms (b) survival of the fittest (c) availability of nutrient supplied (d) enlargement of the territory

59. Catfish cant survive in an aquatic habitat because they have
(a)fore-and hind limbs (b) gills (c) lungs (d)hair on their skin

60. Improper sewage disposal could be dangerous for the following reasons except
(a) the smell of carelessly disposed sewage water is most undesirable (b) the spread of gastrointestinal disease was enhanced (c) resultant out-break of water-borne disease (d)there would be little space for disposal of wases.

Source: Adopted from pass West African Examination Council questions of 1999 to date.

## APPENDIX IV

## BIOLOGY ACHIEVEMENT TEST 1 (BAT 1) MARKING SCHEME

1.A
2.C
3.A
4.D
5.B
6.B
7.D
8.C
9.D
10.D
11.C
12.D
13.C
14.C
15.A
16.C
17.D
18.B
19.C
20.D
21.A
22.C
23.D
24.B
25.D
26.A
27.D
28.D
29.A
30.C
31.A
32.D
33.B
34.A
35.C
36.A.
37.C
38.B
39.B
40.C
41.C
42.C
43.B
44.C
45.B
46.C
47.D
48.D
49.C
50.B
51.C
52.B
53.B
54.B
55.D
56.A
57.C
58.B
59.B
60.D

## APPENDIX V

## BIOLOGY ACHIEVEMENT TEST 1 (BAT 1) ANSWER SHEET

| | A | B | C | D | | A | B | C | D | | A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | O | O | O | O | 21. | O | O | O | O | 41. | O | O | O | O |
| 2. | O | O | O | O | 22. | O | O | O | O | 42. | O | O | O | O |
| 3. | O | O | O | O | 23. | O | O | O | O | 43. | O | O | O | O |
| 4. | O | O | O | O | 24. | O | O | O | O | 44. | O | O | O | O |
| 5. | O | O | O | O | 25. | O | O | O | O | 45. | O | O | O | O |
| 6. | O | O | O | O | 26. | O | O | O | O | 46. | O | O | O | O |
| 7. | O | O | O | O | 27. | O | O | O | O | 47. | O | O | O | O |
| 8. | O | O | O | O | 28. | O | O | O | O | 48. | O | O | O | O |
| 9. | O | O | O | O | 29. | O | O | O | O | 49. | O | O | O | O |
| 10. | O | O | O | O | 30. | O | O | O | O | 50 | O | O | O | O |
| 11. | O | O | O | O | 31. | O | O | O | O | 51 | O | O | O | O |
| 12. | O | O | O | O | 32. | O | O | O | O | 52 | O | O | O | O |
| 13. | O | O | O | O | 33. | O | O | O | O | 53 | O | O | O | O |
| 14. | O | O | O | O | 34. | O | O | O | O | 54 | O | O | O | O |
| 15. | O | O | O | O | 35. | O | O | O | O | 55 | O | O | O | O |
| 16. | O | O | O | O | 36. | O | O | O | O | 56 | O | O | O | O |
| 17. | O | O | O | O | 37. | O | O | O | O | 57 | O | O | O | O |
| 18. | O | O | O | O | 38. | O | O | O | O | 58 | O | O | O | O |
| 19. | O | O | O | O | 39, | O | O | O | O | 59. | O | O | O | O |
| 20. | O | O | O | O | 40. | O | O | O | O | 60. | O | O | O | O |

## APPENDIX VI

## POULTRY KEEPING
## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL I (DATS1) QUESTIONS Student ID No_____

1) Poultry is ----------
(a) wild animals raise for commercial purpose (b) keeping of aquatic animals only (c) domesticated fowls (birds) raised mainly for the purpose of food (d) domesticated bird kept for esthetic life.

2) The following are domesticated fowl except
(a) chicken (b) duck (c) guinea fowl (d) bat

3) The following are domesticated fowl except
(a) turkey (b) goose (c) rabbit (d) pigeon

4) The following are types of poultry keeping in Nigeria
(a) extensive and intensive poultry management (b) open and close poultry management (c) home stead and commercial management (d) substantial and subsistence poultry management.

5) Extensive poultry management system involves
(a) management of large quantity of fish
(b) management of large quantity of birds(c) management small scale bird in and around houses
(d) keeping of poultry for egg production.

6) The following is type of extensive poultry management system
(a) free range system (b) intensive system (c) semi-intensive (d) industrial system.

7) Poultry keeping is a management that provides a means of ----------
(a) gainful employment (b) control of predator (c) control of disease (d) spread of prey on in our environment.

8) Poultry are classified into the following
(a) 2 (b) 5 (c) 6 (d) 3

9) The following are types of poultry enterprise in Nigeria except
(a) hatchery (b) layer farm (c) feed mills (d) slaughtering enterprises

10) Poultry housing is provided for the following reason except
(a) meat production (b) protection from harsh weather (c) protection from predator (d) production from disease

11) The following are types of poultry house except (a) free range or extensive system (b) bungalow
(c) intensive system (d) deep litter system

12) The following housing system is suitable for layers
(a) concrete flow system (b) battery cage system (c) free range system ( d) slated flow system

13) The free range system is important for keeping birds because it provides birds with
(a)natural ventilation (b) small space (c) do not have access to dust bathing (d) does not provide means of taking variety of natural feed

14) Semi-intensive system is practice where there is
(a) harsh weather (b) enough space (c) limited available space (d) no available space

15) Intensive system of poultry keeping provides birds with
(a) single variety of feed (b) adequate warmth (c) have access to other form of feed (d) inadequate ventilation

16) Battery cage system have the a usual floor space per hen of
(a) 14 X 30 inches and 17 inches height (b) 14X16 inches and 17 inches height (c) 20X 20inches and 17 inches height (d) 2X3 inches height and 17 inches height

17) Battery cage system have the following advantages except
(a) birds are easily control (b) birds are easily observed for any infection (c) the environment can be easily disinfected (d) it is labour intensive

18) Deep littered system has advantages over battery cage system in that
(a) it is expensive (b) it is cheaper and contain large birds (c) clean environment is often achieved (d) the environment can easily be disinfected

19) Outer poultry housing type include the following except
(a) fold system (b) portable colony case (c) battery cage system (d) open sided poultry house

20) In constructing poultry house the floor concrete basement formation should have a thickness of
(a) 100 cm (b) 200cm (c) 300cm (d) 10 cm

21) One nest should be provided for every
(a) 5 hens (b) 10 hens (c)1 hen (d) 15 hens

22) The following materials can be used for nest except
(a) box (b) cardboard (c) basket (d) wool

23) Nest should be situated in a ---------- place
(a) open roof (b) shady secluded
(c) moist (d) hot

24) Nest is made up of wooden box measuring ---------- at all sides with nest floor area of about 0.lm$^2$
(a) 20cm (b) 10cm (c) 30cm (d) 40cm

25) Cross section of each perch bar should be ----------
(a) 2 to 3cm (b) 5-10cm (c)10-15cm (d) 15-20cm

26) A perch have a sliding removable platform called ----------
(a) roosting board (b) dropping board (c) nesting board (d) sleeping board

27) Brooder boxes are use for
(a) to conserve heat within a limited area (b) hatch egg (c) layer eggs
(d) transport chicks

28) Feed trough is use for
(a) cleaning feed (b) storing feed (c) feeding birds (d) milling feed

29) Longitudinal feeder should be conducted with rollers at the open ends to prevent chicks from
(a) feeding from in trough (b) dropping feaces (c) jumping into the feed (d) scattering the feed
30) Water trough serve as bird
(a) drinking can (b) water flow through (c) water reservoir (d) water cleanser

31) Egg tray are use for
(a) culling (b) laying of eggs (c) handling eggs transportation (d) cleaning eggs

32) Incubator is use for
(a) natural hatching of eggs (b) artificial hatching of egg (c) counting of egg (d) preservation of eggs

33) Layer reaches point when it attained the age of ----------
(a) 10 weeks (b) 16-18 weeks (c) 5-10 weeks (d) 8-10 weeks

34) Meat poultry is obtained from

(a) broiler (b) layers (c) chicks (d) pullets

35) Poultry compare to other livestock /hen have the following characteristics except
(a) short generation (b) rapid fecundity day (c) rapid turnover of invested capital (d) low death rate

36) Poultry kept for egg production are called
(a) broiler (b) layers (c) chocked (d) chick

37) Fast growing bird (broiler) for meat production reach market weight of
(a) 1.6kg-2kg in 6-8weeks (b) 1kg-1.2kg in 6-8weeks (c) 0.5kg-1kg in 6-8 weeks (d) 0-5kg in 6-8 weeks

38) Mortality rate in broiler production should not exceed
(a) 10% (b) 6% (c) 5% (d) 20%

39) Pullet attaining point of lay are to reach the age of
(a) 5.-10weeks (b) 20-24 weeks (c) 10-15 weeks (d) 2-5 weeks

40) Rearing poultry along with fish is called
(a) fish rotation (b) integrated animal production (c) mix farming (d) inter farming system

41) Egg can be hatched through
(a) artificial and natural incubation (b) hand cracking (c) cool bathing (d) warm bathing

42) Hatching requires the following equipment
(a) egg tray (b) hoe (c) cutlass (d) leather

43) Thermometer is use in measuring
(a) temperature (b) humidity (c) pressure (d) rainfall

44) Barometer is use in measuring
(a) temperature (b) humidity (c) pressure (d) rainfall

45) Hygrometer is use in measuring
(a) temperature (b)humidity (c) pressure (d) rainfall

46) Rain gauge is use in measuring (a) temperature (b)humidity (c) pressure (d) rainfall

47) Weighting balance is used in measuring

(a) mass of an object (b) volume of an object (c) length of an object (d) diameter of an object

48) Measuring cylinder is use in measuring
(a) mass of an object (b) volume of an object (c) length of an object (d) diameter of an object

49) Tape role is use in measuring the
(a) mass of an object (b) volume of an object (c) length of an object (d) diameter of an object

50) Micrometer screw gauge is use in measuring
(a) mass of an object (b) volume of an object (c) length of an object (d) thickness of an object

## APPENDIX VII

# POULTRY KEEPING

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL I (DATS1) MARKING SCHEME Student ID No_____**

| | | | |
|---|---|---|---|
| 1 | D | 26 | B |
| 2 | D | 27 | A |
| 3 | C | 28 | C |
| 4 | A | 29 | C |
| 5 | C | 30 | A |
| 6 | A | 31 | C |
| 7 | A | 32 | B |
| 8 | B | 33 | B |
| 9 | D | 34 | A |
| 10 | A | 35 | D |
| 11 | B | 36 | B |
| 12 | B | 37 | A |
| 13 | A | 38 | C |
| 14 | C | 39 | B |
| 15 | A | 40 | B |
| 16 | B | 41 | A |
| 17 | D | 42 | A |
| 18 | B | 43 | A |
| 19 | C | 44 | C |
| 20 | D | 45 | B |
| 21 | A | 46 | D |
| 22 | D | 47 | A |
| 23 | B | 48 | B |
| 24 | C | 49 | C |
| 25 | A | 50 | D |

## APPENDIX VIII

## POULTRY KEEPING
## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL I (DATS1) QUESTIONS Student ID No_____

1) Hatchery building is designed to provide roam for
(a) a washing eggs only (b) rearing chicks
(c) hiding hatching eggs poor to setting, grading and incubation (d)sexing of chicks only

2) The following activities are carried out on hatchery build except
(a) egg setting (b) egg grading (c) egg cracking (d) egg incubation

3) Additional rooms are provided to eater for the following activities except
(a) fumigation (b) washing equipment (c) storage (d) frying eggs

4) Hatchery house requires the following rooms except
(a) egg rearing room (b) egg storage room (c) egg washing room (d) chick grading and holding room

5) Hatchery house requires the following room
(a) incubation room (b) brooding room (c) laying room (d) roosting room

6) The major goal of optimum hatchery building design and construction are except
(a) cut and contact between egg and chicks (b) increase predatory-prey relationship (c) provide maximum sanitation and disease control (d) provide efficient and effective service delivery

7) Incubator is ----------
(a) machine to which rotten egg are cracked for feed production (b) is a machine use in washing eggs (c) is machine in which fertilized eggs are usually set for hatchery (d) machine use in setting eggs

8) ---------- incubator is used commercially for hatchery eggs (a) cabinet (force drought (b) nest box (c) roost (d) perches

9) In incubator the eggs are initially placed the on them
(a) small ends vertically (b) large ends vertically (c) small end horizontally(d)large ends horizontally.

10) Three days before the eggs are due for hatching, the eggs are transfer from setter to
(a) egg tray (b) hatchers (c) setters (d) dryers.

11) In kerosene incubator the jute bag panel serves as
(a) egg cracker (b) hatchery (c) humidifier (d) egg setter.

12) Eggs turning in kerosene incubator is done by…….
(a) hand (b) automatically done (c) air pressure (d) humidifier.

13) The following are the equipment used in egg handling except
(a) hatchery cart (b) hatchery (c) egg case (d) egg grader.

14) Egg candler is used in identifying egg
(a) fertility (b) fecundity (c) shell thickness (d)yolk largeness.

15) Egg should be cooled and held at temperature of about.
(a)$32^{o}$c (b)$42^{o}$ c (c) $52^{o}$ c (d) $18.6^{o}$ c.

16) Eggs should be moist at a relative humidity of
(a) 75% (b)98% (c)100% (d)20%.

17) After four days of storage hatching time will be increase by
(a) 10 minutes (b) 20 minutes (c) 30minutes (d) 40 minutes

18) After 4 days of storage hatchability is reduced by
(a) 10% per day (b) 4% per day (c) 20% per day (d) 30% per day

19) Egg are set with large end
(a) up (b) down (c) side right ward (d) side left ward.

20) Eggs are candled
(a) once during incubation (b) twice during incubation (c) trice during incubation (d) four times during incubation

21) In the egg with white shell the first candling is from the
(a) first day (b) second day (c) forth day (d) fifth day

22) Egg with brown shell the first candling is from the
(a) first day (b) third day (c) seventh day (d) tenth day

23) Egg with white shell, the second candling is from the
(a) fourth day (b) fifteenth day (c) eighteenth day (d) nineteenth day

24) Egg with brown shell, the second candling is form the
(a) fourth day (b) fifteenth day eighteenth day (d) nineteenth day

25) Infertile egg shows
(a)dark spot with mass little blood vessel radiating in all directions (b) looks clear (c)irregular circle of blood settled at the edge of the yolk (d) blood ring settled at the centre

26) Fertile egg shows
(a)dark spot with mass little blood vessel radiating in all directions (b) looks clear (c)irregular circle of blood settled at the edge of the yolk (d) blood ring settled at the centre

27) Chick are hatched on the ---------- day from the first day of incubation
(a)$20^{th}$ - $22^{nd}$ days (b)) $15^{th}$ -$18^{th}$ days (c) $30^{th}$-$31^{st}$ days (d) $5^{th}$-$10^{th}$ days

28) Hatched chick can be transferred to farm within
(a) 24 hours (b) 20 hours (c) 12 hours (d) 6 hours

29) Newly hatched chicks should be allow to stand in boxes for about
(a) 2 to 3 hours (b) 4 to 5 hours (c) 12 to 24 hours (d) 1 to 2 hours

30) The following are method of egg preservation except
(a)water glass method (b) lime water method (c) oil protection (d) powder method

31) Chick can be sexed by considering the following features except
(a) colour (b) beak (c)feather(d) vent

32) Culling means
(a) adding healthy bird into the pen (b) remove unproductive bird from the hatcheries (c) slaughtering sick birds (d) burn down diseased bird

33) In culling birds the following can be decided by the farmer except
(a)culling birds that lay big eggs (b)cull birds that are sick (c) cull birds that do not feed (d) cull birds that are too fat or too thin.

34) Debeaking is the ----------
(a) Cutting chick finger (b) cutting birds feather (c) cutting birds beak (d) cutting birds genital organ

35) Day-Old debeaking can be done in ----------
(a) two ways (b) three ways (c) four ways (d) five ways

36) Cold debeaking can be done using
(a) chemical (b) fire (c) knife or scissors (d) thread/ spring

37) Hot debeaking can be done using
(a) hot cauterizing blade machine (b) scissors (c) knife (d) fire

38) It is customary to give ---------- extra chicks per box in case of mortality.
(a) 10-20 chicks (b) 20-30 chicks (c) 5-10 chicks (d) 2-4 chicks

39) The following are factors affecting the fertility of eggs except
(a) age (b) sales (c) sperm cell (d) number of hen per cock

40) Hen suppose to reach the ages of ---------- for effective fertility (a) 8-18months (b) 6 -7 months (c) 1-2 months (d) 25-30 months

41) The number or ratio of ---------- ---------- (cock : hens) is recommended for effective productive
(a) 3:5 (b) 1: 10 (c) 5:2 (d) 3:6

42) Prolong deficiency of ---------- leads to sterility in poultry
(a) vitamin C and B (b) vitamin A and C (c) vitamin A and K (d) vitamin A and E

43) Bird reduction in fertility can be caused by temperatures within
(a) $42^0$c (b) $30^0$C - $33^0$C (c) $30^0$C and $29^0$c (d) $34^0$c and $30^0$c

44) The following factors affect hatchability
(a) physical defect (b) feeding (c) heredity defects (d) turning of eggs

45) The storage temperature of egg should not be more than
(a) $45^0$c (b) $55^0$c (c) $65^0$c (d) $35^0$c

46) The temperature requirement for chick within the ages of 4 weeks should be
(a) $32^0$c-$29^0$c (b) $29^0$c-$23^0$c (c)$23^0$c-$20^0$c (d) $34^0$c- $32^0$c

47) Mortality of bird up to 8 weeks should not exceed
(a) 1% (b) 2% (c) 3% (d) 4%

48) Weight of bird at eight weeks should not be below
(a) 2kg/bird (b) 3kg/bird (c) 0. 6kg/bird (d) 4kg/bird

49) New castle disease is a
(a) viral disease (b) bacterial disease (c) fungal disease (d) protozoan disease

50) Infectious Coryza disease is
(a) viral disease (b) bacterial disease (c) fungal disease (d) protozoan infection

## APPENDIX IX

## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL I (DATS1 MARKING SCHEME) Student ID No_____

| | | | |
|---|---|---|---|
| 1 | B | 26 | A |
| 2 | C | 27 | A |
| 3 | D | 28 | C |
| 4 | C | 29 | B |
| 5 | A | 30 | D |
| 6 | D | 31 | B |
| 7 | C | 32 | B |
| 8 | A | 33 | A |
| 9 | A | 34 | C |
| 10 | B | 35 | A |
| 11 | C | 36 | C |
| 12 | A | 37 | A |
| 13 | B | 38 | D |
| 14 | A | 39 | B |
| 15 | D | 40 | A |
| 16 | A | 41 | B |
| 17 | B | 42 | D |
| 18 | B | 43 | A |
| 19 | A | 44 | B |
| 20 | B | 45 | D |
| 21 | D | 46 | C |
| 22 | C | 47 | C |
| 23 | A | 48 | C |
| 24 | C | 49 | A |
| 25 | C | 50 | B |

## APPENDIX X

## POULTRY KEEPING

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 2 (BCET2) DIAGNOSTIC ADAPTIVE SKILL (DATS QUESTION) Student ID No_____**

1) Poultry is ----------
(a) wild animals raise for commercial purpose (b) keeping of aquatic animals only (c) domesticated fowls (birds) raised mainly for the purpose of food (d) domesticated bird kept for aesthetic life.

2) The following are domesticated fowl except
(a) turkey (b) goose (c) rabbit (d) pigeon

3) Extensive poultry management system involves
(a) management of large quantity of fish (b) management of large quantity of birds(c) management small scale bird in and around houses (d) keeping of poultry for egg production.

4) Poultry keeping is a management that provides a means of ----------
(a) gainful employment (b) control of predator (c) control of disease (d) spread of prey on in our environment.

5) The following are types of poultry enterprise in Nigeria except
(a) hatchery (b) layer farm (c) feed mills (d) slaughtering enterprises

6) The following are types of poultry house except
(a) free range or extensive system (b) bungalow (c) intensive system (d) deep litter system

7) The free range system is important for keeping birds because it provides birds with
(a)natural ventilation (b) small space (c) do not have access to dust bathing (d) does not provide means of taking variety of natural feed

8) Intensive system of poultry keeping provides birds with
(a) single variety of feed (b) adequate warmth (c) have access to other form of feed (d) inadequate ventilation.

9) Battery case system have the following advantages except
(a) birds are easily control (b) birds are easily observed for any infection (c) the environment can be easily disinfected (d) it is labour intensive

10) Outer poultry housing type include the following except
(a) fold system (b) portable colony cage (c) battery cage system (d) open sided poultry house

11) One nest should be provided for every
(a) 5 hens (b) 10 hens (c)1 hen (d) 15 hens

12) Nest should be situated in a ---------- place
(a) open roof (b) shady secluded (c) moist (d) hot

13) Cross section of each perch bar should be ---------- (a) 2 to 3cm (b) 5-10cm
(c) 10-15cm (d) 15-20cm

14) Brooder boxes are use for
(a) to conserve heat within a limited area (b) hatch egg (c) layer eggs (d) transport chicks

15) Longitudinal feeder should be conducted with rollers at the open ends to prevent chicks from
(a) feeding from in trough (b) dropping feaces (c) jumping into the feed (d) scattering the feed

16) Egg tray are uses for
(a) culling (b) laying of eggs (c) handling eggs transportation (d) cleaning eggs

17) Layer reaches point of lay when it attained the age of ----------
(a) 10 weeks (b) 16-18 weeks (c) 5-10 weeks (d) 8-10 weeks

18) Poultry compare to other livestock /hen have the following characteristics except
(a) short generation (b) rapid fecundity day (c) rapid turn over of invested capital (d) low death rate

19) Fast growing bird (broiler) for meat production reach market weight of
(a) 1.6kg-2kg in 6-8weeks (b) 1kg-1.2kg in 6-8weeks (c) 0.5kg-1kg in 6-8 weeks (d) 0-5kg in 6-8 weeks

20) Pullet attaining point of lay are to reach the age of
(a) 5.-10weeks (b) 20-24 weeks (c) 10-15 weeks (d) 2-5 weeks

21) Egg can be hatched through
(a) artificial and natural incubation (b) hand cracking (c) cool bathing (d) warm bathing'

22) Thermometer is use in measuring
(a) temperature (b) humidity (c) pressure (d) rainfall

23) Hygrometer is use in measuring
(a) temperature (b)humidity (c) pressure (d) rainfall

24) Weighting balance is used in measuring
(a) mass of an object (b) volume of an object (c) length of an object (d) diameter of an object

25) Tape role is use in measuring the
(a) mass of an object (b) volume of an object (c) length of an object (d) diameter of an object.

26) Hatchery building is designed to provide roam for
(a) washing eggs only(b) rearing chicks (c) hiding hatching eggs poor to setting, grading and incubation (d)sexing of chicks only

27) Additional rooms are provided to eater for the following activities except
(a) fumigation (b) washing equipment (c) storage (d) frying eggs

28) The major goal of optimum hatchery building design and construction are except
(a) cut and contact between egg and chicks (b) increase predatory-prey relationship (c) provide maximum sanitation and disease control (d) provide efficient and effective service delivery

29) ---------- incubator is used commercially for hatchery eggs
(a) cabinet (force drought (b) nest box (c) roost (d) perches

30 Three days before the eggs are due for hatching, the eggs are transfer from setter to
(a) egg tray (b) hatchers (c) setters (d) dryers.

31 Eggs turning in kerosene incubator is done by…….
(a) hand (b) automatically done (c) air pressure (d) humidifier.

32 Egg candler is used in identifying egg (a) fertility (b) fecundity (c) shell thickness (d)yolk largeness.

33 Eggs should be moist at a relative humidity of
(a) 75% (b) 98% (c)100% (d)20%.

34 After 4 days of storage hatchability is reduced by
(a) 10% per day (b) 4% per day (c) 20% per day (d) 30% per day.

35 Eggs set are candled
(a) once during incubation (b) twice during incubation (c) trice during incubation (d) four times during incubation.

36 Egg with brown shell the first candling is from the
(a) first day (b) third day (c) seventh day (d) tenth day.

37 Egg with brown shell, the second candling is form the
(a) fourth day (b) fifteenth day eighteenth day (d) nineteenth day.

38 Fertile egg shows
(a)dark spot with mass little blood vessel radiating in all directions (b) looks clear (c)irregular circle of blood settled at the edge of the yolk (d) blood ring settled at the centre

39 Hatched chick can be transferred to farm within
(a) 24 hours (b) 20 hours (c) 12 hours (d) 6 hours

40 The following are method of egg preservation except
(a)water glass method (b) lime water method (c) oil protection (d) powder method.

41 Culling means
(a) adding healthy bird into the pen (b) remove unproductive bird from the hatcheries (c) slaughtering sick birds (d) burn down diseased bird.

42 Debeaking is the ----------
(a) Cutting chick finger (b) cutting birds feather (c) cutting birds beak (d) cutting birds genital organ

43 Cold debeaking can be done using
(a) chemical (b) fire (c) knife or scissors (d) thread/ spring

44 It is customary to give ---------- extra chicks per box in case of mortality.
(a) 10-20 chicks (b) 20-30 chicks (c) 5-10 chicks (d) 2-4 chicks

45 Hen suppose to reach the ages of ---------- for effective fertility
(a) 8-18months (b) 6 -7 months (c) 1-2 months (d) 25-30 months

46 Prolong deficiency of ---------- leads to sterility in poultry
(a) vitamin C and B (b) vitamin A and C (c) vitamin A and K (d) vitamin A and E

47 The following factors affect hatchability
(a) physical defect (b) feeding (c) heredity defects (d) turning of eggs

48 The temperature requirement for chick within the ages of 4 weeks should be
(a) $32^0$c-$29^0$c (b) $29^0$c-$23^0$c (c)$23^0$c-$20^0$c (d) $34^0$c- $32^0$c

49 Weight of bird at eight weeks should not be below
(a) 2kg/bird (b) 3kg/bird (c) 0. 6kg/bird (d) 4kg/bird

50 Infectious Coryza disease is
(a) viral disease (b) bacterial disease (c) fungal disease (d) protozoan infection

## APPENDIX XI

## POULTRY KEEPING

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 2 (BCET2) DIAGNOSTIC ADAPTIVE SKILL (DATS MARKING SCHEME) Student ID No_____**

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

## APPENDIX XII

## FISHERY
## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL (DATS) QUESTIONS Student ID No_____

1. Fishery is an act of…….
(a) Bird production (b)Animal production (c) Fish production (d) Egg production

2. Stock healthy and disease-free fingerlings requires individual producer to obtain fingerlings from
(a) wild pond (b) fish hatcheries (c) brooding house (d) bird incubators

3. The following are characteristics of home stead fish pond except
(a) It is backyard fish farming (b) it must be near to water source (bore hole) (c) the depth of the pond should exceed 1-2 metre (d) the size of the pond should not exceed 0.001 ha

4. Pond dykes must be compacted to prevent
(a)Seepage (b) disease (c) fertilization (d) pollution

5. General condition for selecting suitable sites for fish pond construction include the following except
(a)water supply and security (B)labour and feed (c) drugs and predators (d)market and nature of soil.

6. Aquaculture is define as
(a) cultivation of agricultural crops (b) cultivation of all forms of aquatic animals and plants in water (c) cultivation of cash crops (d) production of only fish in pond

7. The following are importance of fish culture except
(a) It provides fish protein to the teaming population (b) mean of employment (c) source of income (d) serve as prey to predators

8. A concrete pond of 6ftX 15 ft X 4ft can successfully raise
(a) 1000 fish to maturity (b) 5000 fish maturity (c) 7000 fish to maturity (d) one million fish to maturity

9. The following are type of pond suitable for raising fish in Nigeria except
(a) concrete pond (b) earth pond (c) plastic thank (d) rotator pond

10. Fish culture can be classified into two namely
(a) monoculture and aquaculture (b) monoculture and polyculture (c)polyculture and horticulture (d) apiculture and mono culture

11. Polyculture is the practice of cultivating
(a) one species of fish (b) healthy of fish (c) more than one species of fish (d) commercial fish species

12. Home stead fish pond has the size of
(a) 1 X5X5m (b) 5X 5X1m (c)5X1X1m (d) 5X1X5m

13. Fish production system include the following except
(a) expenditure culture system (b) polyculture system (c) intensive culture system (d) integrated aquaculture system

14. When pH of water is consistently low, the water becomes
(a) acidic (taste sour) (b) encourage phytoplankton grow (c) encourage fish growth (d) encourage aeration

15. If pond is acidic it can be corrected by adding
(a) NPK fertilizer (b) lime (c) water (d) paraffin

16. Maintenance of pond water depth at…….is required in fish culture.
(a) 2-1m (b) 1-0.5m (c) 5m-1m (d) 1-1.5m

17. The tolerable range of fresh water temperature in fish pond is
(a) $20^0$C - $30^0$C (b) $45^0C$-$60^0C$ (d) $42^0C$ -$45^0C$ (d) -$20^0C$- $10^0C$

18. The water turbidity in fish pond can cause
(a) fish fecundity (b) increase fertility (c) clogging of gills (d) increase pond aeration

19. The following are indicators of bad water quality except
(a) Offensive odors (b) light fertilization (c) thick, deep green colour (d) sluggish movement of fish

20. The following are lime materials for fish pond except
(a) quick line (Cao) (b) zinc oxide (ZnO) (c) limestone/agriculture lime (CaCo3) (d) cans tic& slaked lime (CacoH)2

21. The following periods are recommendation for stocking fish in to pond
(a) 10—12am and 1-3am (b)6-8am and 6-8pm (c) 9-11am and q12-1pm (d) 3-4pm and 4-5pm

22. When transporting fish for stocking stop feeding fish for a period of
(a)1-3days (b) 5-6days (c)1 week (d)10-12days

23. In all male (monosex) fish culture of tilapia stock 20-40g size fish at a density of……. Is required
(a) 5-10 fish per $m^2$ (b) 10-15 fish per $m^2$ (c) 1-2 fish per $m^2$ (d) 15- 20 fish per $m^2$

24. Stocking fish for profitable purpose ---------- species is fast grower.
(a) *Clarias* (b) *Tilapia* (c)*Heterobrachus* (d)*Heterotis niloticus*

25. The fish species that is hardy , resistance to disease and suitable for stocking into fish pond is
(a)*Clarias* (b) *Tilapia* (c) *Heterotis niloticus* (d) *Heterobranchus*

26. The fish species that is tolerant to poor water quality and suitable for stocking into fish pond is
(a) *Clarias* (b) *Tilapia* (c) *Heterotis niloticus* (d) *Heterobranchus*

27. The fish species that is easy to breed in captivity in fish pond is
(a) *Clarias* (b) *Tilapia* (c) *Heterotis nilotichus* (d) *Heterobranchus*

28. The following fish species are marketable and acceptable to consumer except
(a) carp fish (b) *Tilapia* (c) *Clarias* (d) star fish

29. The process of producing fingerlings for commercial or consumption purpose is
(a)fish feeding (b) fish harvesting (c) fish preservation (d) fish hatchery

30. Fish hatchery equipment include the following except
(a) aquaria (b) weighing scale (c) lodine (d) netting material

31. The following are common methods in tilapia seed production practice except
(a) intensive pond method (b) open pond method (c) hapa method (d) tank method

32. In hapa method of tilapia seed production practice there is need to stock brood fish at a ratio of
(a) 10:2 or 10:10 (male to female) (b) 1:5 or 1:7 (male to female) (c) 5:1 or 7:1 (male to female) (d) 7:1 or 5 :1 (male to female)

33. Day old fish is called
(a) fry (b) brooder (c)hatchery (d) fingerlings

34. Young stock fish ready for rearing and production is called
(a)Fry (b)fingerlings (c)hatchery (d) brooder fish.

35. Matured Stock fish ready for egg production is called
(a) fry (b) fingerlings (c) hatchery (d) brooder fish

36. Production of all – male (mono sex) fingerlings of tilapia involve two practical methods
(a )computerized and chemical sexing (b) fish sexing and conjugal sexing (c) mouth sexing and anal sexing (d hand sexing and hormonal sexing

37. Manual sexing method should be done in the morning so that fish will not be
(a) Diseased (b) stressed (c) rough (d) contaminated

38. Male tilapia have ……. orifices' (openings) situated near the ventral fine
(a) two (b) three (c) one (d) four

39. Female tilapia have …… orifices (openings)
(a) two (b) three (c) one (d) four

40. After collecting cat fish for spawning disinfect them with…….. bath to prevent the transfer of pathogen
(a) Izal (b) dettol (c) lime (d) formalin

41. In cat fish spawning required the following techniques are except
(a) selecting and handling brooders (b) collecting and injecting pituitary (c)striping the female to fertilize the eggs and incubating the eggs (d) cannibalism

42. Incubate the eggs of a catfish in flowing water with a flow through rate of
(a) 1-3 litres per minute (b) 4-5 litres per minute (c) 20-25 litres per minute (d)30-35 litres per minute

43. After an approximate…….days in hatchery tanks the fry can be transferred to nursery pond
(a) 14 days (b) 10 days (c) 25 days (d) 24 days

44. …….. is the suitable size lither for stocking fish into production pond
(a) 5-10cm (b)2-3cm (c)15-20cm (d) 20-25cm

45. It is required to transfer fry to nursing ponds only after they have reached a size greater than
(a) 10mm (b) 1000mm (c) 10,000mm (d)100,000mm

46. Shade enhance …… rate of fish in a pond
(a) growth and survival (b) disease spread (c) osmoregulation (d) predatory

47. Cannibalism can be reduced by providing
(a) enough water to the pond (b) medical service (c) cover ( shade) (d) adequate feed to fish

48. Dusk mask is use to prevent …… from being inhaled
(a) dusk (b) water (c) temperature (d)pressure

49. Thermometer is used for measuring
(a) pressure (b) temperature (c) wind speed (d) wind direction

50. Litmus paper is use to measure water and soil……
(a) colour (b) acidity and alkalinity (c) temperature (d) pressure

## APPENDIX XIII

## FISHERY
## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL (DATS) MARKING SCHEME Student ID No_____

| | | | |
|---|---|---|---|
| 1 | C | 26 | A |
| 2 | B | 27 | B |
| 3 | C | 28 | D |
| 4 | A | 29 | D |
| 5 | C | 30 | C |
| 6 | B | 31 | A |
| 7 | D | 32 | B |
| 8 | A | 33 | A |
| 9 | D | 34 | B |
| 10 | B | 35 | D |
| 11 | C | 36 | D |
| 12 | B | 37 | B |
| 13 | B | 38 | A |
| 14 | A | 39 | B |
| 15 | B | 40 | D |
| 16 | D | 41 | D |
| 17 | A | 42 | A |
| 18 | C | 43 | A |
| 19 | B | 44 | B |
| 20 | B | 45 | A |
| 21 | B | 46 | A |
| 22 | A | 47 | C |
| 23 | C | 48 | A |
| 24 | C | 49 | B |
| 25 | A | 50 | B |

## APPENDIX XIV

## FISHERY
## BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL (DATS) QUESTIONS Student ID No_____

(1) The following are feed to fish except
(a) lime (b) phytoplankton (c) zooplankton (d) rotifer

(2) Agriculture by – product for supplemented feed of fish is
(a)bean (b) blood meal(c) bone meal (d) chick dropping.

(3) Keeping in cool and dry placed to avoid.
(a)disease (b) moist effect and deterioration (c) rodent (d)heat

(4) Keeping feed on shelves is to provide adequate
(a) moisture (b) temperature (c)air circulation and rodent control (d)disease.

(5) Feed should be arrange properly in order to
(a)avoid rodent attack (b)prevent disease(c) show date of production to avoid spoilage (d)avoid moisture.

(6) Soyabean should be boiled or fried to avoid the following toxicant
(a) heamagglutins (b) gossypol (c) fugus (d)disease.

(7) Cotton seed should be roasted to avoid the following toxicant
(a) heamagglutins (b) gossypol (c) fugus (d) disease.

(8) Cassava should be cooked or roasted to avoid the following toxicant
(a) heamagglutins (b) gossypol (c) cyanine (d) disease.

(9) Supplementary feed is
(a)natural feed given to fish(b) prepared in order to provide adequate nutrition to fish (c) is artificial feed for fingerings only (d) is naturally prepared feed for brooders fish only

(10) Adult fish in fish pond prefer feed available in
(a) powder form (b) crushed form (c) pellet form (d) liquid form

(11) Sink pallets are suitable for fish that are
(a) surface feeder (b) button feeder (c) middle level feeder (d) passive feeder

(12) The type of fish species that are button feeder are
(a) *clarias* and *Heterotis sp* (b) *Tilapia* and *Clarias* (c) *Hetterotis* and *Tilapia* (d) *Clarias* and cat fish

(13) Floating pellets are suitable for fish species that are
(a) surface feeder (b) button feeder (c) middle level feeder (d) passive feeder

(14) The type of fish that is surface feeder is
(a) *Claria* (b)*Hetrotis* (c) *Tilapia* (d) *Heterobranchus*

(15) Suitable feed for fish species should not be more than …….in diametre
(a)3.2mm (b) 4.5m (c) 7.2mm (d) 5.5mm

(16) Example of protein food materials are as follow except
(a) fish meal powder (b) soya meal (c) blood meal (d) oil meal

(17) Example of carbohydrate food materials are as follow except
(a) cereal grams (b) cotton seed cake (c) cassava waste (d) cereal bran

(18) Example of vitamin food material is
(a) vitamin premix (b) palm kennel cake (c) dead animal (d) fatty acid

(19) Example of mineral food materials are as follow except
(a) bone meal (b) mineral premix (c) common salt (d) G/nut cake.

(20) The example of lipid food materials are as follow except
(a) oil meal (b) blood meal (c) oil cake (d) animal fat

(21) The simple and traditional method of feeding fish require the use of
(a) hand for pouring feed into fish pond (b) the use of sprinkling machine (c) blowers (d) disc trousers

(22) The use of mechanical or automatic feeder require the use of the following machine except
(a) hand operating blowers (b) disc trousers (c) automatic feed broad casting machine (d) hand broad casting/torrential form.

(23) Fish can be fed at regular interval of
(a) 6:00am & 10;00am (b) 10:00am & 5:00am (c) 10:00am &5:00am (d) 10:000pm & 5:00am

(24) In feeding fish there is need to maintain
(a) different spots (b) alternating spots (c) single spot (d)surface area

(25) The common unwanted predators include the following except
(a) king fish (b) frog (c) monitor lizard (d) tilapia

(26) The filamentous weed that entangles fish gill thereby causing gill clugging and injury is
(a) moss (b) fern (c) spirogyra (d) rotifer

(27) The floating emergence weed that reduces water surface which gives room for oxygen depletion is
(a) water lilly (b) moss (c) fern (d) rotifer

(28) The following are recommendations for aquatic weed control except
(a) regular removal of water weed (b) regular draining of pond water (c) regular application of herbicides (d) constantly clearing of dead materials

(29) The following are recommendations for aquatic predators control
(a)application of herbicides (b) constant draining of fish pond (c) application of germicide (d)ensure the water of fish pond supply structure (in let) is always screened

(30) Fin rot or body rot is disease caused by
(a) bacterial disease (b) fungal disease (c)viral disease (d) protozoan disease

(31) White spot is a disease caused by organism ……..
(a) protozoa (b) virus (c)bacteria (d) fugus

(32) Cloudily eyes (pop eye) is a disease cause by
(a) virus (b) fungus (c) protozoa (d)bacteria

(33) Fish harvest is equally called
(a) fish draining (b) fish cropping (c) fish egesting (d)fish dropping

(34) Most fish species with proper management reach market size within
(a) 2-4 months (b)6-9 months (c) 3-4 months (d) 3 months

(35) The maximum months for fish to reach market or table size is
(a) 4 months (b) 2 months (c) 3 months (d) 12 months

(36) Cropping is define as
(a) removal of bigger ones (fish) from pond to allow smaller ones to grow (b) cutting fish in to preservable size (c) fish preservation process (d) stocking fish in to pond

(37) Advertise fish…… days ahead of harvest in previously identified market
(a) 2 days (b) a day (c) 3-5 days (d) one month

(38) Marketing of fish depend on the following factors except
(a) the sophistication of the market (b) religious beliefs of consumers (c) pattern of consumers (d) educational back ground of the fishermen

(39) Non contracted market are
(a) marketing fish that the farmer is bounded by agreement (b) ) marketing fish where the farmer is not bounded by agreement (c) is a process of giving contract on fish facilities (d) marketing of only monoculture fish

(40) For effective fish management record keeping is the first hand criteria for
(a)taking decision for successful enterprise (b) providing predator need in aquaculture (c) pathological needs in aquaculture (d) the needs of pest in aquaculture

(41) The main objectives of farm records are as follows except
(a) to control the farm business (b) guide future decisions (c) provide data required for sound farm planning (d) it provides only profit records

(42) Record keeping is important on the following ground except
(a) it aids in evaluating the profitability and general economic achievement (b) it provides vital management information for future planning (c) it does not provides ground for credit facilities (d)it identifies strengthen and weakness of the fish enterprise

(43) The following are types of record in aquaculture farm except
(a) daily record (b)medication record (c) feed record (d) patient record

(44) Balance sheet …….
(a) describes the financial situation of a business at a specific point in time (b)describes record of fish harvested only (c) gives record of vaccination (d)gives record of credit procurement only

(45) Balance sheet is usually prepared at the
(a) middle of year (b) first day of the year (c) last day of the year (d) last day of first month of the year

(46) Net worth (NW) is the
(a) sum of the total asset (A) and total liabilities (L) NW= A +L (b) is the difference of the total asset (A) and total liabilities (L) NW=A-L (c) is the product of the total asset (A)and total liabilities (L) NW=AXL asset and liabilities of business (d) none of the above.

(47) Net worth in balance refers to
(a) surplus (b) deficit (c) debt (d) credit

(48) co-operative group is
(a) venture for profitable purpose (b) a formal voluntary self selected group of people who operate as a business on a non – profit or cost base (c) loss enterprise (d) money contributing venture

(49) tape is use for measuring
(a) length (b) volume (c) mass (d) density

(50) glass cylinder is use for measuring
(a) length (b) volume (c) mass (d) density

**(APENDIX XV)**

**FISHERY**
**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 1 (BCET1) DIAGNOSTIC ADAPTIVE SKILL (DATS) MARKING SCHEME STUDENT ID No_____**

| | | | |
|---|---|---|---|
| 1 | A | 26 | C |
| 2 | A | 27 | A |
| 3 | B | 28 | C |
| 4 | C | 29 | D |
| 5 | C | 30 | A |
| 6 | A | 31 | A |
| 7 | B | 32 | D |
| 8 | C | 33 | B |
| 9 | B | 34 | B |
| 10 | C | 35 | D |
| 11 | B | 36 | A |
| 12 | A | 37 | C |
| 13 | A | 38 | D |
| 14 | C | 39 | B |
| 15 | A | 40 | A |
| 16 | D | 41 | D |
| 17 | B | 42 | C |
| 18 | A | 43 | D |
| 19 | D | 44 | A |
| 20 | B | 45 | C |
| 21 | A | 46 | B |
| 22 | C | 47 | A |
| 23 | B | 48 | B |
| 24 | C | 49 | A |
| 25 | D | 50 | B |

**APPENDIX XVI**

**FISHERY**

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 2 (BCET2) DIAGNOSTIC ADAPTIVE SKILL (DATS) QUESTIONS STUDENT ID No_____**

1. Fishery is an act of
   (a) Bird production (b )Animal production (c) Fish production (d) Egg production

2. The following are characteristics of home stead fish pond except
   (a) It is backyard fish farming (b) it must be near to water source (bore hole) (c) the depth of the pond should exceed 1-2 metre (d) the size of the pond should not exceed 0.001 ha

3. General condition for selecting suitable sites for fish pond construction include the following except (a)water supply and security (B)labour and feed (c) drugs and predators (d)market and nature of soil.

4. The following are importance of fish culture except
(a) It provides fish protein to the teaming population (b) mean of employment(c) source of income (d) serve as prey to predators

5. Fish culture can be classified into two namely
   (a) monoculture and aquaculture (b) monoculture and polyculture (c)polyculture and horticulture (d) apiculture and mono culture

6. Home stead fish pond has the size of
   (a) 1 X5X5m (b) 5X 5X1m (c)5X1X1m (d) 5X1X5m

7. When pH of water is consistently low, the water becomes
   (a) acidic (taste sour) (b) encourage phytoplankton grow (c) encourage fish growth (d) encourage aeration

8. Maintenance of pond water depth at…….is required in fish culture.
   (a) 2-1m (b) 1-0.5m (c) 5m-1m (d) 1-1.5m

9. The water turbidity in fish pond can cause
   (a) fish fecundity (b) increase fertility (c) clogging of gills (d) increase pond aeration

10. The following are lime materials for fish pond except
    (a) quick line (Cao) (b) zinc oxide (ZnO) (c) limestone/agriculture lime (CaCo3) (d) cans tic& slaked lime (CacoH)2

11. When transporting fish for stocking stop feeding fish for a period of
    (a)1-3days (b) 5-6days (c)1 week (d)10-12days

12. In all male (monosex) fish culture of tilapia the stock rang of 20-40g size fish at a density of……. Is required
    (a) 5-10 fish per $m^2$ (b) 10-15 fish per $m^2$ (c) 1-2 fish per $m^2$ (d) 15- 20 fish per $m^2$

13. Stocking fish for profitable purpose ---------- species is fast grower.
(a)*Clarias* (b) *Tilapia* (c)*Heterobrachus* (d)*Heterotis niloticus*

14. The fish species that is hardy , resistance to disease and suitable for stocking into fish pond is
(a)*Clarias* (b) *Tilapia* (c) *Heterotis niloticus* (d) *Heterobranchus*

15. The fish species that is tolerant to poor water quality and suitable for stocking into fish pond is
(a) *Clarias* (b) *Tilapia* (c) *Heterotis niloticus* (d) *Heterobranchus*

16. The following fish species are marketable and acceptable to consumer except
(a) carp fish (b) *Tilapia* (c) *Clarias* (d) star fish.

17. Fish hatchery equipment include the following except
(a) aquaria (b) weighing scale (c) lodine (d) netting material.

18. In hapa method of tilapia seed production practice there is need to stock brood fish at a ratio of
(a) 10:2 or 10:10 (male to female) (b) 1:5 or 1:7 (male to female) (c) 5:1 or 7:1 (male to female) (d) 7:1 or 5 :1 (male to female)

19. Young stock fish ready for rearing and production is called
(a) Fry (b)fingerlings (c)hatcher (d) brooder fish.

20. Production of all – male (mono sex) fingerlings of tilapia involve two practical methods
(a)computerized and chemical sexing (b) fish sexing and conjugal sexing (c) mouth sexing and anal sexing (d hand sexing and hormonal sexing

21. Male tilapia have ……. orifices' (openings) situated near the ventral fine
(a) two (b) three (c) one (d) four

22. Female tilapia have ……..…… orifices (openings)
(a) two (b) three (c) one (d) four

23. After collecting cat fish for spawning disinfect them with…….. bath to prevent the transfer of pathogen (a) Izal (b) dettol (c) lime (d) formalin

24. In cat fish spawning required the following techniques are excep
(a) selecting and handling brooders (b) collecting and injecting pituitary (c)striping the female to fertilize the eggs and incubating the eggs (d) cannibalism

25. Incubate the eggs of a catfish in flowing water with a flow through rate of
(a) 1-3 litres per minute (b) 4-5 litres per minute (c) 20-25 litres per minute (d)30-35 litres per minute

26. …….. is the suitable size lither for stocking fish into production pond
(a) 5-10cm (b)2-3cm (c)15-20cm (d) 20-25cm

27. Shade enhance …… rate of fish in a pond
(a) growth and survival (b) disease spread (c) osmoregulation (d) predatory attack.

28. Dusk mask is use to prevent …… from being inhaled
(a) dusk (b) water (c) temperature (d)pressure

29. The following are feed to fish except
(a) lime (b) phytoplankton (c) zooplankton (d) rotifer

30. Keeping feed in cool and dry placed to avoid.
(a)disease (b) moist effect and deterioration (c) rodent (d)heat

31. Keeping feed on shelves to provide adequate
(a) moisture (b) temperature (c)air circulation and rodent control (d)disease.

32. soyabean should be boiled or fried to avoid the following toxicant
(a) heamagglutins (b) gossypol (c) fugus (d)disease.

33. Cassava should be cooked or roasted to avoid the following toxicant
(a) heamagglutins (b) gossypol (c) cyanine (d) disease.

34. Adult fish in fish pond prefer feed available in
(a) powder form (b) crushed form (c) pellet form (d) liquid form

35.The type of fish species that are button feeder are
(a) *clarias* and *Heterotis sp* (b) *Tilapia* and *Clarias* (c) *Hetterotis* and *Tilapia* (d) *Clarias* and cat fish

36.The type of fish that is surface feeder is (a) *Claria* (b)*Hetrotis* (c) *Tilapia* (d) *Heterobranchus*

37. Example of protein food materials are as follow except
(a) fish meal powder (b) soya meal (c) blood meal (d) oil meal

38. Example of vitamin food material is
(a) vitamin premix (b) palm kennel cake (c) dead animal (d) fatty acid

39. The example of lipid food materials are as follow except
(a) oil meal (b) blood meal (c) oil cake (d) animal fat

40. The use of mechanical or automatic feeder require the use of the following machine except
(a) hand operating blowers (b) disc trousers (c) automatic feed broad casting machine (d) hand broad casting/torrential form.

41. Fish can be fed at regular interval of
(a) 6:00am & 10;00am (b) 10:00am & 5:00am (c) 10:00am &5:00am (d) 10:000pm & 5:00am

42. In feeding fish there is need to maintain
(a) different spots (b) alternating spots (c) specific single spot (d)surface area

43. The floating emergence weed that reduces water surface which gives room for oxygen depletion is
(a) water lilly (b) moss (c) fern (d) rotifer

44. Fin rot or body rot is disease caused by
(a) bacterial disease (b) fungal disease (c) viral disease (d) protozoan disease

45. White spot is a disease caused by organism ……..
(a) protozoa (b) virus (c) bacteria (d) fugus

46. Fish harvest is equally called
(a) fish draining (b) fish cropping (c) fish egesting (d) fish dropping

47. Most fish species with proper management reach market size within
(a) 2-4 months (b)6-9 months (c) 3-4 months (d) 3 months

48. The maximum months for fish to reach market or table size is
(a) 4 months (b) 2 months (c) 3 months (d) 12 months

49. Cropping is define as
(a) removal of bigger ones (fish) from pond to allow smaller ones to grow (b) cutting fish in to preservable size (c) fish preservation process (d) stocking fish in to pond

50. Advertise fish…… days ahead of harvest in previously identified market
(a) 2 days (b) a day (c) 3-5 days (d) one month

## APPENDIX XVII

**FISHERY**

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 2 (BCET2) DIAGNOSTIC ADAPTIVE SKILL (DATS) MARKING SCHEME ID No_____**

(1) C.
(2) A
(3) C.
(4) C.
(5) D.
(6) B.
(7) B.
(8) A.
(9) D.
(10) C.
(11) B
(12) A
(13) C
(14) D
(15) A
(16) A
(17) D
(18) C
(19) B
(20) B
(21) D
(22) A
(23) B
(24) D
(25) D
(26) A
(27) B
(28) A
(29) B
(30) B
(31) B
(32) A
(33) C
(34) C
(35) A
(36) C
(37) D
(38) D
(39) B
(40) C
(41) B
(42) C
(43) A
(44) A
(45) A
(46) B
(47) B
(48) D
(49) A
(50) C

## APPENDIX XVIII

**BIOLOGY CONCEPT FOR ENTREPRENUERSHIP TEST 2 (BCET2) DIAGNOSTIC ADAPTIVE SKILL (DATS) SCORE SHEET STUDENT ID No_____**

| | A | B | C | D | | A | B | C | D | | A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | O | O | O | O | 21. | O | O | O | O | 41. | O | O | O | O |
| 2. | O | O | O | O | 22. | O | O | O | O | 42. | O | O | O | O |
| 3. | O | O | O | O | 23. | O | O | O | O | 43. | O | O | O | O |
| 4. | O | O | O | O | 24. | O | O | O | O | 44. | O | O | O | O |
| 5. | O | O | O | O | 25. | O | O | O | O | 45. | O | O | O | O |
| 6. | O | O | O | O | 26. | O | O | O | O | 46. | O | O | O | O |
| 7. | O | O | O | O | 27. | O | O | O | O | 47. | O | O | O | O |
| 8. | O | O | O | O | 28. | O | O | O | O | 48. | O | O | O | O |
| 9. | O | O | O | O | 29. | O | O | O | O | 49. | O | O | O | O |
| 10. | O | O | O | O | 30. | O | O | O | O | 50 | O | O | O | O |
| 11. | O | O | O | O | 31. | O | O | O | O | 51 | O | O | O | O |
| 12. | O | O | O | O | 32. | O | O | O | O | 52 | O | O | O | O |
| 13. | O | O | O | O | 33. | O | O | O | O | 53 | O | O | O | O |
| 14. | O | O | O | O | 34. | O | O | O | O | 54 | O | O | O | O |
| 15. | O | O | O | O | 35. | O | O | O | O | 55 | O | O | O | O |
| 16. | O | O | O | O | 36. | O | O | O | O | 56 | O | O | O | O |
| 17. | O | O | O | O | 37. | O | O | O | O | 57 | O | O | O | O |
| 18. | O | O | O | O | 38. | O | O | O | O | 58 | O | O | O | O |
| 19. | O | O | O | O | 39, | O | O | O | O | 59. | O | O | O | O |
| 20. | O | O | O | O | 40. | O | O | O | O | 60. | O | O | O | O |

.

**APPENDIX XIX**

**EXPERIMENTAL LESSON PLAN FOR POULTRY AND FISHERY FIRST WEEK**

**-Subject**: Biology for Entrepreneurship/Trade (Fishery)

-**Model of Teaching :**-Project-based Approach

**-Group;** Experimental

- **Topic**: Fish Production Management

**-Sub-topic**: Fish Management Practice

**-Class**: SS2

- **Date** :

- **Duration of lesson**: 2hrs

**Number of students** : 60

- **Rationale**: To practice fish production at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. Practice fish management practice

ii. Identify twelve commandments of fish management practices

- **Pre-requisite/Previous Knowledge**: Students have learnt fish morphology in Biology

- **Learning materials**: Manual for fish production

- **Reference**: Mohammed , I.B.(2015).Entrepreneurship-based Project Approach Training Manual on Fishery Pp 1-3

**-Introduction**

**Teacher's activity**:

The teacher asks questions leading to achievement of learning objectives (see Table i)

**Students' activity**:

Students respond to teacher's questions (see table i)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares Students into group of five

- The teacher asks Students questions as stated below (see Table i)

**Table i** **LESSON DEVELOPMENT**

| Teacher's activity | Student's Activity |
|---|---|
| **Introduction**: (**question/instruction**)<br><br>1. List type of fish you know?<br>2. List some morphological features of fish?<br>3. List type of fish pond in Nigeria?<br><br>**Development/**<br>Step i. State some good fish pond management practices<br><br>Step ii State twelve commandments of fish practice<br><br>**Evaluation (Question/instruction)**<br>i. List some fish pond management?<br><br>ii State twelve commandments of fish practice<br><br>**Conclusion:** The teacher concludes the lesson by highlighting the main points. | **Introduction**: (**Expected response/answer**)<br><br>1. Tilapia, cat-fish, carp fish<br>2. Eye, nostril, fin, mouth scale etc<br>3. Concrete fish pond, Earthen fish pond.<br><br>**Development (expected response/answer**)<br>1. Good management practice<br>i. Pond preparation<br>ii. Fertilization/Living<br>iii. Feeding<br>iv. Stoking fish<br>v. Water quality maintenance<br>vi. Aquatic weed and predation<br>vii. Fish pathology<br>viii. Harvest storage and processing<br>ix. Record keeping<br>2. 12 commandments of fish practice<br>i. Stock healthy fish<br>ii. Maintain good water quality<br>iii. Prevent predators<br>iv. Avoid overcrowding of fish<br>v. Avoid excessive feeding<br>vi. Maintain normal pond water level<br>vii. Watch fish behavior<br>viii. Maintain fish pond structure<br>ix. Keep accurate record |

| | |
|---|---|
| **Assignment /Take Home Project**<br>Teacher write assignment on chalk board | x. Consult service provider<br>xi. Consult primary manure<br>xii. Feed fish regularly<br><br>**Assignment /Take Home Project**<br>Draw three different types of fish pond you've seen in your locality.<br>Construct any one type wooden fish pond you havre seen<br>List five fish farm of small scale production in Nigeria. |

**SECOND WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Fishery)

- **Model of Teaching:** Entrepreneurship-based Project-based Approach

-**Group;** Experimental

- **Topic**: Pond Construction

- **Date** :

- **Duration of lesson**: 2hrs second week

-**Sub-topic**: Site Selection and construction of Fish Pond

-**Class**: SS2

**Number of students:** 60

- **Rationale**: Construct suitable fish pond at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. select suitable site for fish pond

ii. identify type of fish pond

iii. identify requirements for constructing fish pond

iv. practice fertilization and liming of fish pond construction before stocking

- Pre-**requisite**/**Previous Knowledge**: Students have learnt monopoly of fish in Biology

- **Learning materials**: Tarpaulin, wood pond, basin

- **Reference**: Ditto Fishery Manual pg4-9

-**Introduction**

**Teacher's activity**:

The teacher asks questions leading to achievement of learning objectives (See Table ii)

**Students' activity**:

Students respond to teacher's questions (See Table ii)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares learners into group of five

- The teacher asks learners questions as stated below (See Table ii)

**Table ii** **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's Activity** |
|---|---|
| **Introduction:** (question/instruction)<br><br>1. List type of soil?<br>2. List type of land forms?<br>3. List requirements for establishing fish pond?<br><br>**Lesson Development**<br>Step i. Requirements needed for selecting suitable site for fish pond<br>Step ii Types of fish pond<br>Step iii. Requirement for fish pond construction<br>Step iv Fertilization and liming practices in fish pond.<br><br>**Evaluation (Question/instruction)**<br>i. List requirements needed for selecting suitable site for fish pond?<br>ii List type of fish pond?<br>iii. Outline the requirement for fish pond construction?<br>iv. Demonstrate fertilization and liming practices in fish pond.<br><br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br>**Assignment /Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br><br>1. Sandy, loamy and clay soil<br>2. Undulated land form,/flat land form or high land and low land<br>3. i. Proximity to water source<br>ii. Soil/ land form<br>iii. Market<br>iv. Availability of fish input etc.<br><br>**Lesson Development (expected response/answer)**<br>1. i. Proximity female<br>ii. Retentive soil<br><br>iii. Adequate topography<br><br>iv. Water source most not be polluted<br><br>v. Require suitable drainages<br><br>2. i. Concrete fish pond<br>ii. Earthen fish pond<br>iii. Plastic/fiber tank<br>iv. Tarpaulin<br>3. The requirement for fish pond constructions (see fishery manual pg4-8)<br>4. Demonstrate fertilization and liming practice (see fishery manual pg18-24).<br><br>**Assignment /Take Home Project**<br>**i.** Construct any fish pond of your interest.<br>**ii.** Demonstrate fertilization procedure in the constructed fish pond |

**THIRD WEEK**

**Subject**: Biology for Entrepreneurship/Trade (Poultry)

-**Model of Teaching**:; Project-based Approach .

-**Group** :Experimental

- **Topic**: General Poultry Management

- **Date** :

- **Duration of Lesson**: 2 hours third week

-**Sub-topic**: Fish Management Practice

-**Class**: SS2

- **Number of Students** :60

-**Learning Objectives**: By the end of the lesson Students should be able to:

i. define poultry keeping

ii. identify types of poultry management systems.

iii explain the importance of poultry management systems

iv identify different types of poultry management practices in Nigeria.

- **Pre-requisite/Previous Knowledge**: Pupils have learnt much about some concepts of poultry

- **Learning materials**: Entrepreneurship-Based Project Approach Training Manual on Poultry and its Work Book

- **Reference**: Mohammed, I.B. (2015).Entrepreneurship-based Project Approach Training Manual on Poultry Pp 1-6

-**Introduction**

**Teacher's activity**:

The teacher asks questions leading to achievement of learning objectives (See Table iii)

**Students' activity**:

Students respond to teacher's questions (See Table iii)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares learners into group

- The teacher asks learners questions as stated below (See table)

**Table iii** **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's Activity** |
|---|---|
| **Introduction:** (question/instruction)<br>1. What is poultry?<br>2. State the importance of poultry keeping in Nigeria<br><br>**Development**<br>The teacher present the lesson based on the following steps:<br>Step i. Poultry keeping.<br>Step ii: Types of poultry management systems.<br>Step iii: Importance of poultry management systems.<br>Step iv: Different types of poultry management practices in Nigeria.<br>**Evaluation (Question/instruction)**<br>The teacher evaluate the lesson by asking the following questions:<br>i : Define poultry keeping ?<br><br>ii: State types of poultry management systems?.<br><br>iii: Mention the importance of poultry management systems?<br><br>iv: List three different types of poultry management practices or enterprises in Nigeria.?<br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br>**Assignment Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br>**1.** Poultry keeping is an act of keeping domestic birds<br>2. Poultry are managed for the following purpose: i. meat production .ii, eggs production iii. Source of employment v. source of income<br>**Development (expected response/answer)**<br><br>1. Poultry keeping is an act of keeping domestic birds<br>2. i. Extensive management system<br>ii..Intensive management system<br>3. Poultry are managed for the following purpose: I meat production .ii, eggs production iii. Source employment v. source of income<br>4. The types of poultry enterprises are :<br>i. meat production enterprises<br>ii. Physical facility enterprises<br>ii. Medication enterprises<br>iii. feed mills enterprises<br>iv. Breeding hatchery production<br>v. product marketing enterprises<br><br>**Assignment Take Home Project**<br>List five recommendations required by poultry production in Nigeria<br>Draw three different breeds of poultry |

**FORTH WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Poultry)

-**Model of Teaching**: Project-based Approach.

**-Group** :Experimental

- **Topic**: Poultry Production

- **Sub-topic**: Poultry Production Practice in Nigeria

**-Class**: SS2

-**Number of students**: 60

- **Date** :

- **Duration of lesson**: 2 hrs forth week

- **Rationale**: Raise domestic fowl at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. identify suitable poultry house

ii. state importance of housing poultry

iii. list type of poultry housing

iv. construct poultry housing and its equipment

- Pre-**requisite**/**Previous Knowledge**: Student have learnt much about some concepts of poultry

- **Learning materials**: Cage domesticated fowl Manual

- **Reference**: Mohammed, I.B.(2015). Ditto, poultry Manual Pg 7-22

Introduction:

**Teacher's Activity**

- The teacher briefly review the previous lesson

- The teacher ask questions leading to achievement of learning objectives (see Table iv)

**Student' Activity**

-Students respond to teacher's questions (see Table iv)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares Students into group

**Table iv** **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's Activity** |
|---|---|
| **Introduction:** (question/instruction)<br><br>- List why housing is necessary for domestic fowl?<br>- List type of poultry housing system<br>**Development**<br>Step i. List of suitable poultry housing system<br>Step ii Importance of poultry housing?.<br>Step iii. Types of poultry housing?<br>Step iv Types of equipment that can be found in poultry house?<br><br>**Evaluation (Question/instruction)**<br>i. List suitable poultry housing system?<br><br>ii State the importance of poultry housing?.<br><br>iii. List type of poultry housing?<br><br>iv List some equipment that can be found in poultry house?<br><br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br><br>**Assignment /Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br><br>1. Protect birds against predatory attack<br>- prevent disease infestation<br>- Maintain genetic quality of bird<br>2. Free range, semi intense, battery cage<br><br>**Development (expected response/answer)**<br><br>1.Intensive housing system is the most suitable housing system<br>2.Importance of poultry housing<br>Poultry housing provide the following:<br><br>i. Protection against predating attack<br>ii. Protection from harsh weather<br>iii. Provision of enough space<br>iv. Provision of adequate ventilation<br>v. Provision of clear environment<br>3. Type of poultry housing<br>i. Free range – Expletive system<br>ii. Semi intensive<br>iii. Slated flour type<br>iv. Deep litter system<br>v. Intensive system<br>vi. Battery cage system<br>4. Poultry house equipment:- Water trough, feeding trough, bucket, perches, nest saw dust, broom, etc.<br>**Assignment /Take Home Project**<br>Construct chick poultry house |

**FIFTH WEEK**

**Subject**: Biology for Entrepreneurship/Trade (Poultry)

-**Model of Teaching**: Project-based Approach .

**-Group** :Experimental

- **Topic**: Domestic bird Production

**-Sub-topic**: Type of Domestic Bird Production

**-Class**: SS2

-**Number of Students**:60

- **Date** :

- **Duration** of lesson: 2 hrs fifth week

- **Rationale**: To be able to raise domestic bird of different types at home.

**Learning objectives**: By the end of the lesson Students should be able to:

i. demonstrate poultry housing by type

ii. demonstrate broilers management practice

iii. demonstrate pullet and chick management practice

iv demonstrate layer management practice

- **Pre-requisite/Previous Knowledge**: Students have learnt much about some concepts of poultry

- **Learning materials**: Teaching manual on poultry

- **Reference**: Ditto Pg 23-28

**Introduction**

**Teacher's Activity**

- The teacher briefly review the previous lesson

- The teacher asks questions leading to achievement of learning objectives (see table v)

**Student's Activity**

-Students respond to teacher's questions (see table v)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares Students into group

**Table v** **LESSON DEVELOPMENT**

| Teacher's activity | Student's activity |
|---|---|
| **Introduction: (question/instruction)**<br>- List different housing practices in poultry?<br>**Development**<br>Step i. List of equipment and housing type of broiler production<br><br>Step ii List of equipment and housing type of pullet and chick<br><br>Step iii. List of equipment/requirement of layers for management practice<br><br>**Evaluation (Question/instruction)**<br>i. List equipment and housing type of broiler production?<br><br>ii List equipment and housing type of pullet and chick?<br><br>iii. List equipment/requirement of layers for management practice?<br><br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br><br>**Assignment /Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br>Free range, battery cage, deep littered system, slatted poultry system.<br>**Development (expected response/answer)**<br><br>See manual pg 24, 25, for poultry management practice of all age different<br>1.List of equipment and housing type of broiler production.<br>i. Brooding box ii. Kerosene lamp iii. Broom iv. Shovel. v. wheel barrow vi .chick feeder and drinker. Vii. water jar/ tank viii. Feed scoop ix bucket x. record book xi. Izal<br>ii List of equipment and housing type of pullet and chick.<br>.i. Brooding box ii. Kerosene lamp iii. Broom iv. Shovel. v. wheel<br>barrow vi .chick feeder and drinker. Vii .water jar/ tank viii. Feed scoop ix bucket x. record book xi. Izal xii. Perches<br>iii. List of equipment/requirement of layers for management practice<br>.i. Nest ii. Egg rack and tray iii. Broom iv. Shovel. v. wheel<br>barrow vi .chick feeder and drinker. vii. water jar/ tank viii. Feed scoop ix bucket x. record book xi. Izal xii. Perches xii weighing scale xiv Jute sack loaded with litter material.<br>**Assignment /Take Home Project**<br>Demonstrate chick management practice in Nigeria using low or no-cost materials. |

**SIXTH WEEK**

**-Subject**: Biology for Entrepreneurship/Trade (Poultry)

-**Model of Teaching**:; Project-based Approach .

**-Group** :Experimental

- **Topic**: Broiler Management Domestic Birds Production

- **Date**

- **Duration** of lesson: 2 hrs sixth week

-**Sub-topic**: Broiler Management Production

**Class**: SS2

**Number of Students**:60

**Learning objectives**: By the end of the lesson Students should be able to:

i. Identify the suitable housing for poultry

ii. Practice broiler management practice

iii. List equipment requirement for broiler

- **Rationale**: Provide adequate protein level for teaming production

- **Pre-requisite/Previous Knowledge**: Students have learnt housing type and its facilities

- **Learning materials**: Poultry manual

- **Reference**: Ditto poultry manual Pg 26

**Introduction**

**Teacher's Activity**

- The teacher briefly review the previous lesson

- The teacher asks questions leading to achievement of learning objectives (See Table vi)

**Student's Activity**

-Students respond to teacher's questions (See Table vi)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares students into group

Table vi **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's activity** |
|---|---|
| **Introduction:** (question/instruction)<br>-List type of housing in poultry and list the facilities?<br>**Development**<br>Step .i. List of suitable housing type for keeping broilers.<br><br>Step ii Procedure for broiler management.<br><br>Step iii. List of equipment required in broiler management.<br><br>**Evaluation (Question/instruction)**<br>i. List suitable housing type for keeping broilers?<br>ii Demonstrate the procedure for broiler management?<br>iii.List equipment required in broiler management?<br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br>**Assignment /Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br>- Free range, cage, water trough<br>- Battery cage – cage, water receptacle, feeding trough<br>- Deep littered system – litter, nest, perch, feeding trough, water trough etc.<br>**Development (expected response/answer)**<br>1. Housing type:- well ventilated housing type (cage). Also adequate temperature provision house for chicks.<br>2. See manual for detail pg 26 – 29.<br>**3.** Feeding trough, drinkers, litter materials, kerosene lamp, broom, shawls disinfectant, bucket, record book.<br>**Assignment /Take Home Project**<br>List type of housing and facilities for layer management<br>Construct chick feeder and water trough for layers |

**SEVENTH WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Poultry)
- -**Model of Teaching**; Project-based Approach .
-**Group** :Experimental
- **Topic**: Pullet Management
-**Sub**-topic: Pullet Management
-**Class**: SS2
- **Number of Students**: 60
- **Date** :
- **Duration** of lesson: 2 hrs seventh week
- **Rationale**: Students should be able to raise pullets at home
- **Learning objectives**: By the end of the lesson teachers should be able to:
    i. Carryout feeding practice and feed of pullets
    ii. List equipment on pullets house
    iii. Demonstrate Practice debeaking of pullets
- **Pre-requisite/Previous Knowledge**: Student have learnt housing type and its facilities
- **Learning materials**: Text books, manual on Poultry
- **Reference**: Ditto poultry manual Pg 29-31

**Introduction**

**Teacher's Activity**

- The teacher briefly review the previous lesson
- The teacher asks questions leading to achievement of learning objectives (See Table vii)

**Student's Activity**

-Student respond to teacher's questions (See Table vii)

**Presentation**:

**Teacher's Activity**:

-The teacher prepares Students into group

**Table vii** **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's Activity** |
|---|---|
| **Introduction:** (question/instruction)<br><br>- List some equipment found in broiler house?<br>**Development**<br>Step i. Types of feed used in feeding pullet.<br><br>Step ii Required equipment found in pullet house<br><br>Step iii. Debeaking procedure in pullet?<br><br>Step iv. Importance of debeaking<br><br>**Evaluation (Question/instruction)**<br>i. Which type of feed is use to feed pullet?<br><br>ii What are equipment found in pullet house?<br>iii.Describe debeaking procedure in pullet?<br>iv Enumerate the importance of debeaking?<br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br><br>**Assignment/Take Home Project**<br>Teacher write assignment on chalk board | **Introduction: (Expected response/answer)**<br><br>- Bucket, feeder, water trough, lamp litter, etc<br>**Development (expected response/answer)**<br><br>1. After been fed with chick mash from 0 – 8 weeks, growers mash will be introduced from 8weeeks to point of layering, feed the birds with the required mash,<br>Feeding management practice is spelt out to include, feed them regularly.<br><br>2. The equipment found in pullet house is same as that of broiler aforementioned.<br><br>3. Cutting the edge of bird beak using knife, scissors.<br><br>4. The importance of debeaking it reduce mortality of bird, reduces egg peaking, reduces feed wastage.<br>**Assignment /Take Home Project**<br>Demonstrate debeaking procedure in pullet .<br>Prepare layer mash considering feed formulation of layers |

**EIGHTH WEEK**

**Subject**: Biology for Entrepreneurship/Trade (Poultry)

-**Model of Teaching**:; Project-based Approach .

**-Group** :Experimental

- **Topic**: Hatchery Management

-**Sub-topic**: Hatchery Practice in Poultry Management

-**Class**: SS2

- **Number of Students**: 60

- **Date** :

- **Duration** of lesson: 2 hrs

- **Rationale**: Students would be able hatch chicks at home

-**Learning objectives**: By the end of the lesson Students should be able to:

i. demonstrate hatchery management practice in poultry

ii. carryout chick handling practice.

iii practice poultry sexing , culling and vaccination

iv carryout chick transportation

v. demonstrate factors affecting egg hatchability and fertility in poultry

- Pre-**requisite**/**Previous Knowledge**: Students have learnt layer management

- **Learning materials**: Text books and Poultry manual

- Reference: Ditto poultry manual

**Introduction**

**Teacher's Activity**

- The teacher briefly review the previous lesson

- The teacher asks questions leading to achievement of learning objectives (See Table viii)

**Student's Activity**

- Students respond to teacher's questions (See Table viii )

**Presentation**:

**Teacher's Activity**:

-The teacher prepares students into group

**Table viii** **LESSON DEVELOPMENT**

| **Teacher's activity** | **Student's Activity** |
|---|---|
| **Introduction:** (question/instruction)<br>I . Which type of feed is use to feed pullet?<br>**Development**<br>Step i. demonstrate hatchery management practice in poultry<br><br>Step ii. carryout chick handling practice.<br><br>Step iii, practice poultry sexing , culling and vaccination<br><br>Step iv. carryout chick transportation<br><br>Step v. demonstrate factors affecting egg hatcerbility and fertility in poultry.<br><br>**Evaluation (Question/instruction)**<br>i. what are the requirement for hatchery management practice in poultry?<br><br>ii. what a re the method s used in chick handling practice.?<br><br>iii what are the ways used in practicing poultry sexing , culling and vaccination? | **Introduction: (Expected response/answer)**<br>I, After been fed with chick mash from 0 – 8 weeks, growers mash will be introduced from 8weeeks to point of layering, feed the birds with the required mash.<br>**Development (expected response/answer)**<br>**1** provision of hatchery buildings<br>**2** provision of adequate hatchery equipment<br>1. Chick handling practice<br>- Transfer chick from incubator within 12hours after been hatched.<br>-Pull out chick and process them into chick boxes .<br>-Remove the healthy chick from the hatching tray.<br>-Count and record the marketable chicks.<br>-Vaccinate before transporting the chicks<br>3. culling is the removing of the unhealthy chick from the hatching tray<br>Vaccination is carried out on routine basis see the poultry manual pages 81-89,<br>4 chick transportation is using chick box rack |

| | |
|---|---|
| Iv describe the ways used in chick transportation?<br><br>v. Explain factors affecting egg hatcherbility and fertility in poultry ?<br><br>**Conclusion:** The teacher concludes the lesson by highlighting the main points.<br><br>**Assignment/Take Home Project**<br>Teacher write assignment on chalk board | before chick leaves hatchery ensure that<br>-record of the breed is taken.<br>- provide adequate ventilation.<br>-vaccinate the chick<br>-Provide the customer with adequate record of the chicks.<br>-it customary to give 2p4 extra chicks per box in case of mortality<br>5. Factors affecting egg hatcherbility and fertility in poultry are:<br>- Physical defects<br>- hereditary defects<br>- Handling and storage<br>- Cleaning of shells<br>- Turning of eggs<br>- Eggs candling-<br>**Assignment /Take Home Project**.<br>Construct egg candling device<br>Construct kerosene incubator and egg tray |

**CONTROL GROUP LESSON PLAN**

**FIRST WEEK**

**-Subject**: Biology for Entrepreneurship/Trade (Fishery)

- **Model of Teaching:** Lecture Method

**-Group;** Control

- **Topic**: Fish Production Management

**-Sub-topic**: Fish Management Practice

**-Class**: SS2

- **Date** :

- **Duration of lesson**: 2hrs

**Number of students**: 60

- **Rationale**: To practice fish production at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. Practice fish management practice

ii. Identify twelve commandments of fish management practices

- **Pre-requisite/Previous Knowledge**: Learners have learnt fish morphology in Biology

- **Learning materials**: Manual for fish production

- **Reference**: Mohammed, I.B. (2015).Entrepreneurship-based Project Approach Training Manual on Fishery Pp 1-3

**-Introduction**

The teacher asks questions leading to achievement of learning objectives:

3. List type of fish you know?
4. List some morphological features of fish?
5. List type of fish pond in Nigeria?

Students respond to teacher's questions

**Presentation**:

- The teacher presents the lesson as follows:

**Lesson Development**

Step i. State some good fish pond management practices

Step ii State twelve commandments of fish practice

**Evaluation (Question/instruction)**

i. List some fish pond management?

ii State twelve commandments of fish practice ?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**SECOND WEEK**

- **Subject**: Entrepreneurship/Trade (Fishery)
- **Model of Teaching :** Lecture Method
-**Group;** Control
- **Topic**: Pond Construction
- **Date** :
- **Duration of lesson**: 2hrs
-**Sub-topic**: Site Selection and construction of Fish Pond
-**Class**: SS2

**Number of students:** 60

- **Rationale**: Construct suitable fish pond at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. select suitable site for fish pond

ii. identify type of fish pond

iii. identify requirements for constructing fish pond

iv. practice fertilization and liming of fish pond construction before stocking

- Pre-**requisite**/**Previous Knowledge**: Students have learnt monopoly of fish in Biology
- **Learning materials**: Tarpaulin, wood pond, basin
- **Reference**: Ditto Fishery Manual pg4-9

-**Introduction**:

The teacher asks questions leading to achievement of learning objective.

4. List type of soil?
5. List type of land forms?
6. List requirements for establishing fish pond ?

Students respond to teacher's questions

**Presentation**:

- The teacher presents the lesson as follows:

**Lesson Development**

Step i. Requirements needed for selecting suitable site for fish pond

Step ii Types of fish pond

Step iii. Requirement for fish pond construction

Step iv Fertilization and liming practices in fish pond.

**Evaluation (Question/instruction)**

i. List requirements needed for selecting suitable site for fish pond?

ii List type of fish pond?

iii. Outline the requirement for fish pond construction?

iv. Demonstrate fertilization and liming practices in fish pond.

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**THIRD WEEK**

- **Subject**: Biology of Entrepreneurship/Trade (Fishery)
- **Model of Teaching :** Lecture Method
-**Group;** Control
- **Topic**: Water Quality and Maintenance

**Sub-topic**: Water Quality and Maintenance

**Class**: SS2

- **Date** :
- **Duration of lesson**: 2hrs

**Number of Students**: 60

- **Rationale**: To identify suitable water in culturing fish at home,

**Learning objectives**: By the end of the lesson Students should be able to:

i. carryout ways of monitoring good water quality

ii . monitor water quality of fish pond

iii. identify the parameters of good water quality

- **Pre-requisite/Previous Knowledge**: The Students have learnt selection of suitable area for fish pond construction

- **Learning materials**: Water, sample pictures

- **Reference**: Manual pp.19-21

-**Introduction**:

The teacher asks questions leading to achievement of learning objectives.

1. List some of the requirements for selecting suitable land for fish pond?

Learners respond to teacher's questions.

**Presentation**:

- The teacher presents the lesson as follows:

**Lesson Development**

Step i. Requirements for good water fish pond culturing

Step ii Water that is not suitable for stocking fish

Step iii. Parameters of good water for fish culturing.

**Evaluation (Question/instruction)**

i. State the requirement for good water fish pond culturing?

ii What do you observe with water that is not suitable for stocking fish?

iii. State the parameters of good water for fish culturing ?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**FORTH WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Fishery)

- **Model of Teaching :** Lecture Method

-**Group;** Control

- **Topic**: Fish Stocking

**Sub-topic**: Stocking of Fish

-**Class**: SS2

- **Date** :

- **Duration of lesson**: 2hrs

**-Number of Students**: 60

- **Rationale**: To be able to stock fish of different type in fish pond at home

**Learning objectives**: By the end of the lesson Students should be able to:

i. demonstrate fish stocking techniques

ii. state the recommendations for fish stocking

iii, practice the techniques involved in stocking fish in pond.

iv. list type of fish for stocking

- Pre-**requisite**/**Previous Knowledge**: Students have learnt water quality and maintenance in pond

- **Learning materials**: Bucket, Jerry can, fishery manual

- **Reference**: Ditto Fishery Manual pg30-34

**-Introduction**

The teacher asks questions leading to achievement of learning objectives

1. What is stocking of fish?
2. List any suitable species of fish to be stocked in pond

Learners respond to teacher's questions.

**Presentation**:

- The teacher presents the lesson as follows:

**Lesson Development**

Step i. Procedures of stocking fish.

Step ii Recommendations of stocking fish in a pond.

Step iii. Types of fish species for stocking.

**Evaluation (Question/instruction)**

i. State the procedures involve in stocking fish?

ii State the recommendation of stocking fish in a pond?

iii. List type of fish species for stocking

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**FIFTH WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Fishery)

- **Model of Teaching :** Lecture Method

**-Group;** Control

- **Topic**: General fish hatchery

**-Sub-topic**: Hatchery of Tilapia species

**-Class**: SS2

- **Date** :

- **Duration** of **lesson**: 2hrs

**-Number of Students**: 60

- **Rationale**: Students should be able to carry out hatchery of fish at home.

- **Learning objectives**: by the end of the lesson teachers should be able to:

i. Identify the hatchery equipment

ii. List fish rearing facilities in hatchery

iii. Demonstrate tilapia seed production in hatchery

- **Pre-requisite/Previous Knowledge**: The Students have learnt procedure of stocking fish in pond

- **Learning materials**: Text book, Fishery Manual

- **Reference**: Ditto Fishery Manual pg35-49.

**-Introduction:**

The teacher asks questions leading to achievement of learning objectives:

1. What is hatchery?

Students respond to teacher's questions

**Presentation**:

- The teacher presents the lesson as follows:

**Lesson Development**

i. Fish equipment in hatchery

ii. Fish rearing facilities.

**Evaluation (Question/instruction)**

i. List fish equipment in hatchery?

ii List fish rearing facilities?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**SIXTH WEEK**

**Subject**: Biology for Entrepreneurship/Trade (Poultry)

- **Model of Teaching :** Lecture Method

-**Group;** Control

- **Topic**: General Poultry Management

- **Date** :

- **Duration of lesson**: 2hrs

-**Sub-topic**: Fish management practice

-**Class**: SS2

- **Number of students**: 60

-**Learning objectives**: By the end of the lesson Students should be able to:

i. define poultry keeping

ii. Identify types of poultry management systems.

iii explain the important of poultry management systems

iv identify different types of poultry management practices in Nigeria.

- **Pre-requisite/Previous Knowledge**: Student have learnt much about some concepts of poultry

- **Learning materials**: Entrepreneurship-Based Project Approach Training Manual on Poultry and its Work Book

- **Reference**: Mohammed, I.B.(2015).Entrepreneurship-based Project Approach Training Manual on Poultry Pp 1-6

-**Introduction**

The teacher asks questions leading to achievement of learning objectives

6. What is poultry?
7. State the importance of poultry keeping in Nigeria.

**Lesson development/Presentation**:

The teacher presents the lesson based on the following steps:

Step i. Poultry keeping.

Step ii: Types of poultry management systems.

Step iii: Importance of poultry management systems.

Step iv: Different types of poultry management practices in Nigeria.

**Evaluation (Question/instruction)**

The teacher evaluate the lesson by asking the following questions:

i : Define poultry keeping ?

ii: State types of poultry management systems?.

iii: Mention the importance of poultry management systems?

iv: List three different types of poultry management practices or enterprises in Nigeria.?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**SEVENTH WEEK**

- **Subject**: Entrepreneurship/Trade (Poultry)
- **Model of Teaching :** Lecture Method
-**Group;** Control
- **Topic**: Poultry production
- **Sub-topic**: Poultry production practice in Nigeria
-**Class**: SS2
-**Number of Students**:60
- **Date** :
- **Duration of lesson**: 2 hrs Seventh Week
- **Rationale**: Raise domestic fowl at home

**Learning objectives**: by the end of the lesson Students should be able to:

I. identify suitable poultry house

II. state importance of housing poultry

III. list type of poultry housing

IV construct poultry housing and its equipment

- Pre-**requisite**/**Previous Knowledge**: Pupils have learnt much about some concepts of poultry
- **Learning materials**: Cage domesticated fowl Manual
- **Reference**: Mohammed, I.B.(2015). Ditto, poultry Manual Pg 7-22

**Introduction**:

- The teacher briefly review the previous lesson

- The teacher asks questions leading to achievement of learning objectives.
- List why housing is necessary for domestic fowl?
- List type of poultry housing system

-Students respond to teacher's questions.

**Lesson Development**

Step i. List of suitable poultry housing system

Step ii Importance of poultry housing?.

Step iii. Types of poultry housing?

Step iv Types of equipment that can be found in poultry house?

**Evaluation (Question/instruction)**

i. List suitable poultry housing system?
ii. State the importance of poultry housing?.
iii. List type of poultry housing?
iv List some equipment that can be found in poultry house?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**EIGHTH WEEK**

**Subject**: Entrepreneurship/Trade (Poultry)

- **Model of Teaching :** Lecture Method

-**Group;** Control

- **Topic**: Domestic bird production

-**Sub-topic**: Type of domestic bird production

-**Class**: SS2

-**Number of Students**:60

- **Date** :

- **Duration** of lesson: 2 hrs Eighth week

- **Rationale**: To be able to raise domestic bird of different types at home.

**Learning objectives**: by the end of the lesson Students should be able to:

i.. demonstrate poultry housing by type

ii. demonstrate broilers management practice

iii. demonstrate pullet and chick management practice

iv demonstrate layer management practice

- **Pre-requisite/Previous Knowledge**: Pupils have learnt much about some concepts of poultry

- **Learning materials**: Teaching manual on poultry

- **Reference**: Ditto Pg 23-28

**Introduction**

- The teacher briefly review the previous lesson

- The teacher asks questions leading to achievement of learning objectives

-List different housing practices in poultry?

-Students respond to teacher's question

**Lesson Development**

Step i. List of equipment and housing type of broiler production

Step ii List of equipment and housing type of pullet and chick

Step iii. List of equipment/requirement of layers for management practice

**Evaluation (Question/instruction)**

i. List equipment and housing type of broiler production?

ii. List equipment and housing type of pullet and chick?

iii. List equipment/requirement of layers for management practice?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**NINETH WEEK**

**-Subject**: Biology for Entrepreneurship/Trade (Poultry)

- **Model of Teaching :** Lecture Method

**-Group;** Control

- **Topic**: Broiler management Domestic birds production

- **Date** :

- **Duration** of lesson: 2 hrs Nineth week

-**Sub-topic**: Broiler Management Production

**Class**: SS2

**Number of students**: 60

**Learning objectives**: by the end of the lesson Students should be able to:

i. Identify the suitable housing for poultry

ii. Practice broiler management practice

iii. List equipment requirement for broiler

- **Rationale**: Provide adequate protein level for teaming production

- **Pre-requisite/Previous Knowledge**: Student have learnt housing type and its facilities

- **Learning materials**: Poultry manual

- **Reference**: Ditto poultry manual Pg 26

**Introduction:**

- The teacher briefly review the previous lesson

- The teacher ask questions leading to achievement of learning objectives

  - List type of housing in poultry and list the facilities?

Students respond to teacher's questions.

**Lesson Development**

Step .i. List of suitable housing type for keeping broilers.

Step ii Procedure for broiler management.

Step iii. List of equipment required in broiler management.

**Evaluation (Question/instruction)**

i. List suitable housing type for keeping broilers?

ii Demonstrate the procedure for broiler management?

iii. List equipment required in broiler management?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**TENTH WEEK**

- **Subject**: Biology for Entrepreneurship/Trade (Poultry)
- **Model of Teaching :** Lecture Method
-**Group;** Control
- **Topic**: Pullet Management
-**Sub**-topic: Pullet Management
-**Class**: SS2
- **Number of Studentss**:60
- **Date** :
- **Duration of lesson**: 2 hrs tenth week
- **Rationale**: Students should be able to raise pullet at home
- **Learning objectives**: by the end of the lesson teachers should be able to:

i. Carryout feeding practice and feed of pullet

ii. List equipment on pullet house

iii. Demonstrate Practice debeaking of pullet

- **Pre-requisite/Previous Knowledge**: Student have learnt housing type and its facilities
- **Learning materials**: Text books, manual on Poultry
- **Reference**: Ditto poultry manual Pg 29-31

**Introduction**

**Teacher's Activity**

- The teacher briefly review the previous lesson
- The teacher ask questions leading to achievement of learning objectives.
    - List some equipment found in broiler house?

Students respond to teacher's questions (see table below )

**Lesson Development**

Step i. Types of feed used in feeding pullet.

Step ii Required equipment found in pullet house

Step iii. Debeaking procedure in pullet?

Step iv. Importance of debeaking

**Evaluation (Question/instruction)**

i. Which type of feed is use to feed pullet?

ii. What are equipment found in pullet house?

iii. Describe debeaking procedure in pullet?

iv Enumerate the importance of debeaking?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

**ELEVENTH WEEK**

**Subject**: Biology for Entrepreneurship/Trade (Poultry)

- **Model of Teaching :** Lecture Method

-**Group;** Control

- **Topic**: Hatchery Management

-**Sub-topic**: Hatchery Practice in Poultry Management

-**Class**: SS2

- **Number of Students** :60

- **Date** :

- **Duration of Lesson**: 2 hrs eleventh week

- **Rationale**: Students would be able hatch chicks at home

**-Learning objectives**: by the end of the lesson Students should be able to:

i. demonstrate hatchery management practice in poultry

ii. carryout chick handling practice.

Iii practice poultry sexing , culling and vaccination

iv carryout chick transportation

v. demonstrate factors affecting egg hatchability and fertility in poultry

- Pre-**requisite**/**Previous Knowledge**: Student have learnt layer management

- **Learning materials**: Text books and Poultry manual

- Reference: Ditto Poultry Manual

Introduction:

- The teacher briefly review the previous lesson

- The teacher ask questions leading to achievement of learning objectives:

-Students respond to teacher's questions (see table

I . Which type of feed is use to feed pullet?

**Lesson Development**

Step i. demonstrate hatchery management practice in poultry

Step ii. carryout chick handling practice.

Step iii, practice poultry sexing , culling and vaccination

Step iv. carryout chick transportation

Step v. demonstrate factors affecting egg hatchability and fertility in poultry.

**Evaluation (Question/instruction)**

i. what are the requirement for hatchery management practice in poultry?

ii. what a re the method s used in chick handling practice.?

iii what are the ways used in practicing poultry sexing , culling and vaccination? Iv describe the ways used in chick transportation?

v. Explain factors affecting egg hatchability and fertility in poultry ?

**Conclusion:** The teacher concludes the lesson by highlighting the main points.

# DEPARTMENT OF SCIENCE EDUCATION

## AHMADU BELLO UNIVERSITY ZARIA

*Vice Chancellor:* ***Professor Abdullahi Mustapha*** *B.Sc(Hons)Pharm(ABU), Ph.D(London) FPSN*
*Head of Department:* ***Dr. Mamman Musa*** *B.Ed, M.Ed, Ph.D (ABU, FMAN, FANE, DAC.*

***Your Ref:***

***Our Ref:*** DSE/R/I/Vol.1

***Date:*** 4/2/2013

Dear Sir/Madam,

**AN INTRODUCTORY LETTER TO ACCESS RESEARCH DATA**

The bearers, MOHAMMED IBRAHIM BALA with Reg. Nos. Ph.D/EDu/12431/2011-12.

~~are~~ our ~~B.Sc(Ed)~~ Ph.D SCIENCE EDUCATION students at ~~his~~ Ph.D level who ~~are~~/is conducting a research on the topic: EFFECTS OF PROJECT APPROACH AND DIAGNOSTIC ADAPTIVE TESTING SKILLS ON TEACHING ENTREPRENEURSHIP CONCEPTS OF BIOLOGY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN NIGER STATE, NIGERIA.

Please accord them every necessary assistance they require to build on to be able to usefully contribute their quota to knowledge.

Yours faithfully,

P.G. SCIENCE EDUCATION DATE

**Dr. Mamman Musa**
Head, Science Education Department

# NIGER STATE SECONDARY EDUCATION BOARD

Office of the Executive Chairman
Private Mail Bag No. 61,
Minna,
Niger State of Nigeria.

Our Ref: NSSEB/GEN/686/VOL.T/26

Date: 12th - 03 - 015

Your Ref:

The Principal,
DAY SECONDARY SCHOOL
KUSHI

**RE: ACCESSING RESEARCH DATA FROM SOME SECONDARY SCHOOLS IN NIGER STATE**

With reference to a letter dated 26th November, 2014 on the above **Subject-Matter**, I write to recommend the bearer MOHAMMED IBRAHIM BALA (Ph.d Science Education) from AHMADU BELLO UNIVERSITY, Zaria to pursue his Research Data at your school(s) on ***Effects of Project Approach And Diagnostic Adaptive Testing Skills On Teaching Entrepreneurship Concepts on Biology Among Senior Secondary School Students In Niger State, Nigeria, Please.***

2. Thanks.

Chairman
Niger State Secondary Education Board
P. M. B. 61, Minna

HAJ. BILKISU .Y. NDANUSA
*EXECUTIVE CHAIRMAN*

16/3/15

Faculty of Education,
Department of Science Education,
Ahmadu Bello University,
Zaria.

23rd May, 2015.

_____

_____

_____

Dear Sir,

**VALIDATION OF RESEARCH INSTRUMENTS**

I am writing a Ph.D Dissertation Titled Effects of Project –based Appproch Acquisition of Skills, Retention and Performance in Biology among Secondary School Students in Niger State Nigeria. I am developing research instruments design to generate data for my Ph.D dissertation on the teaching Biology for entrepreneurship using the following instruments:

1. Project-based Approach Training Manual on Fishery Production
2. Project –based Approach Training Manual on Poultry Production.
3. Project-Based Approach Producer workbook on fishery production.
4. Project-Based Approach producer workbook on fishery production.
5. Biology Achievement Test
6. Entrepreneurship-Based Skills Acquisition Test
7. Project-Based Approach Test Check List

As an experienced biology teacher in secondary school could you examine and validate all the contents and items of the aforementioned instruments with the regard to the following:

i. Whether the contents and items conform with the subject matter they are suppose to test or not?

ii. Whether the contents and items are clear, readable, free from ambiguity for the level of students they are deisgned to test or not?

iii. Whether the contents and items satisfy the conditions of constructing DATs multiple choice items or not?

iv. Whether the contents and items are tested by the instruments are relevant to and prerequisite to introductory aspect of fishery and poultry production as an entreneurship study in secondary school.

v. Any general criticism and suggestions that could be made for the improvement of the instruments.

vi. Proffer solutions or suggestions that would be useful in improving the contents and itmes quality.

Thanks for the anticipated cooperation.

Yours faithfully,

**MOHAMMED Ibrahim Bala**

## POULTRY DATS 1 ITEM ANALYSIS

| | | | Item Difficulty | Item Discrimination | | | | Item Difficulty | Item Discriminatio |
|---|---|---|---|---|---|---|---|---|---|
| Item No. | Upper (U) | Lower (L) | $\frac{U+L}{N}$ | $\frac{U-L}{{}^1/_2N}$ | Item No. | Upper (U) | Lower (L) | $\frac{U+L}{N}$ | $\frac{U-L}{{}^1/_2N}$ |
| 1 | 2 | 4 | 0.60 | 0.20 | 26 | 2 | 1 | 0.30* | 0.10 |
| 2 | 5 | 1 | 0.60 | 0.50 | 27 | 5 | 2 | 0.70 | 0.30 |
| 3 | 4 | 2 | 0.60 | 0.30 | 28 | 1 | 2 | 0.30* | 0.10 |
| 4 | 4 | 1 | 0.50 | 0.30 | 29 | 4 | 1 | 0.50 | 0.30 |
| 5 | 5 | 1 | 0.60 | 0.40 | 30 | 5 | 1 | 0.60 | 0.40 |
| 6 | 5 | 1 | 0.60 | 0.40 | 31 | 1 | 5 | 0.60 | 0.40 |
| 7 | 3 | 1 | 0.40 | 0.20 | 32 | 4 | 2 | 0.60 | 0.20 |
| 8 | 5 | 2 | 0.70 | 0.30 | 33 | 1 | 3 | 0.40 | 0.20 |
| 9 | 4 | 1 | 0.50 | 0.30 | 34 | 2 | 5 | 0.70 | 0.30 |
| 10 | 2 | 5 | 0.70 | 0.20 | 35 | 6 | 1 | 0.70 | 0.50 |
| 11 | 4 | 1 | 0.50 | 0.30 | 36 | 1 | 2 | 0.50 | 0.20 |
| 12 | 2 | 5 | 0.70 | 0.30 | 37 | 5 | 2 | 0.70 | 0.30 |
| 13 | 5 | 2 | 0.70 | 0.30 | 38 | 5 | 2 | 0.70 | 0.10 |
| 14 | 5 | 2 | 0.60 | 0.30 | 39 | 4 | 1 | 0.50 | 0.30 |
| 15 | 2 | 5 | 0.70 | 0.30 | 40 | 4 | 2 | 0.60 | 0.20 |
| 16 | 4 | 1 | 0.50 | 0.30 | 41 | 5 | 2 | 0.70 | 0.30 |
| 17 | 1 | 5 | 0.60 | 0.40 | 42 | 2 | 1 | 0.30* | 0.10 |
| 18 | 2 | 5 | 0.70 | 0.30 | 43 | 1 | 0 | 0.10* | 0.10 |
| 19 | 1 | 5 | 0.60 | 0.40 | 44 | 2 | 1 | 0.20* | 0.10 |
| 20 | 4 | 1 | 0.50 | 0.30 | 45 | 1 | 2 | 0.30* | 0.10 |
| 21 | 5 | 2 | 0.70 | 0.30 | 46 | 4 | 3 | 0.70 | 0.10 |
| 22 | 5 | 2 | 0.70 | 0.30 | 47 | 2 | 5 | 0.70 | 0.30 |
| 23 | 4 | 2 | 0.60 | 0.20 | 48 | 4 | 3 | 0.70 | 0.10 |
| 24 | 3 | 1 | 0.40 | 0.20 | 49 | 4 | 1 | 0.50 | 0.30 |
| 25 | 1 | 4 | 0.50 | 0.30 | 50 | 5 | 2 | 0.70 | 0.30 |

44 number of question selected without modification.
5 numbers selected with modification
1 number discarded and reconstructed

## POUTRY DATS 2 ITEM ANALYSIS

| Item No. | Upper (U) | Lower (L) | Item Difficulty $\frac{U+L}{N}$ | Item Discrimination $\frac{U-L}{^1/_2N}$ | Item No. | Upper (U) | Lower (L) | Item Difficulty $\frac{U+L}{N}$ | Item Discriminat $\frac{U-L}{^1/_2N}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 4 | 0.50 | 0.30 | 26 | 3 | 5 | 0.40 | 0.20 |
| 2 | 11 | 1 | 0.10* | 0.00 | 27 | 1 | 2 | 0.10* | 0.30 |
| 3 | 4 | 1 | 0.50 | 0.30 | 28 | 4 | 0 | 0.50 | 0.30 |
| 4 | 1 | 5 | 0.60 | 0.40 | 29 | 2 | 1 | 0.70 | 0.30 |
| 5 | 5 | 1 | 0.60 | 0.40 | 30 | 1 | 1 | 0.60 | 0.40 |
| 6 | 2 | 5 | 0.70 | 0.30 | 31 | 11 | 1 | 0.20* | 0.10 |
| 7 | 5 | 1 | 0.60 | 0.40 | 32 | 4 | 1 | 0.60 | 0.20 |
| 8 | 1 | 4 | 0.50 | 0.30 | 33 | 5 | 1 | 0.70 | 0.30 |
| 9 | 2 | 5 | 0.70 | 0.30 | 34 | 1 | 2 | 0.60 | 0.40 |
| 10 | 5 | 2 | 0.70 | 0.30 | 35 | 5 | 5 | 0.70 | 0.30 |
| 11 | 5 | 2 | 0.70 | 0.30 | 36 | 1 | 0 | 0.10* | 0.10 |
| 12 | 4 | 2 | 0.60 | 0.20 | 37 | 4 | 1 | 0.50 | 0.30 |
| 13 | 1 | 1 | 0.20* | 0.00 | 38 | 5 | 1 | 0.60 | 0.40 |
| 14 | 5 | 2 | 0.70 | 0.30 | 39 | 5 | 1 | 0.60 | 0.40 |
| 15 | 2 | 5 | 0.70 | 0.30 | 40 | 3 | 1 | 0.40 | 0.20 |
| 16 | 5 | 2 | 0.70 | 0.30 | 41 | 3 | 1 | 0.40 | 0.20 |
| 17 | 5 | 1 | 0.60 | 0.40 | 42 | 4 | 2 | 0.60 | 0.20 |
| 18 | 4 | 1 | 0.50 | 0.30 | 43 | 1 | 5 | 0.60 | 0.40 |
| 19 | 1 | 1 | 0.20* | 0.10 | 44 | 1 | 5 | 0.60 | 0.40 |
| 20 | 2 | 4 | 0.60 | 0.20 | 45 | 4 | 1 | 0.50 | 0.30 |
| 21 | 3 | 1 | 0.40 | 0.20 | 46 | 1 | 1 | 0.20* | 0.10 |
| 22 | 5 | 2 | 0.70 | 0.30 | 47 | 4 | 1 | 0.50 | 0.30 |
| 23 | 2 | 5 | 0.70 | 0.30 | 48 | 2 | 5 | 0.70 | 0.30 |
| 24 | 1 | 4 | 0.50 | 0.30 | 49 | 5 | 2 | 0.70 | 0.30 |
| 25 | 2 | 4 | 0.60 | 0.20 | 50 | 4 | 1 | 0.50 | 0.30 |

- 43 without modification
- 7 with modification

## FISHERY DATS 1 ITEM ANALYSIS

| Item No. | Upper (U) | Lower (L) | Item Difficulty $\frac{U+L}{N}$ | Item Discrimination $\frac{U-L}{\frac{1}{2}N}$ | Item No. | Upper (U) | Lower (L) | Item Difficulty $\frac{U+L}{N}$ | Item Discriminatio $\frac{U-L}{\frac{1}{2}N}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 2 | 0. 60 | 0.20 | 26 | 5 | 2 | 0.70 | 0.30 |
| 2 | 4 | 1 | 0. 50 | 0.30 | 27 | 2 | 5 | 0.70 | 0.30 |
| 3 | 5 | 2 | 0. 70 | 0.30 | 28 | 5 | 1 | 0.60 | 0.40 |
| 4 | 2 | 5 | 0. 70 | 0.30 | 29 | 4 | 1 | 0.50 | 0.30 |
| 5 | 4 | 2 | 0. 60 | 0.20 | 30 | 4 | 2 | 0.60 | 0.20 |
| 6 | 1 | 5 | 0. 60 | 0.40 | 31 | 2 | 2 | 0.60 | 0.20 |
| 7 | 5 | 2 | 0. 70 | 0.30 | 32 | 4 | 4 | 0.50 | 0.30 |
| 8 | 3 | 1 | 0. 40 | 0.20 | 33 | 4 | 4 | 0.50 | 0.30 |
| 9 | 4 | 2 | 0. 60 | 0.20 | 34 | 0 | 0 | 0.20* | 0.10 |
| 10 | 5 | 1 | 0. 60 | 0.40 | 35 | 1 | 1 | 0.20* | 0.33 |
| 11 | 4 | 1 | 0. 50 | 0.30 | 36 | 3 | 3 | 0.20 | 0.20 |
| 12 | 5 | 2 | 0. 70 | 0.30 | 37 | 5 | 5 | 0.70 | 0.30 |
| 13 | 1 | 4 | 0. 50 | 0.30 | 38 | 4 | 4 | 0.50 | 0.30 |
| 14 | 3 | 1 | 0. 40 | 0.20 | 39 | 4 | 4 | 0.60 | 0.20 |
| 15 | 4 | 1 | 0. 50 | 0.30 | 40 | 3 | 3 | 0.40 | 0.20 |
| 16 | 1 | 5 | 0. 60 | 0.40 | 41 | 5 | 5 | 0.60 | 0.40 |
| 17 | 1 | 5 | 0. 60 | 0.40 | 42 | 5 | 5 | 0.70 | 0.30 |
| 18 | 5 | 2 | 0. 70 | 0.30 | 43 | 4 | 4 | 0.50 | 0.30 |
| 19 | 5 | 1 | 0. 60 | 0.40 | 44 | 5 | 5 | 0.70 | 0.30 |
| 20 | 4 | 1 | 0. 50 | 0.30 | 45 | 4 | 4 | 0.50 | 0.30 |
| 21 | 2 | 5 | 0. 70 | 0.30 | 46 | 2 | 2 | 0.70 | 0.30 |
| 22 | 5 | 2 | 0.70 | 0.30 | 47 | 1 | 1 | 0.60 | 0.40 |
| 23 | 4 | 2 | 0.60 | 0.20 | 48 | 5 | 5 | 0.70 | 0.30 |
| 24 | 3 | 1 | 0.40 | 0.20 | 49 | 1 | 1 | 0.20* | 0.00 |
| 25 | 5 | 2 | 0.70 | 0.30 | 50 | 3 | 3 | 0.50 | 0.20 |

- 47 without modification
- 3 with modification

## FISHERY DATS 2 ITEM ANALYSIS

| | | | Item Difficulty | Item Discrimination | | | | Item Difficulty | Item Discrimination |
|---|---|---|---|---|---|---|---|---|---|
| Item No. | Upper (U) | Lower (L) | $\frac{U+L}{N}$ | $\frac{U-L}{\frac{1}{2}N}$ | Item No. | Upper (U) | Lower (L) | $\frac{U+L}{N}$ | $\frac{U-L}{\frac{1}{2}N}$ |
| 1 | 3 | 1 | 0.40 | 0.20 | 26 | 4 | 2 | 0.60 | 0.20 |
| 2 | 4 | 1 | 0.50 | 0.30 | 27 | 5 | 2 | 0.70 | 0.30 |
| 3 | 1 | 5 | 0.60 | 0.40 | 28 | 3 | 1 | 0.40 | 0.20 |
| 4 | 1 | 5 | 0.60 | 0.40 | 29 | 5 | 2 | 0.70 | 0.30 |
| 5 | 4 | 2 | 0.60 | 0.20 | 30 | 2 | 5 | 0.70 | 0.30 |
| 6 | 3 | 1 | 0.40 | 0.20 | 31 | 3 | 1 | 0.40 | 0.20 |
| 7 | 3 | 1 | 0.40 | 0.20 | 32 | 4 | 1 | 0.50 | 0.30 |
| 8 | 5 | 1 | 0.60 | 0.40 | 33 | 4 | 1 | 0.50 | 0.30 |
| 9 | 5 | 1 | 0.60 | 0.40 | 34 | 5 | 2 | 0.70 | 0.30 |
| 10 | 4 | 1 | 0.50 | 0.30 | 35 | 1 | 5 | 0.60 | 0.40 |
| 11 | 3 | 1 | 0.40 | 0.20 | 36 | 3 | 1 | 0.40 | 0.20 |
| 12 | 5 | 2 | 0.70 | 0.30 | 37 | 4 | 2 | 0.60 | 0.20 |
| 13 | 4 | 1 | 0.50 | 0.30 | 38 | 5 | 2 | 0.70 | 0.30 |
| 14 | 4 | 1 | 0.50 | 0.30 | 39 | 1 | 0 | 0.10* | 0.10 |
| 15 | 5 | 2 | 0.70 | 0.30 | 40 | 1 | 5 | 0.60 | 0.40 |
| 16 | 3 | 1 | 0.40 | 0.20 | 41 | 4 | 1 | 0.50 | 0.30 |
| 17 | 1 | 4 | 0.50 | 0.30 | 42 | 2 | 5 | 0.70 | 0.30 |
| 18 | 3 | 1 | 0.40 | 0.20 | 43 | 1 | 4 | 0.50 | 0.30 |
| 19 | 4 | 1 | 0.50 | 0.30 | 44 | 5 | 2 | 0.70 | 0.30 |
| 20 | 5 | 1 | 0.60 | 0.40 | 45 | 4 | 1 | 0.50 | 0.30 |
| 21 | 5 | 1 | 0.60 | 0.40 | 46 | 5 | 2 | 0.70 | 0.30 |
| 22 | 5 | 2 | 0.70 | 0.30 | 47 | 4 | 1 | 0.50 | 0.30 |
| 23 | 4 | 1 | 0.50 | 0.30 | 48 | 2 | 4 | 0.60 | 0.20 |
| 24 | 5 | 2 | 0.70 | 0.30 | 49 | 5 | 2 | 0.60 | 0.30 |
| 25 | 2 | 5 | 0.70 | 0.30 | 50 | 1 | 5 | 0.60 | 0.40 |

- 49 without modification
- 1 with modification

**APPENDIX XX**

**POULTRY AND FISHERY RESEARCH WORK**

**(a)** Students at field trip to poultry house



**(b)** Students observing eggs picking.



## (c) Eggs picking, selection and arrangement by students



## (d) Student individual work assessment



## (e) Group of five students project




## (f) Group D work poultry brooding



**(g)** Fish pond preparation



**(h)** Concrete fish pond maintenance by students



(i) Students individual work = local fish hatchery



(j) Gravid fish for hatchery



(k) Students individual work = constructed wooden fish pond



(l) Group work = construction of wooden fish pond showing water outlet



## (m) Poultry graduating students



## (n) Fishery graduating students



## (o) Graduation ceremony at D.S.S Kutigi



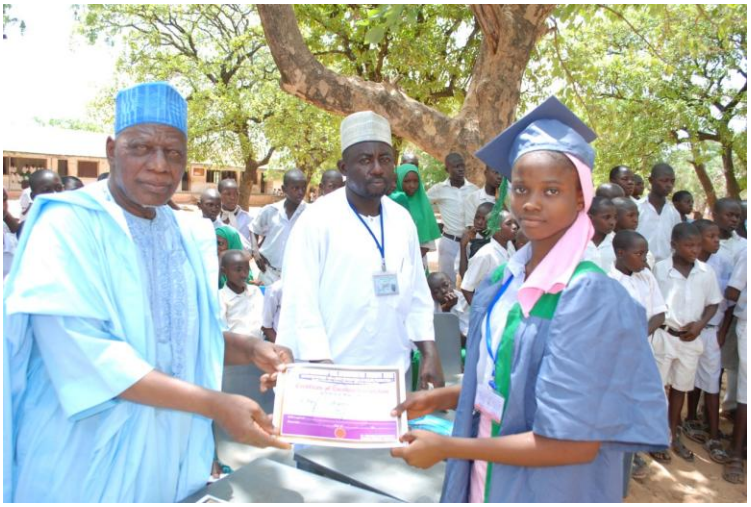

## (p) Inauguration of young farmers club.



(q) Award presentation to fishery students.



(r) Award presentation to poultry students.



## APPENDIX XXI

## ANALYSIS ON HYPOTHESES TESTING

**Test of Homogeneity of Variances**

| | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| PRE- BCET | .521 | 2 | 147 | .595 |
| POST_ BCET | 4.404 | 2 | 147 | .014 |
| POST_POST_ BCET | .117 | 2 | 147 | .890 |
| PRE_SAT | 1.850 | 2 | 147 | .161 |
| POST_SAT | .133 | 2 | 147 | .876 |
| POST_POST_SAT | .173 | 2 | 147 | .841 |
| BAT | .133 | 2 | 147 | .876 |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| PRE- BCET | Between Groups | 123.693 | 2 | 61.847 | .841 | .433 |
| | Within Groups | 10807.140 | 147 | 73.518 | | |
| | Total | 10930.833 | 149 | | | |
| POST_ BCET | Between Groups | 10583.080 | 2 | 5291.540 | 33.219 | .000 |
| | Within Groups | 23415.780 | 147 | 159.291 | | |
| | Total | 33998.860 | 149 | | | |
| POST_POST _ BCET | Between Groups | 15254.973 | 2 | 7627.487 | 85.008 | .000 |
| | Within Groups | 13189.860 | 147 | 89.727 | | |
| | Total | 28444.833 | 149 | | | |
| PRE_SAT | Between Groups | 246.880 | 2 | 123.440 | 1.340 | .265 |
| | Within Groups | 13545.760 | 147 | 92.148 | | |
| | Total | 13792.640 | 149 | | | |
| POST_SAT | Between Groups | 8434.120 | 2 | 4217.060 | 30.993 | .000 |
| | Within Groups | 20001.380 | 147 | 136.064 | | |
| | Total | 28435.500 | 149 | | | |
| POST_POST_SAT | Between Groups | 25654.613 | 2 | 12827.307 | 96.974 | .000 |
| | Within Groups | 19444.460 | 147 | 132.275 | | |
| | Total | 45099.073 | 149 | | | |
| BAT | Between Groups | 8434.120 | 2 | 4217.060 | 30.993 | .000 |
| | Within Groups | 20001.380 | 147 | 136.064 | | |
| | Total | 28435.500 | 149 | | | |

**Robust Tests of Equality of Means**

| | | Statistic[a] | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| PRE- BCET | Welch | .933 | 2 | 97.508 | .397 |
| | Brown-Forsythe | .841 | 2 | 143.822 | .433 |
| POST_ BCET | Welch | 28.777 | 2 | 94.552 | .000 |
| | Brown-Forsythe | 33.219 | 2 | 123.515 | .000 |
| POST_POST_ BCET | Welch | 80.857 | 2 | 97.739 | .000 |
| | Brown-Forsythe | 85.008 | 2 | 145.255 | .000 |
| PRE_SAT | Welch | 1.533 | 2 | 96.794 | .221 |
| | Brown-Forsythe | 1.340 | 2 | 141.453 | .265 |
| POST_SAT | Welch | 31.349 | 2 | 97.878 | .000 |
| | Brown-Forsythe | 30.993 | 2 | 146.316 | .000 |
| POST_POST_SAT | Welch | 102.473 | 2 | 97.137 | .000 |
| | Brown-Forsythe | 96.974 | 2 | 142.933 | .000 |
| BAT | Welch | 31.349 | 2 | 97.878 | .000 |
| | Brown-Forsythe | 30.993 | 2 | 146.316 | .000 |

a. Asymptotically F distributed.

## Post Hoc Tests

**Multiple Comparisons**

| Dependent Variable | | (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|---|
| PRE- BCET | Scheffe | EG1 | EG2 | .620 | 1.715 | .937 |
| | | | CG | -1.540 | 1.715 | .669 |
| | | EG2 | EG1 | -.620 | 1.715 | .937 |
| | | | CG | -2.160 | 1.715 | .454 |
| | | CG | EG1 | 1.540 | 1.715 | .669 |
| | | | EG2 | 2.160 | 1.715 | .454 |
| | LSD | EG1 | EG2 | .620 | 1.715 | .718 |
| | | | CG | -1.540 | 1.715 | .371 |
| | | EG2 | EG1 | -.620 | 1.715 | .718 |
| | | | CG | -2.160 | 1.715 | .210 |
| | | CG | EG1 | 1.540 | 1.715 | .371 |
| | | | EG2 | 2.160 | 1.715 | .210 |
| POST_ BCET | Scheffe | EG1 | EG2 | 14.120* | 2.524 | .000 |
| | | | CG | 20.020* | 2.524 | .000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | EG2 | EG1 | -14.120* | 2.524 | .000 |
| | | | CG | 5.900 | 2.524 | .068 |
| | | CG | EG1 | -20.020* | 2.524 | .000 |
| | | | EG2 | -5.900 | 2.524 | .068 |
| | LSD | EG1 | EG2 | 14.120* | 2.524 | .000 |
| | | | CG | 20.020* | 2.524 | .000 |
| | | EG2 | EG1 | -14.120* | 2.524 | .000 |
| | | | CG | 5.900* | 2.524 | .021 |
| | | CG | EG1 | -20.020* | 2.524 | .000 |
| | | | EG2 | -5.900* | 2.524 | .021 |
| POST_POST_ BCET | Scheffe | EG1 | EG2 | 15.820* | 1.894 | .000 |
| | | | CG | 24.340* | 1.894 | .000 |
| | | EG2 | EG1 | -15.820* | 1.894 | .000 |
| | | | CG | 8.520* | 1.894 | .000 |
| | | CG | EG1 | -24.340* | 1.894 | .000 |
| | | | EG2 | -8.520* | 1.894 | .000 |
| | LSD | EG1 | EG2 | 15.820* | 1.894 | .000 |
| | | | CG | 24.340* | 1.894 | .000 |
| POST_POST_ BCET | LSD | EG2 | EG1 | -15.820 | 1.894 | .000 |
| | | | CG | 8.520 | 1.894 | .000 |
| | | CG | EG1 | -24.340 | 1.894 | .000 |
| | | | EG2 | -8.520 | 1.894 | .000 |
| PRE_SAT | Scheffe | EG1 | EG2 | 3.080 | 1.920 | .279 |
| | | | CG | 1.000 | 1.920 | .873 |
| | | EG2 | EG1 | -3.080 | 1.920 | .279 |
| | | | CG | -2.080 | 1.920 | .557 |
| | | CG | EG1 | -1.000 | 1.920 | .873 |
| | | | EG2 | 2.080 | 1.920 | .557 |
| | LSD | EG1 | EG2 | 3.080 | 1.920 | .111 |
| | | | CG | 1.000 | 1.920 | .603 |
| | | EG2 | EG1 | -3.080* | 1.920 | .111 |
| | | | CG | -2.080* | 1.920 | .280 |
| | | CG | EG1 | -1.000* | 1.920 | .603 |
| | | | EG2 | 2.080 | 1.920 | .280 |
| POST_SAT | Scheffe | EG1 | EG2 | 10.040* | 2.333 | .000 |
| | | | CG | 18.340 | 2.333 | .000 |
| | | EG2 | EG1 | -10.040* | 2.333 | .000 |
| | | | CG | 8.300* | 2.333 | .002 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | CG | EG1 | -18.340* | 2.333 | .000 |
| | | | EG2 | -8.300* | 2.333 | .002 |
| | LSD | EG1 | EG2 | 10.040* | 2.333 | .000 |
| | | | CG | 18.340* | 2.333 | .000 |
| | | EG2 | EG1 | -10.040* | 2.333 | .000 |
| | | | CG | 8.300* | 2.333 | .001 |
| | | CG | EG1 | -18.340* | 2.333 | .000 |
| | | | EG2 | -8.300* | 2.333 | .001 |
| POST_POST_SAT | Scheffe | EG1 | EG2 | 17.280* | 2.300 | .000 |
| | | | CG | 32.000* | 2.300 | .000 |
| | | EG2 | EG1 | -17.280* | 2.300 | .000 |
| | | | CG | 14.720* | 2.300 | .000 |
| POST_POST_SAT | Scheffe | CG | EG1 | -32.000 | 2.300 | .000 |
| | | | EG2 | -14.720 | 2.300 | .000 |
| | LSD | EG1 | EG2 | 17.280 | 2.300 | .000 |
| | | | CG | 32.000 | 2.300 | .000 |
| | | EG2 | EG1 | -17.280 | 2.300 | .000 |
| | | | CG | 14.720 | 2.300 | .000 |
| | | CG | EG1 | -32.000 | 2.300 | .000 |
| | | | EG2 | -14.720 | 2.300 | .000 |
| BAT | Scheffe | EG1 | EG2 | 10.040 | 2.333 | .000 |
| | | | CG | 18.340 | 2.333 | .000 |
| | | EG2 | EG1 | -10.040 | 2.333 | .000 |
| | | | CG | 8.300 | 2.333 | .002 |
| | | CG | EG1 | -18.340* | 2.333 | .000 |
| | | | EG2 | -8.300* | 2.333 | .002 |
| | LSD | EG1 | EG2 | 10.040* | 2.333 | .000 |
| | | | CG | 18.340 | 2.333 | .000 |
| | | EG2 | EG1 | -10.040* | 2.333 | .000 |
| | | | CG | 8.300 | 2.333 | .001 |
| | | CG | EG1 | -18.340* | 2.333 | .000 |
| | | | EG2 | -8.300* | 2.333 | .001 |

*. The mean difference is significant at the 0.05 level.

## Univariate Analysis of Variance

**Descriptive Statistics**

Dependent Variable: POST_ BCET

| METHOD | SEX | Mean | Std. Deviation | N |
|---|---|---|---|---|
| EG1 | Male | 52.80 | 17.578 | 25 |
| | Female | 56.48 | 14.286 | 25 |
| | Total | 54.64 | 15.961 | 50 |
| EG2 | Male | 44.08 | 12.007 | 25 |
| | Female | 36.96 | 9.902 | 25 |
| | Total | 40.52 | 11.470 | 50 |
| CG | Male | 34.28 | 9.289 | 25 |
| | Female | 34.96 | 10.019 | 25 |
| | Total | 34.62 | 9.568 | 50 |
| Total | Male | 43.72 | 15.263 | 75 |
| | Female | 42.80 | 15.035 | 75 |
| | Total | 43.26 | 15.106 | 150 |

**Tests of Between-Subjects Effects**

Dependent Variable: POST_ BCET

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 11391.820[a] | 5 | 2278.364 | 14.512 | .000 |
| Intercept | 280714.140 | 1 | 280714.140 | 1788.064 | .000 |
| METHOD | 10583.080 | 2 | 5291.540 | 33.706 | .000 |
| SEX | 31.740 | 1 | 31.740 | .202 | .654 |
| METHOD * SEX | 777.000 | 2 | 388.500 | 2.475 | .088 |
| Error | 22607.040 | 144 | 156.993 | | |
| Total | 314713.000 | 150 | | | |
| Corrected Total | 33998.860 | 149 | | | |

a. R Squared = .335 (Adjusted R Squared = .312)

**Estimates**

Dependent Variable: POST_ BCET

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| EG1 | 54.640 | 1.772 | 51.138 | 58.142 |
| EG2 | 40.520 | 1.772 | 37.018 | 44.022 |
| CG | 34.620 | 1.772 | 31.118 | 38.122 |

**Pairwise Comparisons**

Dependent Variable: POST_ BCET

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 14.120* | 2.506 | .000 | 9.167 | 19.073 |
| | CG | 20.020* | 2.506 | .000 | 15.067 | 24.973 |
| EG2 | EG1 | -14.120* | 2.506 | .000 | -19.073 | -9.167 |
| | CG | 5.900* | 2.506 | .020 | .947 | 10.853 |
| CG | EG1 | -20.020* | 2.506 | .000 | -24.973 | -15.067 |
| | EG2 | -5.900* | 2.506 | .020 | -10.853 | -.947 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_ BCET

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 10583.080 | 2 | 5291.540 | 33.706 | .000 |
| Error | 22607.040 | 144 | 156.993 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

## 2. SEX

**Estimates**

Dependent Variable: POST_ BCET

| SEX | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Male | 43.720 | 1.447 | 40.860 | 46.580 |
| Female | 42.800 | 1.447 | 39.940 | 45.660 |

**Pairwise Comparisons**

Dependent Variable: POST_ BCET

| (I) SEX | (J) SEX | Mean Difference (I-J) | Std. Error | Sig.[a] | 95% Confidence Interval for Difference[a] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Male | Female | .920 | 2.046 | .654 | -3.124 | 4.964 |
| Female | Male | -.920 | 2.046 | .654 | -4.964 | 3.124 |

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_BCET

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 31.740 | 1 | 31.740 | .202 | .654 |
| Error | 22607.040 | 144 | 156.993 | | |

The F tests the effect of SEX. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

**Descriptive Statistics**

Dependent Variable: POST_POST_ BCET

| METHOD | SEX | Mean | Std. Deviation | N |
|---|---|---|---|---|
| | Male | 65.80 | 10.223 | 25 |
| EG1 | Female | 66.24 | 10.317 | 25 |
| | Total | 66.02 | 10.167 | 50 |
| | Male | 53.36 | 8.770 | 25 |
| EG2 | Female | 47.04 | 8.739 | 25 |
| | Total | 50.20 | 9.234 | 50 |
| | Male | 40.88 | 8.328 | 25 |
| CG | Female | 42.48 | 9.683 | 25 |
| | Total | 41.68 | 8.975 | 50 |
| | Male | 53.35 | 13.647 | 75 |
| Total | Female | 51.92 | 14.040 | 75 |
| | Total | 52.63 | 13.817 | 150 |

**Tests of Between-Subjects Effects**

Dependent Variable: POST_POST_ BCET

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 15788.673[a] | 5 | 3157.735 | 35.928 | .000 |
| Intercept | 415540.167 | 1 | 415540.167 | 4727.957 | .000 |
| METHOD | 15254.973 | 2 | 7627.487 | 86.784 | .000 |
| SEX | 76.327 | 1 | 76.327 | .868 | .353 |
| METHOD * SEX | 457.373 | 2 | 228.687 | 2.602 | .078 |
| Error | 12656.160 | 144 | 87.890 | | |
| Total | 443985.000 | 150 | | | |
| Corrected Total | 28444.833 | 149 | | | |

a. R Squared = .555 (Adjusted R Squared = .540)

**Estimates**

Dependent Variable: POST_POST_ BCET

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| EG1 | 66.020 | 1.326 | 63.399 | 68.641 |
| EG2 | 50.200 | 1.326 | 47.579 | 52.821 |
| CG | 41.680 | 1.326 | 39.059 | 44.301 |

**Pairwise Comparisons**

Dependent Variable: POST_POST_ BCET

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 15.820* | 1.875 | .000 | 12.114 | 19.526 |
| | CG | 24.340* | 1.875 | .000 | 20.634 | 28.046 |
| EG2 | EG1 | -15.820* | 1.875 | .000 | -19.526 | -12.114 |
| | CG | 8.520* | 1.875 | .000 | 4.814 | 12.226 |
| CG | EG1 | -24.340* | 1.875 | .000 | -28.046 | -20.634 |
| | EG2 | -8.520* | 1.875 | .000 | -12.226 | -4.814 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_POST_ BCET

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 15254.973 | 2 | 7627.487 | 86.784 | .000 |
| Error | 12656.160 | 144 | 87.890 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

**Estimates**

Dependent Variable: POST_POST_ BCET

| SEX | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Male | 53.347 | 1.083 | 51.207 | 55.486 |
| Female | 51.920 | 1.083 | 49.780 | 54.060 |

**Pairwise Comparisons**

Dependent Variable: POST_POST_ BCET

| (I) SEX | (J) SEX | Mean Difference (I-J) | Std. Error | Sig.[a] | 95% Confidence Interval for Difference[a] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Male | Female | 1.427 | 1.531 | .353 | -1.599 | 4.453 |
| Female | Male | -1.427 | 1.531 | .353 | -4.453 | 1.599 |

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_POST_ BCET

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 76.327 | 1 | 76.327 | .868 | .353 |
| Error | 12656.160 | 144 | 87.890 | | |

The F tests the effect of SEX. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

**Descriptive Statistics**

Dependent Variable: POST_SAT

| METHOD | SEX | Mean | Std. Deviation | N |
|---|---|---|---|---|
| EG1 | Male | 68.00 | 12.689 | 25 |
| | Female | 63.12 | 8.871 | 25 |
| | Total | 65.56 | 11.112 | 50 |
| EG2 | Male | 59.44 | 11.188 | 25 |
| | Female | 51.60 | 11.255 | 25 |
| | Total | 55.52 | 11.791 | 50 |

| | | | | |
|---|---|---|---|---|
| | Male | 48.44 | 13.153 | 25 |
| CG | Female | 46.00 | 11.015 | 25 |
| | Total | 47.22 | 12.070 | 50 |
| | Male | 58.63 | 14.625 | 75 |
| Total | Female | 53.57 | 12.547 | 75 |
| | Total | 56.10 | 13.815 | 150 |

**Tests of Between-Subjects Effects**

Dependent Variable: POST_SAT

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 9574.540[a] | 5 | 1914.908 | 14.620 | .000 |
| Intercept | 472081.500 | 1 | 472081.500 | 3604.256 | .000 |
| METHOD | 8434.120 | 2 | 4217.060 | 32.196 | .000 |
| SEX | 957.607 | 1 | 957.607 | 7.311 | .008 |
| METHOD * SEX | 182.813 | 2 | 91.407 | .698 | .499 |
| Error | 18860.960 | 144 | 130.979 | | |
| Total | 500517.000 | 150 | | | |
| Corrected Total | 28435.500 | 149 | | | |

a. R Squared = .337 (Adjusted R Squared = .314)

## Estimated Marginal Means

## 1. METHOD

**Estimates**

Dependent Variable: POST_SAT

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| EG1 | 65.560 | 1.619 | 62.361 | 68.759 |
| EG2 | 55.520 | 1.619 | 52.321 | 58.719 |
| CG | 47.220 | 1.619 | 44.021 | 50.419 |

**Pairwise Comparisons**

Dependent Variable: POST_SAT

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 10.040* | 2.289 | .000 | 5.516 | 14.564 |
| | CG | 18.340* | 2.289 | .000 | 13.816 | 22.864 |
| EG2 | EG1 | -10.040* | 2.289 | .000 | -14.564 | -5.516 |
| | CG | 8.300* | 2.289 | .000 | 3.776 | 12.824 |
| CG | EG1 | -18.340* | 2.289 | .000 | -22.864 | -13.816 |
| | EG2 | -8.300* | 2.289 | .000 | -12.824 | -3.776 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_SAT

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 8434.120 | 2 | 4217.060 | 32.196 | .000 |
| Error | 18860.960 | 144 | 130.979 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

**Estimates**

Dependent Variable: POST_SAT

| SEX | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Male | 58.627 | 1.322 | 56.015 | 61.239 |
| Female | 53.573 | 1.322 | 50.961 | 56.185 |

**Pairwise Comparisons**

Dependent Variable: POST_SAT

| (I) SEX | (J) SEX | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Male | Female | 5.053* | 1.869 | .008 | 1.359 | 8.747 |
| Female | Male | -5.053* | 1.869 | .008 | -8.747 | -1.359 |

Dependent Variable: POST_SAT

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 957.607 | 1 | 957.607 | 7.311 | .008 |
| Error | 18860.960 | 144 | 130.979 | | |

The F tests the effect of SEX. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Dependent Variable: POST_POST_SAT

| METHOD | SEX | Mean | Std. Deviation | N |
|---|---|---|---|---|
| | Male | 78.40 | 10.046 | 25 |
| EG1 | Female | 84.68 | 9.241 | 25 |
| | Total | 81.54 | 10.066 | 50 |
| | Male | 72.20 | 10.724 | 25 |
| EG2 | Female | 56.32 | 6.675 | 25 |
| | Total | 64.26 | 11.937 | 50 |
| | Male | 50.80 | 12.230 | 25 |
| CG | Female | 48.28 | 12.631 | 25 |
| | Total | 49.54 | 12.370 | 50 |
| | Male | 67.13 | 16.131 | 75 |
| Total | Female | 63.09 | 18.465 | 75 |
| | Total | 65.11 | 17.398 | 150 |

**Tests of Between-Subjects Effects**

Dependent Variable: POST_POST_SAT

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 29379.153[a] | 5 | 5875.831 | 53.825 | .000 |
| Intercept | 635961.927 | 1 | 635961.927 | 5825.635 | .000 |
| METHOD | 25654.613 | 2 | 12827.307 | 117.503 | .000 |
| SEX | 612.060 | 1 | 612.060 | 5.607 | .019 |
| METHOD * SEX | 3112.480 | 2 | 1556.240 | 14.256 | .000 |
| Error | 15719.920 | 144 | 109.166 | | |

| | | | | | |
|---|---|---|---|---|---|
| Total | 681061.000 | 150 | | | |
| Corrected Total | 45099.073 | 149 | | | |

a. R Squared = .651 (Adjusted R Squared = .639)

**Estimates**

Dependent Variable: POST_POST_SAT

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| EG1 | 81.540 | 1.478 | 78.619 | 84.461 |
| EG2 | 64.260 | 1.478 | 61.339 | 67.181 |
| CG | 49.540 | 1.478 | 46.619 | 52.461 |

**Pairwise Comparisons**

Dependent Variable: POST_POST_SAT

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 17.280* | 2.090 | .000 | 13.150 | 21.410 |
| | CG | 32.000* | 2.090 | .000 | 27.870 | 36.130 |
| EG2 | EG1 | -17.280* | 2.090 | .000 | -21.410 | -13.150 |
| | CG | 14.720* | 2.090 | .000 | 10.590 | 18.850 |
| CG | EG1 | -32.000* | 2.090 | .000 | -36.130 | -27.870 |
| | EG2 | -14.720* | 2.090 | .000 | -18.850 | -10.590 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_POST_SAT

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 25654.613 | 2 | 12827.307 | 117.503 | .000 |
| Error | 15719.920 | 144 | 109.166 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

## 2. SEX

**Estimates**

Dependent Variable: POST_POST_SAT

| SEX | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Male | 67.133 | 1.206 | 64.749 | 69.518 |
| Female | 63.093 | 1.206 | 60.709 | 65.478 |

**Pairwise Comparisons**

Dependent Variable: POST_POST_SAT

| (I) SEX | (J) SEX | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Male | Female | 4.040* | 1.706 | .019 | .668 | 7.412 |
| Female | Male | -4.040* | 1.706 | .019 | -7.412 | -.668 |

Dependent Variable: POST_POST_SAT

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 612.060 | 1 | 612.060 | 5.607 | .019 |
| Error | 15719.920 | 144 | 109.166 | | |

The F tests the effect of SEX. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

## T-Test

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean | t | df | sig |
|---|---|---|---|---|---|---|---|---|
| Pair 1 | PRE-BATEG | 21.17 | 150 | 8.565 | .699 | 17.964 | 149 | .000 |
| | POST_BATEG | 43.26 | 150 | 15.106 | 1.233 | | | |

## T-Test

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean | t | df | Sig |
|---|---|---|---|---|---|---|---|---|
| Pair 1 | PRE_SATEG | 25.68 | 150 | 9.621 | .786 | 29.552 | 149 | .000 |
| | POST_SATEG | 56.10 | 150 | 13.815 | 1.128 | | | |

## METHOD = EG1

**Group Statistics[a]**

| | SEX | N | Mean | Std. Deviation | Std. Error Mean | t | Df | Sig |
|---|---|---|---|---|---|---|---|---|
| PRE-BATEG | Male | 25 | 19.12 | 8.565 | 1.713 | -1.320 | 48 | .193 |
| | Female | 25 | 22.60 | 10.017 | 2.003 | | | |
| POST_BATEG | Male | 25 | 52.80 | 17.578 | 3.516 | -.812 | 48 | .421 |
| | Female | 25 | 56.48 | 14.286 | 2.857 | | | |
| POST_POST_BATEG | Male | 25 | 65.80 | 10.223 | 2.045 | -.151 | 48 | .880 |
| | Female | 25 | 66.24 | 10.317 | 2.063 | | | |
| PRE_SATEG | Male | 25 | 31.52 | 10.316 | 2.063 | 3.539 | 48 | .001 |
| | Female | 25 | 22.56 | 7.338 | 1.468 | | | |
| POST_SATEG | Male | 25 | 68.00 | 12.689 | 2.538 | 1.576 | 48 | .122 |
| | Female | 25 | 63.12 | 8.871 | 1.774 | | | |
| POST_POST_SATEG | Male | 25 | 78.40 | 10.046 | 2.009 | -2.300 | 48 | .026 |
| | Female | 25 | 84.68 | 9.241 | 1.848 | | | |

a. METHOD = EG1

## METHOD = EG2

**Group Statistics[a]**

| | SEX | N | Mean | Std. Deviation | Std. Error Mean | t | df | sig |
|---|---|---|---|---|---|---|---|---|
| PRE-BATEG | Male | 25 | 19.60 | 7.188 | 1.438 | -.535 | 48 | .595 |
| | Female | 25 | 20.88 | 9.558 | 1.912 | | | |
| POST_BATEG | Male | 25 | 44.08 | 12.007 | 2.401 | 2.288 | 48 | .027 |
| | Female | 25 | 36.96 | 9.902 | 1.980 | | | |
| POST_POST_BATEG | Male | 25 | 53.36 | 8.770 | 1.754 | 2.552 | 48 | .014 |
| | Female | 25 | 47.04 | 8.739 | 1.748 | | | |
| PRE_SATEG | Male | 25 | 26.32 | 7.867 | 1.573 | 2.106 | 48 | .040 |
| | Female | 25 | 21.60 | 7.979 | 1.596 | | | |
| POST_SATEG | Male | 25 | 59.44 | 11.188 | 2.238 | 2.470 | 48 | .017 |
| | Female | 25 | 51.60 | 11.255 | 2.251 | | | |
| POST_POST_SATEG | Male | 25 | 72.20 | 10.724 | 2.145 | 6.286 | 48 | .000 |
| | Female | 25 | 56.32 | 6.675 | 1.335 | | | |

a. METHOD = EG2

**Group Statistics**[a]

| | SEX | N | Mean | Std. Deviation | Std. Error Mean | t | Df | sig |
|---|---|---|---|---|---|---|---|---|
| PRE-BATEG | Male | 25 | 23.32 | 9.419 | 1.884 | .824 | 48 | .414 |
| | Female | 25 | 21.48 | 5.994 | 1.199 | | | |
| POST_BATEG | Male | 25 | 34.28 | 9.289 | 1.858 | -.249 | 48 | .805 |
| | Female | 25 | 34.96 | 10.019 | 2.004 | | | |
| POST_POST_BATEG | Male | 25 | 40.88 | 8.328 | 1.666 | -.626 | 48 | .534 |
| | Female | 25 | 42.48 | 9.683 | 1.937 | | | |
| PRE_SATEG | Male | 25 | 27.68 | 10.339 | 2.068 | 1.107 | 48 | .274 |
| | Female | 25 | 24.40 | 10.614 | 2.123 | | | |
| POST_SATEG | Male | 25 | 48.44 | 13.153 | 2.631 | .711 | 48 | .480 |
| | Female | 25 | 46.00 | 11.015 | 2.203 | | | |
| POST_POST_SATEG | Male | 25 | 50.80 | 12.230 | 2.446 | .717 | 48 | .477 |
| | Female | 25 | 48.28 | 12.631 | 2.526 | | | |

a. METHOD = CG

**Tests of Between-Subjects Effects**

Dependent Variable: POST_ BCET

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 14073.569[a] | 3 | 4691.190 | 34.374 | .000 |
| Intercept | 20267.867 | 1 | 20267.867 | 148.510 | .000 |
| PRE_BATEG | 3490.489 | 1 | 3490.489 | 25.576 | .000 |
| METHOD | 11243.932 | 2 | 5621.966 | 41.194 | .000 |
| Error | 19925.291 | 146 | 136.475 | | |
| Total | 314713.000 | 150 | | | |
| Corrected Total | 33998.860 | 149 | | | |

a. R Squared = .414 (Adjusted R Squared = .402)

## Estimated Marginal Means

**Estimates**

Dependent Variable: POST_ BCET

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |

| | | | | |
|---|---|---|---|---|
| EG1 | 54.814[a] | 1.652 | 51.548 | 58.080 |
| EG2 | 41.047[a] | 1.655 | 37.775 | 44.318 |
| CG | 33.919[a] | 1.658 | 30.642 | 37.196 |

a. Covariates appearing in the model are evaluated at the following values: PRE-BATEG = 21.17.

**Pairwise Comparisons**

Dependent Variable: POST_ BCET

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 13.768* | 2.337 | .000 | 9.148 | 18.387 |
| | CG | 20.895* | 2.343 | .000 | 16.265 | 25.525 |
| EG2 | EG1 | -13.768* | 2.337 | .000 | -18.387 | -9.148 |
| | CG | 7.128* | 2.349 | .003 | 2.485 | 11.770 |
| CG | EG1 | -20.895* | 2.343 | .000 | -25.525 | -16.265 |
| | EG2 | -7.128* | 2.349 | .003 | -11.770 | -2.485 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_ BCET

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 11243.932 | 2 | 5621.966 | 41.194 | .000 |
| Error | 19925.291 | 146 | 136.475 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

**Tests of Between-Subjects Effects**

Dependent Variable: POST_SAT

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 14072.675[a] | 3 | 4690.892 | 47.684 | .000 |
| Intercept | 28233.737 | 1 | 28233.737 | 287.000 | .000 |
| PRE_SATEG | 5638.555 | 1 | 5638.555 | 57.317 | .000 |
| METHOD | 7838.566 | 2 | 3919.283 | 39.840 | .000 |

| | | | | | |
|---|---|---|---|---|---|
| Error | 14362.825 | 146 | 98.376 | | |
| Total | 500517.000 | 150 | | | |
| Corrected Total | 28435.500 | 149 | | | |

a. R Squared = .495 (Adjusted R Squared = .485)

**Estimates**

Dependent Variable: POST_SAT

| METHOD | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| EG1 | 64.683[a] | 1.407 | 61.901 | 67.464 |
| EG2 | 56.630[a] | 1.410 | 53.842 | 59.417 |
| CG | 46.988[a] | 1.403 | 44.215 | 49.761 |

a. Covariates appearing in the model are evaluated at the following values: PRE_SATEG = 25.68.

**Pairwise Comparisons**

Dependent Variable: POST_SAT

| (I) METHOD | (J) METHOD | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| EG1 | EG2 | 8.053* | 2.001 | .000 | 4.098 | 12.007 |
| | CG | 17.695* | 1.986 | .000 | 13.771 | 21.619 |
| EG2 | EG1 | -8.053* | 2.001 | .000 | -12.007 | -4.098 |
| | CG | 9.642* | 1.992 | .000 | 5.706 | 13.578 |
| CG | EG1 | -17.695* | 1.986 | .000 | -21.619 | -13.771 |
| | EG2 | -9.642* | 1.992 | .000 | -13.578 | -5.706 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

**Univariate Tests**

Dependent Variable: POST_SAT

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Contrast | 7838.566 | 2 | 3919.283 | 39.840 | .000 |
| Error | 14362.825 | 146 | 98.376 | | |

The F tests the effect of METHOD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.