PROJECT-BASED LEARNING AND SELF-REGULATORY STRATEGIES AS DETERMINANTS OF SECONDARY SCHOOL STUDENTS' ACHIEVEMENT, ATTITUDE AND PRACTICAL SKILLS IN BIOLOGY CONCEPTS IN IBADAN, NIGERIA

BY

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CERTIFICATION

I certify that the research work that culminated in the writing of this project was carried out by IBITOYE Temitope Martina in the Department of Science and Technology Education, University of Ibadan.

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DEDICATION

This research work is dedicated to Almighty God for making his presence blossom in my total being and the sweet memories of my late father, Barrister Jonathan Ajayi, Ibitoye, for his love for education, I believe he inspired me to be great and supported me all through.

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ABSTRACT

Biology concepts are taught in senior secondary schools to equip students with knowledge and skills to solve real-world problems. However, reports have shown that students' achievement in biology is poor in Ibadan. This has been attributed to the use of teacher-centred methods of instruction. Previous studies focused largely on predisposing student-related factors with little attention on project-based learning and self-regulatory strategies. This study, therefore, was carried out to determine the effects of Project-based Learning Strategy (PBLS) and Self-regulatory Strategy (SRS) on students' achievement, attitude and practical skills in biology in Ibadan, Nigeria. It also examined the moderating effects of students' mental ability and their learning styles (visual, auditory, reading/writing and kinaesthetic).

Constructivist Theory provided the framework, while the pretest-posttest control group quasi experimental design with 3x2x4 factorial matrix was adopted. Three out of the 11 Local Government Areas (LGAs) (Akinyele, Ibadan North and Ibadan North East) were randomly selected. From each LGA, two public senior secondary schools were randomly selected, while an intact class of senior secondary II students was selected from each school, totalling 303 students. The schools were assigned to PBLS (106), SRS (100) and control (97) groups. The instruments used were Biology Achievement Test (r=0.81), Biology Attitude Questionnaire (r=0.80), Biology Practical Skills Rating Scale (r=0.81), Student Mental Ability Test (r=0.82), Student Learning Style Questionnaire (r=0.89) and instructional guides. The treatment lasted eight weeks. Data were subjected to descriptive statistics, Analysis of covariance and Bonferroni post-hoc test at 0.05 level of significance.

Participants' age was 17.30±2.50 years, and 67.5% were females. The participants' mental ability ($\bar{x} = 3.50$) was high as against the threshold of 2.50. The participants learning style distribution was auditory (30.7%), visual (30.4%), kinaesthetic (25.0%) and read/write (13.9%). Treatment had a significant main effect on students' achievement in biology ($F_{(2, 278)}$=16.05, partial η^2 = 0.10). Participants exposed to SRS had the highest post mean achievement score (28.75), followed by PBLS (28.44) and control (22.45) groups. Treatment had significant main effect on students' practical skills in biology ($F_{(2, 278)}$=7.95, partial η^2 = 0.05). Participant in PBLS group had the highest post-practical skills mean score in biology (20.80), followed by SRS (19.80) and control (17.88) groups. Treatment had no significant main effect on students' attitude to biology. Mental ability and learning style had no significant main effects on students' achievement, attitude and practical skills. There were no significant two-way and three-way interaction effects.

Project-based learning and self-regulatory strategies enhanced students' achievement and practical skills in biology in secondary schools in Ibadan, regardless of their mental ability and learning style. Teachers should adopt these strategies to improve students' achievement, attitude and practical skills in biology.

Keywords: Achievement in biology, Determinant of students' achievement, Project-based learning strategy, Self-regulatory strategy

Word count: 435

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Biology is a branch of natural science that involves the study of living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanisms, development and evolution. It is a subject that engages the students in varied process skills such as observation, clarification, interpretation, prediction of events, experimentation, organization of information, and in reporting adequately. Biology education aims at helping individuals to procure necessary innovative abilities to function in the society. Biology pervades all aspects of everyday life. People rely on living things and their products for food they eat, their homes, their personal care, their fuel and their medicine (Dotson, 2018). The importance of Biology cannot be over rated, it's a vital tools in the development of nation's economy (Adeyemo, 2010). Similarly, knowledge of Biology proffers solution to life threatening issues such as health, growth, and environmental system (Olagunju, 2002). The concept contributes immensely to the technological growth of the nation (Ogundiwin and Ahmed, 2015). Furthermore, the concepts helps the students understand principles, theories and laws. It's a prerequisite and compulsory subject for many fields of learning. As a result of this, its role in the development of a nation cannot be overemphasized. In the same vain, National Policy on Education (NERDC, 2013) pinpoint some significant goals of teaching-learning Biology which are as follows:

(i) Ability to acquire manipulative skills, practical and projects in Biology.

(ii) Students would be able to obtain scientific skills and processes such as observation, classification, and interpretation among others.

(iii) Ability to gain scientific attitudes for problem solving such as curiosity, scepticism, open mindedness, and objectivity among others.

(iv) Learners would be able to apply biological principles into real life situations.

(v) Provision of foundation for future professions such as Medicine, Nursing, Botany, Zoology, and Agriculture among others

(vi) Awareness of nature of things around them (NERDC, 2013).

The observation of Umoke and Nwafor (2014) was that students' performance in the Secondary School Certificate Examinations (SSCE) administered by the West African Examinations Council (WAEC), and the National Examination Council (NECO) has continued to deteriorate from year to year, particularly in the areas of Biology. Specifically, WAEC, (2016) Chief Examiner's report maintained that students' knowledge of pollination and reproductive system in flowering plants in Biology was poor despite the fact that several crucial efforts have continually been made over the years to remedy the yearly poor students' performance. In the same vain, examination bodies' reports have indicated that there is wide declining in standard of teaching-learning biology most especially public secondary school which has resulted to low rate in achievement of the subject concept (Ugochi, 2012). As much as laudable objectives and benefits of Biology is in the school curriculum, the teaching of the subject is done mostly by conventional strategy. Learning in a traditional classroom tends to be individual, and students are passive learners as consumers of knowledge (Wagner, 2016).

It has been noted that lack of good strategies in the teaching of Biology is affecting students' performance and on the long run affects students' enrolment (Olagunju, 2014). The teaching strategies to be employed by teachers at any given situation, depend on factors arising from teacher and student characteristics, teaching objectives, classroom learning environment, the nature and needs of the subject (Alebiosu, 2013). As pertinent as the study of Biology is to the people and innovative for technological development of a country, perception on students' performance in Biology result for May/June WASSCE 2008-2016 in Oyo State, uncovered a relatively poor performance. Table 1.1 further indicate the line of discourse as presented here a wide decline in standard

Table 1.1: Percentage Distribution of Candidates' Performance in May/June (WAEC) SSCE Results (Biology) in Oyo State (2010-2017)

Year	Total Entry	Credit Passes 1-6	Failure	Percentage Passes	Percentage Failure
	Number of Candidates	Number of Candidates	Number of Candidates	% of Candidates	% of Candidates
2010	41,845	9,497	32,048	22.69	77.14
2011	45,970	6,236	39,734	13.57	86.43
2012	43,164	6,586	36,578	15.26	84.74
2013	42,940	24,153	48,679	32.80	66.12
2014	24,098	6,092	18,006	25.28	74.72
2015	19,371	5,937	13,434	30.65	69.35
2016	19,942	13,495	6,447	67.67	32.32
2017	11,698	7,052	4,646	60.28	39.72
Average		9881	24947	33.53	66.32

Source: Planning, Research and Statistics Department, Oyo State Ministry of Education, Secretariat, Ibadan

Table 1.1 shows the rate of students who passed Biology in percentage, at credit level or beyond in Oyo state senior secondary schools from 2010-2017. For a long time, the most elevated level of learners who passed Science (Biology) was 67.67% and 60.28% in the year 2016 and 2017 respectively, which is not sufficient particularly for a country that is striving for development of science and technology innovations. In spite of its significance in the nation, accessible insights from the West Africa Examination Council (2008 to 2015) on senior secondary school students' achievement in Biology revealed that although Biology had the highest enrolment relative to other subject matter, it had recorded students' achievement in Biology is poor in Ibadan.

In addition, Oyo state is far behind as West African Examination Council (WAEC) released the 2018 ranking of all the 36 states in Nigeria (Insideoyo, 2018). Oyo state emerged 26th, the only southern state after Osun state among the least states. According to Nairaland forum (2019) Oyo state had worst WAEC result in southwest, only 19% passed, available statistics from WAEC revealed that among the science subjects, Biology had recorded very poor achievement. In addition, all the West Africa Examination Council (WAEC) Chief Examiners' Report each year from 2010 to 2017 have identified Biology Paper 3 (Practical) as an area of major concern. From year 2011 to 2018, WAEC Chief Examiners' report revealed persistent poor performance on questions that were on pollination and reproductive system in flowering plants. It further stressed that some candidates' weaknesses include their inability to: draw according to specification and size; classify organisms; understand what observable difference means; spell technical words correctly; relate the differences in a tabular form; match structures with functions correctly; draw guidelines to touch the label on the diagram; and label correctly.

As good and imperative study of biology is to the growth of a nation, most especially Biology in the midst of learners, performance of subject matter had been considered unacceptable in terms of achievement most especially at senior secondary school level (Aderainimu, Aworanti and Kasali, 2007; Ahmed, 2008,). Poor technique for teaching is one of those reasons for learners academic failure in science subjects (Njoku, 2007; Jegede 2007), improper introduction to laboratory practicals (Ugwu, 2007), tutors' qualities (Alebiosu, 2012), absence of infrastructures for practical (Bilesanmi-Awoderu, 2012).

For a long time, attitudes tends to influence conduct, and moreover can be viewed as significant part of instruction (Nelson, 2011). Disposition of individual are usually developed via knowledge or by exposure to learning, and can be changed through impact utilizing various techniques. In real sense, attitude have found not to be static, it usually dynamic as a result of what individual got introduced to, in-term of information this could also affect disposition of a person (Adeoye, 2011). Disposition towards science is firmly identified with performance (Jegede, 2007). Positive frame of mind may prompt better performance in Biology (Ryan, 2018). Attitude with its cognitive, affective and behavioural dimensions is a psychological construct considered to be a critical predictor of behaviour of an individual (Babajide and Ngurukwen, 2013). According to Olagunju and Babayemi (2014) it was revealed that the most presumption of the change in teaching is the change in students' attitude, this implies that attitude of learners determine how they learn as well as of teachers' attitude in passing instruction via various methodology adopted in the process. Ogundiwin (2013) and Fasasi (2014) concluded that for science education, one of the critical problem is the students'/ teachers negative attitude towards science. Attitude can distort the perception of information and affect the degree of their retention (Festus and Ekpett, 2012).

Meanwhile, it has been observed that not much work has been carried out on students' acquisition of Biology practical skills (Raimi and Fabiyi, 2008). This implies that secondary schools students do not possess sufficient skills that can aid their problem solving skills, also ability to be self-creative, manage and explore is drastically fading away among secondary students which have resorted to inability to conform with the new innovative that drive the development of a nation. The practical skills that were tested in this study include the following: observation, recording, drawing, labelling, manipulation of apparatus and classification.

In an attempt to develop the standard of Biology teaching and learning, numerous studies had been investigated, Olagunju (2014) reported that if teachers employ problem solving instructional strategies which will equip the learners with science process skills, reflective thinking and problem solving skills, they will be able to perform better in Biology. In spite of the various effort and innovations introduced into the educational system by the government, and educators, the attainment of the desired goal remains an illusion. Hence, Bas and Beyhab (2017) and their counterpart Gidalevich and Kramarski, (2019) recommended PBL (Project-based learning) and

SRS (Self-regulatory strategies) to be used as a teaching strategies most especially for science oriented subjects since they permit progressively dynamic involvement of learners in learning process. PBL strategy aims to give students a more active, hands-on approach to learning, touching on real-life that students can develop in school and then carry out as adults (Moffitt, 2019).

One compelling tool made available to develop learners' academic performance, regardless of ability is self-regulatory strategy. It is a strategy that encourages learning ability of learners and helps students cope with the challenges of lifelong learning in a knowledge society, Organisation for Economic Co-operation and Development, and the Programme for International Student Assessment (OECD, PISA, 2012). It is widely accepted that Self-regulatory strategy has a crucial role in school achievement. Several studies have stressed the importance of self-regulatory strategy in the learning process.

It has been noted that the ability of the students to handle quantitative information during instruction and score high in cognitive tasks could be linked with mental ability. In view of this statement, Veltmann, Raudfepp, and Pullmann (2011) predicted mental ability on achievement in mathematics adopting an ex-post facto design involving 969 students'. The results revealed that mental ability predicted significantly students' achievement in mathematics. Olagunju, Duyilemi, and Adesina (2014) noted that mental ability significantly predicted the students' academic achievement in agricultural economics.

Learning style is another variable that is considered to have an impact on students learning outcomes. Given the conflicting result on the impact of learning-style on learners academic achievement, there is therefore need to carry out more research to affirm the conflicting claims. Again, most of previous studies made use of learning style as independent variable but in this study it was used as moderator variable. In an attempt to examine its effects on Biology students' learning outcomes and their mental ability and learning style, this study therefore determined the effects of Project-based learning and Self-regulatory Strategies on senior secondary school students' achievement in and attitude to, and practical skills in Biology concepts in Ibadan Nigeria.

1.2 Statement of the Problem

Biology is an important subject in senior secondary school curriculum. However, past West Africa Examinations Council (WAEC), and National Examinations Council (NECO) Chief Examiners reports indicate students' inability to apply the knowledge obtained from pollination and reproductive system in flowering plants creatively in a novel situation, and failure of candidates to calculate and disclose magnification of their drawing. Many candidates failed to give correct headings to their drawings. The report further revealed failure of candidates to relate the theory they have learnt to practical skills. The continuous decline of students academic in Biology concepts is an evidence to support this. Students find it difficult to explore the situation and reflect on their experiences.

However, teachers who adopt the teacher-centred teaching methods aggravated the problem, because students finds it difficult to explore the situation and reflect on their experiences. Some candidates' weaknesses also include their inability to draw according to specification and size; classify organisms; understand what observable difference means; spell technical words correctly; relate the differences in a tabular form together; match structures with functions correctly; draw guidelines to touch the label on the diagram; and label correctly. Efforts to address these problems have led scholars to embark on intervention programmes such as the use of efficient teaching strategies like the advance organizers, reciprocal teaching and the role play among others. Despite these interventions, the performance of students in Biology concepts has not satisfactorily improved, thereby fuelling suspicion that other factors could be responsible such as students factors, gender, emotional intelligence, and school location. Among such factors are students' learning styles and mental ability which this study investigated.

Relevant studies have indicated connections between these variables and students' academic success in mathematics, English language, economics, and agricultural science to mention a few, but relatively none in Biology. Thus, there is need for further studies to establish the appropriate instructional strategies for both high and low mental ability levels of students with different Learning styles in Biology. The past studies on PBL and SRS shown little or no concentration on moderating effects of mental ability and learning styles on senior secondary schools students. The two strategies have been used separately and in different subjects. None

of the researchers examined the combined effects of the two strategies in Biology. On this note, the study therefore observed the PBL and SRS impacts on students' achievement, attitude and practical skills in Biology concepts taking into consideration students' mental ability and learning styles.

1.3 Objectives of the Study

The presents study therefore adopted Project-based learning and Self-regulatory strategies taking into consideration the students' mental ability and learning style and their effects on student's achievement in, attitude to, and practical skills in Biology concepts in Ibadan, Nigeria.

1.4 Hypotheses

This study tested the following hypotheses at 0.05 level of significance.

Ho1: There is no significant main effect of treatment on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho2: There is no significant main effect of mental ability on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho3: There is no significant main effect of learning style on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho4: There is no significant interaction effect of treatment and mental ability on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho5: There is no significant interaction effect of treatment and learning style on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho6: There is no significant interaction effect of mental ability and learning style on students' achievement in Biology, attitude to Biology, and practical skills in Biology

Ho7: There is no significant interaction effect of treatment, mental ability, and learning style on students' achievement in Biology, attitude to Biology,s and practical skills in Biology

1.5 Scope of the Study

The study involved Senior Secondary School II Biology students in Ibadan, Nigeria. The study determined the impact of PBL, SRS and learners' test-performance in, disposition to and hand-on activities in Biology concepts. It investigated the moderating effects of mental ability and learning style in secondary school students. The selected concept for the study are pollination and reproductive system in flowering plants. The practical skills used was selected on the basis that these are the specific areas where the WAEC Chief Examiners in Biology have reported that students have problems.

1.6 Significance of the Study

The findings from this study is expected to improve students' practical skills, academic achievement and provide opportunities for student-constructed learning, increase mastery of subject-matter, and improve confidence of students. Report of the study would serve as a motivating factor for parents and guardians concerning their wards' performance in Biology. The information from this study would form a basis for achieving the objectives of teacher education programme in Nigeria which states that teacher education will continue to take cognizance of changes in methodology and curriculum and teachers would be regularly exposed to several forms of innovation in their profession.

The result of this study would provide the teachers in secondary schools with guidelines for adopting effective strategies that can be used in teaching pollination and reproductive system concepts in Biology. It would also make available the empirical evidence for determining the effectiveness of Project-Based learning and Self-regulatory Strategies as determinants of student's achievement, attitude and practical skills in Biology. More so, the validated empirical data which was generated in this study would provide useful information to researchers in the nearest future for further studies.

1.7 Operational Definition of Terms

Students' Achievement in Biology: This is the performance of senior secondary school II students in Biology test as measured by their test score on Biology Achievement Test (BAT) in pollination and reproductive system in flowering plants.

Students' Attitude towards Biology: This refers to disposition of senior secondary school II students towards concepts in Biology which was measured using Biology Attitude Questionnaire (BAQ).

Project-based Learning Strategy: This is an instructional strategy that provides students with opportunity to acquire a deeper knowledge through active exploration of real-world problems.

Self-regulatory Strategy: Self-regulatory Strategy is an instructional strategy that provides students with accurate picture of progress, immediate feedback, and facilitates better communication between teacher and student.

Practical skills in Biology: This is the ability or competency acquired by student in carrying out Biology problems and is measured by Biology Practical Skills Rating Scale (BPSRS).

Students Mental Ability: is the ability of the students to solve simple problems as reflected by scores obtained from Students' Mental Ability Test (SMAT). This were grouped into high Students that score 50% and above, and low, those that score 49% and below.

Students Learning Style: is the preferred mode of learning by students. This was measured by using Students' Learning Style Questionnaire (SLSQ).

Students: this could be refers to understudies, schoolchildren and learners

Achievement: refers to a thing done successfully with effort, skill or courage

Attitude: it is considered as assertiveness, disposition toward learning Biology

1.8 Acronyms

Project-based Learning Strategy – PBLS

Project-based Learning – PBL

Self-regulatory Strategy – SRS

Students Learning Style – SLS

CHAPTER TWO

LITERATURE REVIEW

This section presents literature for the research in the following order: conceptual review, theoretical framework, empirical and appraisal of literatures.

2.1 The Conceptual Review

2.1.1 Concept of Project-based Learning Strategy

Project-based learning depends on learning gathering whereby learners determine what to learn or which learning activities to practice. This will help students to be actively engaged and help learners to be responsible for their learning. It encourages learners' participation in learning process. The core idea of Project-based learning is that real-world problems capture students' interest and provoke serious thinking as the students acquire and apply new knowledge in a problem-solving context. The teacher plays the role of facilitator, working with students to frame worthwhile questions, structuring meaningful tasks, coaching both knowledge development and social skills, and carefully assessing what students have learned from the experience. Project-based learning relies on learning groups, student groups determine their projects, in so doing, and they engage student voice by encouraging students to take full responsibility for their learning. This is what makes Project-based learning constructivist. Students work together to accomplish specific goals. More important than learning science, students need to learn to work in a community, thereby taking on social responsibilities. The most significant contributions of Project-based learning have been in schools languishing in poverty stricken areas; when students take responsibility, or ownership, for their learning, their self-esteem soars. It also helps to create better work habits and attitudes toward learning. Project-based Learning students also learn skills that are essential in higher education. The students learn more than just finding answers, Project-based learning Strategy allows them to expand their minds and think beyond what they normally would. Students have to find

answers to questions and combine them, using critically thinking skills to come up with answers.

Project-based Learning Strategy is a method in which students gain knowledge and skills by working to investigate and respond to an engaging question, or problem (Shaffer, 2018). Studies have shown that PBL strategy is linked to significant improvements in student test scores, attendance and classroom engagement. Furthermore, it also gives teachers the opportunity to build stronger relationship with their students (Shaffer, 2018).

Generally speaking, Project-based Learning Strategy urges students to build up a reasonable, different approach to solving certifiable problems. Project-based Learning Strategy prepares students for achievement in this present reality like no other teaching style can. However, a Project-based learning demands from students a heightened level of self-confidence, motivation, and ability to organize their own work plans. Teachers who teach Biology concepts through Project-based learning strategy will promote learning because it brings about engagement and where there is engagement, it will definitely lead to higher learning outcomes (Bas and Beyhab, 2017). Project-based learning system offers instructors the chance to educate, watch, and measure the development of veritable limits. What should a Project join into requesting to be seen for instance of Project-Based Learning Strategy? The five criteria utilized for the reasons behind this evaluation, which are as much of the time as possible referred to in the writing, are centrality, driving inquiries, helpful examinations, independence, and genuine application (Barron, Schwartz, Vye, Moore, Petrosino, Zech, Bransford; Insight and Innovation Gathering at Vanderbilt, 1998; Chime, 2010).

Project-based Learning Strategy concentrated on curriculum and learners. It is a strategy of an instructional method that allows students to generate questions and guidelines on how to work-out solutions to problems questions that was raised. This activities would be supervised by the teacher (Bell, 2010). Instead of students using teachers lesson plan which is always rigid in nature, this stategy allows learners to do more exploration and investigation on various project topic given to them to explore (Erdem, 2002). Thomas, (1999) described PBL as strategy that allows student to be the determinant of what to learn and how to go by it. They help learners to design their content and implement it. In Project-Based Learning Strategy, learners design,

facilitate also examine activities that can be directly related to life experience (Blank, 1997).

Classroom teaching-learning situations are specifically prepared and structure in a way to facilitate learning, learners would be adequately engaged and have opportunity to interact, explore and construct a brilliant idea of providing solution or find answers to complex topics, real problems and tasks is project-based learning strategy. It make learning real and simplify biology concepts that seems difficult to learners, makes abstract situation to be practical and real experience to students. More so, the strategy allow learners to learn at their own pace (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palincsar, 1991). The strategy made possible in the classroom because it make provision for every information needed for learners. This emphasize that classroom activities should be focused on learners, collaborate and be interactive session (Moursund, 1999). Project-based learning urge students to learn, gain experience enabling them to make revelations that will assist them with designing exercise substance that are identified with their condition (Moursund, 1999; Thomas, Michealson and Mergendoller, 2002). Learners are familiar with different of capacities and abilities, for instance, learners collaboration effort, adventure orchestrating, essential authority similarly as time the officials through PBL (Blank, 1997; Dickinson, 1998). Thusly, it extends motivation and attitude of understudies to learn.

When instructors pleasingly execute project-based learning, learners can be greatly stimulated, more engaged and excited about learning (Blumenfeld et al., 1991). PBLS is still in the formative stage. There isn't adequate research to state with conviction that this method is an indicated choice instead of different sorts of learning. Considering the affirmation assembled over the prior years, PBLS shows up, clearly, as presumably the best procedures for making gains in educational achievement (Meyer, 1997).

The strategy (PBL) is a student-focused way to deal with teaching-learning process (Gultekin, 2005; Condliffe, Visher, Banger, Drohojowska, 2016). Learning by doing is real learning strategy that allow learners to plan, execute, and evaluate projects that have genuine applications beyond the classroom (Saco, 2016). Students drive their very own learning through inquiry, interaction and practice by doing among their contemporaries. More so, as work agreeably to investigate and make projects that mirror their insight. Project-based learning strategy advocates conviction that it can

stir students who may by one way find school boring or meaningless, Project-based learning ensures a move in the process of learning in a school (Buck Institute for Instruction, 2011).

Bas and Beyhab (2017) considered the impacts of Project-based learning strategy on students' accomplishment levels and attitudes towards English exercise. The study was done between years 2009 to 2010 with two schools of grade five who were the participants, their population consisted of 50 learners in one of the Primary School in Nigde, Turkey. The consequences of the enquiry indicated a substantial distinction of evidence between the attitudes scores of the two groups used in the study. It was uncovered that the disposition of learners that got introduced to the strategy (learning by doing) were progressively effective and have an upper motivation level than their counterpart who were treated with the conventional strategy. This implies that the treatment was very consequential to improve learner's motivation and when students are inspired to learn this would affect their attitude and towards achieving learning goals. Holmes (2016) considered the impacts of PBL strategy in secondary arithmetic training. The research explored the merit of project-based learning on students' academic attitude progression and impelled methodologies for learning. Results demonstrated that students profited significantly from project-based learning strategy in learning arithmetic. PBL school children were all the more intrinsically propelled, indicated fundamentally higher basic thinking skills, and acknowledged peer learning. In essence, the approach found to be very active and impactful for in development of learners disposition in the direction of learning.

Project-based Learning Strategy include the encouragement of student initiative, self-directiveness, inventiveness, and independence. Another benefit of Project-based Learning Strategy is its effect on students' interpersonal skills. Students are grouped together to work, which cultivates relational abilities and energizes even students with assorted and perhaps conflicting characters to find a shared belief, or at any rate an approach to work together without steady strain.

2.1.2 Nature and Importance of Project-based Learning Strategy

David (2008) concluded that PBL Technique consolidates knowing and doing. Learners gather information and parts of the fundamental subjects, yet also apply what they know to deal with genuine issues and produce results. In project based learning learners use propelled instruments to make high gauge, network arranged items.

Project-based learning with the "situated learning" point of view and with the constructivist theories. Blumenfeld, et.al, (1991) Project-based learning Strategy is an exhaustive point of view concentrated on educating by connecting with students in learning forms, students seek after answers for nontrivial issues by posing and refining inquiries, discussing thoughts, making expectations, structuring plans and/or investigations, gathering and dissecting information, making inferences, conveying their thoughts and discoveries to other people, posing new inquiries, and making relics. The premise of Project-based learning strategy lies in the authenticity or genuine utilization of the examination.

The advocates of Project-based learning procedure allude to different points of interest to the application of its methods in the classroom, including a progressively vital significance of comprehension of thoughts, increasingly broad data base, improved correspondence and social/social abilities, overhauled organization aptitudes, extended creativity, and improved writing proficiency. Project based learning strategy is a kind of guide, where students coordinate to deal with genuine issues in their schools and society. Efficacious enquiring frequently anticipates that students should draw on practices from different fields and apply them in an exceptionally rational manner. The assurance of seeing an obvious impact transforms into the motivation for learning.

Project-Based Learning Strategy cultivates relational abilities and energizes even students with different and perhaps contrary characters to discover mutual understanding, or in any event an approach to cooperate without consistent pressure. Some portion of this collaboration building supports students with the specialization and appointment that are incredibly noticeable in reality. Certain students will normally be more proficient at some critical thinking strategies than others, so students will solve how to assign ability (themselves) perfectly by having portion of the gathering take a shot at one subset of work while another part deals with another subset. Project-Based Learning Strategy urges students to build up a reasonable, varied way to clarifying realistic challenges, alone and in a group. Project-based learning strategy equips students for progress in reality like no other learning style can.

i. There is basic collaborative pattern of learning in the study hall this would help learner in effective study.

ii. Begins with a section development that fills in as the impelled organizer to get and energize student interest.

iii. Is shifted around a bonafide, open-finished driving request.

iv. Established means to understand fundamental content and abilities and offers ways for students to decide during learning activities.

v. benefits from helpful solicitation to learn, issue to handle as well as to make something novel

vi. Develops basic reasoning, critical thinking, coordinated effort, and different types of correspondence, regularly tag as skills of recent time.

vii. Allows a growing point of learners' voice and choice all through the PBL unit.

viii. Consolidates info and correction with open entryways for self, companion and tutors evaluation of capacity, essential increasingly significant learning aptitudes, students made things and PBL methodology, for instance, research and presentations.

ix. Results in an unreservedly shown thing or execution.

x. advances and extends learners association (voice and choice)

xi. Is improved by blend of cutting edge aptitudes especially while mentioning that student do explore, make appraisals of the methodology, 21st Century basic abilities.

xii. Is improved when instructors is teaching and combine most effective instructional procedures, for instance, metacognition, helpful learning and realistic coordinators.

xiii. Allows for bona fide elective evaluations and rubrics for the recent time learning abilities similarly as capacity and their trade over the instructive program and into authentic conditions.

xiv. Can be used as a model for all secondary school in all existing and new elective instructions

xv. Enriches teacher's accomplishment with progressively significant learning results when proficient improvement propels instructors' bent improvement for figuring out ways configure and assess in all given learning activities.

xvi. Has strong related research showing predominance over regular instructional methodologies.

Project based learning (PBL) technique updates learning and prompts legitimately raised level academic improvement by students' involvement with innovative productions, it is very effective in promoting learners' ability and self-educating style which in return produce and bring about new idea of solving critical problems students may encounter in the process of studying. Learners are appeared to a wide degree of outlook (mentality) and inspirations driving verbalization, for example, invigorated exertion, experience orchestrating, key power, and time the heads through project based learning (Blank, 1997; Dickinson et al., 1998). The Project-based learning methodology helps students to develop a wide range of understanding and better attitude towards learning whereby teacher exposed learners to activities that are real, investigate and explore things around them. PBL extends the motivation of students. It grows basically from the relationship between the tutors and students, where students are successfully included into singular periods of the instructing and learning technique and they viably participate in tackling the issues. The Project-based learning technique less starts with the starter arrange where the teacher sets fundamental thoughts which the person being referred to explain with the activity.

The strategy can be allotted in the accompanying manners. As content to be fathomed hypothetically; as content, to be illuminate through customary; and as an incomplete test to confirm a hypothesis; the teacher organizes the students in gatherings; relegate obligations to each student to perform during activities. The teacher notes down each conceivable finding's and do an investigation to check the right discoveries. The teacher interfaces learning to life and practice and where the student can experience this, or less complex problems toward the end, the teacher goes with the students through the inquiries and tasks assign in their worksheets.

2.1.3 Concept of Self-regulatory Strategy

Students separate the learning assignment and set unequivocal targets toward finishing that attempt during the thinking ahead and arranging stage. At the point when learners adjust new subjects, regardless, they may not comprehend the most ideal approaches to advance toward the activity or what goals may be the most authentic. Instructors further allows learners to feedback on their experience on the field as often as possible. Unfathomably, when systems are new, learners here and there return to

utilizing constantly run of the mill and perhaps insufficient procedures. For instance, using a very close but not productive procedure like flash card by students to study biology as a result of its simplicity in the face of users than newly introduce strategy by their instructor which is more effective. But unknown to the user, interaction with the latest approach by the students could end-up to more gained and positive learning outcome, however, when learners use their abandoned learning approach would most likely end-up in less productive outcome. Close teacher checking and express examination can engages learners comprehend how to utilize new methods with acknowledgment, particularly if students face thwarted expectation. In the prop up reflection on accomplishment arrange, learners assess their presentation on the learning task concerning the common sense of the procedures that they picked. During this stage, learners additionally ought to deal with their notions about the results of the learning experience. These self-reflections then impact learners future organizing and goals, starting the cycle to start afresh.

Self-regulation is the procedure or practices that allows student to be in focus of learning whereby determine their learning style, supervise the way they learn and progress of their learning also gaining from each other as they learn. It is the way by which learning is being transfer from theory to practical and application of what they learn into the real life experience. Several strategies that mentor can introduce in both classroom and beyond are as follows:

Setting Goals:

This is a basic part of self-directed which can be an auxiliary based to numerous self-controlled systems. Utilizing this sensibly, it will give students capacity to screen the manner in which they learn and find their frail and quality point in other to make a fundamental redress. It empower learners to have understanding on what to be done, how to pass by it in causing it to actualise additionally urge them to act capable in making in doing anticipated work. It help students to set an objectives and achieved it by taking care of expressed objective from easy to complex. For example, when students are taking part in task at home, one of the learners may arrangement targets to screen the advancement of gathering exercises. The key learners may see time on the stack up as an issue and choose to release an obstruction to progress so as to accomplish the objective of finishing homework before dinnertime constantly that

week. In the same way, learners may get a handle on what they needs such as class notes home from school every day so that they would possess the information that is require of them to achieve the target of completing the aggregate of his schoolwork assignments for the week.

Self-Monitoring: this system set-out to screen students' exercises, whereby students checkmate themselves on how they participate with a certain goal in mind or conduct. Learners may test each other by tending to, am I utilizing my time in the correct manner to finish my learning rehearses at home (schoolwork) by dinnertime? learners may envision that it is dependable to self-checking for practices and keeping an eye on execution needs, for example, finishing all learning exercises at home.

Self-Instruction: this is one of the development of young children which is sometime called "self-talk". When use by learners in other to specifically self-regulate and direct their learning behaviour, this can be somehow powerful when used. For instance, a student who is endeavouring to understand a seriously structured book may think, I have to ask about the outcomes of new discoveries and read over and over for more understanding. Students can utilize self-converse with remind themselves to think, to make positive advances when looked with bothers, to help positive practices, and that is just a gander at something greater. Teachers can show viable self-talk, yet ought to relate each understudy to make and utilize her very own exceptional requesting. A little early system can be imperative here. In any case, putting aside a little effort to turn out some focal verbalizations before beginning another learning works out, learning task given to mentees to try at home can empower them to get themselves out of a difficult position.

Self-Reinforcement: This happens when a student picks an inciting prize and connects with themselves to achieve more when they attain a landmark. This system can be adopted for more than immediate knowledge of result as well as delay knowledge of responses period of learning activities also, it has capacity to blend with latest technology usage for learning. Our learner who has observed time-control as an issue, for instance, may pick, I can go out to cinemas on Sunday since I completed my homework before dinnertime dependably this week. Teachers and learners can pick repays together and tutors can show students how to win them.

Purposeful Learning: Improving as a self-director, it's a panacea for educational problems, at any rate students with educational impairments acquire efficient self-regulatory technique will have several benefits. Mentees have instruments in their kit which they can attempt to convey before looking for outside assistance at whatever point there is problem. Students perceived how action causes their outcomes, in addition understand that their learning is a purposeful, astonishing structure in which they observe the standard work. The best part is that self-managerial structure can profit all tutees.

Self-regulatory technique for perusing happens when an student eases back the pace of their perusing when stood up to with increasingly troublesome or less natural content. Obviously, checking on any part obviously material (address notes, writings, lab material, past tests and papers) that one doesn't recollect or comprehend that well while reading for a test mirrors a general self-regulatory system. During a test, skipping questions and coming back to them later is another methodology that students can use to direct their conduct during a test. Every one of these procedures are expected to improve learning by helping learners right their contemplating conduct and fix deficiencies in their comprehension. Butler (2013) examined what happens when instructors work cooperatively to enhance self-regulatory methodology through perusing in learners. They revealed the discoveries of a longitudinal venture wherein optional teachers worked cooperatively to help learners' self-controlled learning in classrooms. Self-regulatory technique is the capacity to take part in gainful exercises on one's volition.

It is a form of self-control, it is the good things one does when nobody is watching for example,

i. determining to come to school early
ii. determining not to leave school before closing hour
iii. determining to do all assignments
iv. determining to practice exercise on one's own and
v. seeking the teachers assistance

One of the profitable thing a self-regulating student can do is to have a determination to study. Emphasis on the following words of question: what, when and

how to study, similarly, punctuality, attentiveness and good use of free period. The participant must get used to studying without any prompting. A way to avoid poor academic achievement is to engage in self-study. Making this statement your policy ‘‘Read a book today’’. Don’t allow your work to pile up. Read every day even when examination is still far away. Learners must be ready to jot down points from important instruction both in and out of school. Availability of jotting materials all the time (pen and jotting book). It was stressed that a student who jots down points remembers more than their non-jotting counterpart. A self-regulating student is a voracious reader.

Passionate improvement and procedures of feeling guideline are viewed as affecting and being impacted by the advancement of official subjective capacities, including working memory, inhibitory control, and mental adaptability significant for the effortful guideline of consideration and conduct. Self-administrative System is additionally comprehended to mirror a developing harmony between procedures of enthusiastic excitement and psychological guideline. The potential for hurt proposes that elective methodologies are expected to deliver what might seem, by all accounts, to be a developing issue of ineffectively directed conduct in learners and the need among guardians for help with dealing with students' concern conduct.

2.1.4 Nature and Importance of Self-regulatory Strategy

Self-administrative (Self-regulatory) procedure isn't a mental limit or an insightful introduction inclination, rather it is oneself request process by which mentees change their mental limits into educational aptitudes Zimmerman (2001). Directly off the bat, self-administrative procedure incorporates more than bare essential data of a capacity, it incorporates the self-cognizance, self-motivation, and physiological ability to perform that concept appropriately. The point here is that immense differences have been seen between the way wherein amateurs and experts perceive their learning. Amateurs depend upon commitment from others, they weigh their attainment with those of others. They decline to set objectives or supervise their learning. Proficient learner deal with their learning at each stage. They detect when they have foiled but then focus on how they can fix what erroneously arose.

In addition, Self-regulatory Technique is definitely not a trademark that a few learners have and others don't rather it consolidates the particular utilization of unequivocal strategy that must be in a little while changed as per each learning activities. This has to do with appended to expressed goals, select a procedure to achieved the expressed targets, arrangement observing methodology and assess the procedure in other to check if the expressed goal is being cultivated utilizing time usefully, self-assessing the techniques picked, and adjusting future approaches subject to what was found this time through. At long last, there is a relationship between self-monitoring and self-sufficiency and trademark intrigue. Mentees need to recognize they can comprehend, whatever the goal before them, and they should be prompted. Various expertise as chess, sports, and music, the proportion of a students' considering and rehearsing is a solid marker of their degree of limit. The certifiable procedure of Self-regulatory Methodology can be a wellspring of inspiration, in any event, for those undertakings' that may not be moving themselves. Self-regulatory Procedure helps the learning technique, before the academic attainment is accepted. It enables students to examine the learning exercises or task given to them, assess expressed goals and build up a game plan of approach.

Irrespective of the competency of self-regulatory strategy to empower students and to expand their accomplishment, scarcely any teachers practically get learners ready to learn individually. Mentees are simply given a decision with respect to attainment abilities to perform, methodology for doing complex assignments, or study group. Barely any educators request that scholar grow express targets in regard of the learning assignment or measure their wellbeing on new aims. Zimmerman (2001) uncovered that educators don't give tutees chances to self-evaluate their work and most don't investigate learners' emotions about themselves. Self-administrative system unites the psychological, metacognitive, social, moving, phase of learning. It is from now on, a momentous umbrella under which an astounding number of segments that impact learning (self-sensibility, volition, and mental philosophies) are broke down inside a broad and expansive framework.

Therefore, Self-regulatory strategy has gotten one of the most significant territories of research. Numerous reasons had been detected why teachers currently favor self-regulatory strategy. Students are less disposed to partake in rehearses that

are dangerous. It outfits learners with significant opportunities to practice their social skills in a sorted out space. The tutor can then clearly screen social correspondence. Moreover, getting or giving self-regulatory strategy to rudimentary age learner with conduct issues is better in schools. They particularly improved in perusing, jargon, and increase realities.

Administration for Children and Families (ACF) in their report the key considerations for understanding Self-regulatory Strategy in setting, including the relationship between self-viability and self-guideline, incorporates the sorts of self-managerial intercessions that have been assessed, the sorts of people groups that have been considered, and the idea of proof for various sorts of results for various ages. Lastly and explicitly, we address how our present theory and learning of self-regulatory procedure may apply to various Administration for kids and Families (ACF) programs, including those youngsters and families living in tribulation. A blend of self-rule intercessions acknowledge huge valuable outcomes on mental, vivacious, and social self-rule correspondingly as logically wide results transversely over progress like energetic wellbeing and scholarly accomplishment. Notwithstanding, results are very factor, with different mediations neglect to discover fundamental impacts. There are in like way different openings in the to and fro development confirmation base for self-regulatory method, and continuously creative work is required. Specifically, there are different regions where mediations could be redesigned utilizing a section of the standards and assessments.

i. Provide an increasingly purposeful and focused on center around self-guideline, where intellectual and enthusiastic guideline aptitudes and their reconciliation are deliberately instructed.

ii. Increase the attention on creating expressive guideline aptitudes during youth.

ii. Provide support for parental figures' own self-guideline with the goal that they can meet the self-guideline needs of helpless learners.

iii. Teach (guardians, educators, guides, or program staff) of mentees of any age to display, mentor, strengthen, and bolster self-guideline aptitude advancement inside the setting of a warm and responsive relationship and positive conduct bolster abilities. We call this procedure "co-administrative" instruction.

Many promising intervention approaches exist for supporting self-regulation progress that could be melded into existing ACF programs, including many evidence based kids raising tasks likewise as brisk capacities direction with students. Complete self-guideline intercessions would unite interventions joining attitude direction and self-regulatory getting ready, mediations gave transversely over movement and settings, self-guideline preparing for students, and support for watchmen stand-out self-managed limit. Care is required in picking those that might be a useful for significant people groups and settings despite impacting result zones of intrigue. Express exercises ought to also be picked carefully given amazing irregularity found in results. Additional execution thoughts joins: getting ready structure staff in how self-administrative methodology grows so they can sensibly show it, and coach it in standard practice conditions for learners, and using best practices recommended from use science. Given the noteworthy effects that self-regulatory technique can have transversely over zones of working into adulthood, and given that no single intercession is likely going to accomplish significant built up self-administrative destinations, we endorse a self-rule system to help the achievement of understudies living in setback, (Zumbrunn, Tadlock and Danielle, 2011). Self-managerial Strategy is seen as a basic marker of student scholastic inspiration and accomplishment. This procedure foresees that students ought to energetically plan, screen, and evaluate their learning.

2.1.5 Practical Skills in Biology

According to Fore (2018) official chief of the United Nations Children's Agency (UNCA, 2018) upheld that learners ought to be given applicable information for their future business, from plant harvesting to computerized innovation. Constantly 2030, half of the world's youngsters won't have the essential abilities they have to find a new line of work. So essentially getting tutees into school and giving them customary instruction isn't going to be sufficient. Helping them to get familiar with the abilities they requirement for the employments of things to come will be pivotal. Fore (2018) accepts that auxiliary schools ought to show increasingly handy abilities and advanced information to plan adolescents for what's to come.

The European commission (2010) made this known to the world that the main major causes of any productive educational structure in any Nation is the how well equipped and knowledgeable of its teachers in handling and the use of appropriate and

accurate approaches to teaching-learning ways that yielded quality result in terms of development of human capital and strong economy. This is because the instructional strategy used at the long-run enhance the students' performance and this in turn affects the necessary changes that will result in the facilitation of the expected outcomes of the educational system (Ukoh, 2012).

Practical activities in Biology enable learners to be more interested in learning science subjects because through practising which will help them to understand the concepts. According to Nzewi (2008), practical activities helps students and instructors to make teaching or learning more real, make abstract or theoretical concepts to be more factual to learners. The author maintained that when students are exposed to practical activities, it engage learners in hands-on, mind-on activities, also help students to be able to make use of different kind of materials or instructional aids to drive learning. The conventional instructor-as-information-supplier has neglected to achieve the ideal result of delivering thinking learners. Researchers therefore suggested that practical's most especially in biology should be made mandatory to teachers and students to enhance their problem solving skills.

Throughout the years, approaches to upgrade the securing of aptitudes for common sense's for powerful educating and learning has been consistently be a steady needs in instructional framework. Since handy is the securing of aptitudes which is the bases of science improvement. Ibe (2004) stated that handy abilities enable students to create skills independent from anyone else by experience and rehearsing what they have realized. Correspondingly the maker in like manner investigated the American Relationship for the Progress of Science built up a program known as 'Science A Process Approach' (SAPA) this program sees supportive as clear exemplification of science. The program was proposed to improve youths' abilities during procedure of science. Ajunwa (2000) revealed that science teachers and informational program specialists changed them by either making or assembling them to suit their needs One of the national objective of direction is that presence of mind aptitudes in science subjects must be made required in other to help learners with getting huge limits, science farthest point and headway competency in other to have the choice to have a living aptitudes for the future profit and take part in building general society (FRN, 2004).

Moreover, this invariably can as well lead to learners' poor academic performance in senior school certificate examinations (SSCE). However, improving

students' performance and development of self-actualisation through knowledge of sciences is the major concern educational stakeholders most especially the science educators. In spite of all the benefits inherent in the acquisition of skills in practical Biology, students flounder, are ill-prepared and perform poorly.

However, UNICEF (2018) Chief stated that secondary schools must teach more practical skills. Practical activities provide opportunities for learners to genuinely do science (Biology) instead of learning about other science subjects. Ehikhamenor (2013) referred to practical skills as the processes scientists use in conducting science. Practical skills promote logical sequential problem solving which can be used in many aspect of school life (Webb 2012). The examiners have therefore suggested that because of the poor skills demonstrated by the students, there is need for Biology teachers to help students develop these skills by teaching them better (May/June, 2015 WASSCE Report). The practical skills that were tested in this study include the following; observation, recording, drawing, labelling, manipulation of apparatus and classification. These skills were selected on the basis that these are the specific areas where the WAEC and NECO Chief Examiners in Biology reported the students do have problems.

Moreover, it has been noted that practical's are an essential part of Biology education, and presents with necessary skills for higher education and employment, deepens their knowledge of scientific ideas and enables them to engage in the processes of Biology. Interestingly, hand-on ability enable learners to understand science and how scientific ideas are developed because it's formative in nature (Watts, 2013). To achieve the goals of Biology education, it is imperative that an attempt is made to balance emphasis on both theory and experiments. Experiments in Biology illustrate the fact that Biology is not a theoretical abstraction as it describes the real world around us. Authors and researchers have identified some factors that likely to be responsible for the unproductive performance of learners in Biology and other related sciences subject in secondary schools. These factors may cut across all levels of education where Biology is offered. The identified factors include; textbook and laboratory based reasons (Ivowi, 2000), misconceptions of concepts identified (Olagunju and Abiona, 2004; D'Avanzo, 2008), large class size (Olagunju, 2005), and insufficient practical skills (Danmole, 2012).

The reasons for practical skills include: motivation of students; fervor of disclosure (excitement of discovery); combination of hypothesis (consolidation of

theory); improvement of manipulative skills; information on standard strategies; general understanding of information handling; advancement of different skills like logical, evaluative, planning, applied and numerical (mathematics) and developing an understanding of how Biology functions through idea of logical procedure, collective working, reproducible outcomes and reasonable testing. The study also discovered that state of teaching science most especially Biology had really gone bad in Nigerian schools, this approach was more of contents which was teacher centred rather supposed to be students centred that allow collaboration effort by practicing what the teacher exposed learners to in the classroom. This limitation have caused diminishing in aspect of students attitude to study Biology, the multiplier effects of this have great implication on students' performance (Watts, 2013).

Nevertheless, there are various factors attributed as problems that affect the acquisition of skills by learners most especially secondary level of students, similarly poor teaching method in practical aspect of science could also be a major factors in teaching and learning science, this have found contributing to poor performance and poor attitude in instructing-learning process (Nwagbo, 2001). Moreover, Okoli (2006) displayed that distinctive science teachers lean toward the standard system for enabling that is, a demonstrating structure whereby the instructor, shows a passed on chat on a particular subject and evade action masterminded demonstrating procedures which are student loped, (for instance, demand methodology, divulgence strategy, logical lab approach). Nwagbo (2008) saw that such teacher centered methodology which puts the instructor as the sole holder of information and the students as isolated recipients of learning may not improve accomplishment. Practical limits is a key factor in interfacing with, enthusing and propelling mentees, thusly enlivening significant set up interest. High bore, genuine proper aptitudes are irreplaceable to reasonable instructing and learning. The general public accepts that it is critical to help and elevate pragmatic abilities because of the accompanying:

i. Stimulates imagination, interest, and basic reasoning
ii. Underpins and delineates ideas, information, and standards
iii. Promotes learners commitment with the logical strategy
iv. Encourages dynamic learning and critical thinking
v. Allows collective working
vi. Provides chances to gather and dissect information and apply numerical aptitudes

Another significance of common sense abilities is that from the littlest of life forms to the biggest, at an atomic level through to the investigation of populaces and their collaborations with an evolving world, the innate fluctuation related with the down to earth investigation of life forms and organic material requires explicit educating of fitting, numerical, factual, and displaying aptitudes. It is essential to help and advance top notch reasonable abilities since it:

i. illustrate the excellence and unpredictability of the living scene
ii. Promotes comprehension of how to remove data from complex living frameworks
iii. Provides experience of examining and assessing variable information
iv. Highlights and advances the discourse of moral issues
iv. Gives tutees the abilities to handle worldwide difficulties

Great guidance includes exchange of investigations, perception, and hypothetical deductions. For examinations to be utilized there ought to be a research facility with essential hardware and consumables. The lack of these hardware and consumables in many schools combined with a deficiency of qualified and experienced instructors has made it hard to evaluate viable science abilities and consequently its developmental capacity, of helping with getting science and how logical thoughts are created, has not been accomplished. In spite of this, analyses would at present should be directed and evaluation of down to earth's done as a significant segment of evaluations in confirmation assessments on finish of auxiliary school. Instructors assume a significant job in the planning of students for affirmation assessments in conveyance of hypothesis exercises and lead of handy activities. The inquiry, which at that point must be addressed is the thing that evaluation rehearses are utilized in the arrangement of mentees for the affirmation assessment. In order to assess practical skills in science, two approaches have been used: direct and indirect assessment.

Manipulative skills involve proper handling of apparatus, setting up of experiment as well as the preparation of instructional materials. Assessment on manipulative skills is based on direct observation of students when they are doing their laboratory work. Observational skills involve students' ability to observe what takes place during practical investigation. Communication skills are essential skills which involves students' ability to represent findings of practical skills in a logical manner with correct illustrations; cognitive skills also measure the understanding of the theoretical aspect of Biology in a practical test.

As demonstrated by Abraham, Reiss and Sharpe (2013), while direct evaluation incorporates tutees controlling indisputable articles to show down to earth abilities, the circuitous appraisal incorporates translating students' competency from the data they make as well as reports of the handy work they endeavoured. Evaluation is affirmed as it drives instructing and learning (Pollard, et al., 2000). In the evaluation of common-sense work different typologies have been used. Watts (2013) depicted seven sorts of science pragmatic appraisals which include: standard useful task or evaluation formed evaluation which studies down to earth work, examinations, activities, and aptitudes centered appraisals; arrangement of required evaluations, and homeroom-based appraisal. Each of these is depended upon to yield reliable information about aptitudes constrained by learners.

In Nigeria, the Science educational program for instance suggests that the guided disclosure approach be utilized in the instructing of the subject. The exertion is to encourage the innovativeness and obtaining of down to earth aptitudes and frames of mind by the students. Thus, it is normal that the accentuation ought to be on drawing in mentees in experimentation, addressing, talk and critical thinking. Unfortunately, it would appear that these have rarely been successful (Afemikhe and Imobekhai, 2014) and most schools wait till a few weeks to the commencement of final examinations before practical activities are given much impetus. Under these circumstances what kind of practical skills assessment is predominant in Nigerian schools? The ability to accurately observe, dissect and record an organism is a key skill for students. Many students are intimidated by the idea of making a scientific drawing, and struggle to develop their skills in this area.

Teacher observes students undertaking practical work and rates them are not unexpected as experience shows that hands-on activities that supposed to be the brain behind science subject are fading away in resent time, this effort should be a deliberate practices in other to make actualised the objective of science course in our educational system. However, it has been observed that learners only got exposed to this aspects of learning only when about to write final examinations approach (Afemikhe and Imobekhai, 2014). Under such circumstances the ‘fire-brigade’ approach may be adopted leading to teaching to the test.

Abrahams and Saglam (2010) recommend that mentors' three expansive points regarding handy aptitudes can be arranged into three spaces: procedural, applied and full of feeling. They found that instructors need: to energize precise perception and

cautious account, to advance basic, sound judgment, logical techniques for thought, to create manipulative aptitudes, to get ready students for surveyed functional work, to excite and keep up enthusiasm for the subject, to make natural, substance and physical marvels all the more genuine through genuine encounters (Abrahams and Saglam, 2010). The importance of practical skills can be succinctly described in the following ways:

i. Practical skills enhances pupils' development of the ethnical dimension of science like curiosity, humility, scepticism, objectivity, open mindedness, determination, careful observation and persistence.
ii. Consistency in investigating science results in the perfection of the skills of doing, motor skills are learnt by doing.
iii. Engaging in practical consolidates the understanding of scientific concepts, hypotheses, laws, facts, theories and principles.
iv. Practical skills increases the ability of critical thinking and instils confidence and the spirit of inquiry in learners.
v. Practical skills instils the spirit of cooperation and active participation among learners.
vi. When learners engage in practical work, their interest are aroused, they raised questions, probe into situations and solve problems. They apply what they learnt into new situations.
vii. Doing practical work enable s the evaluation of students learning
viii. Practical activity plays a vital role in consolidating teaching.

Raimi and Fabiyi (2008) also observed that not much research has been carried out on students' acquisition of practical skills. This implies that students do not possess sufficient practical skills that can aid their problem solving skills. This might have been caused by the instructional strategies used in teaching and learning Biology which do not promote the development of practical skills. This accordingly proposes a self-action based showing procedure which encourages students' support and dynamic inclusion in the learning procedure would be a suitable choice for tending to issues related with students absence of common-sense abilities. The American Relationship for the Headway of Science (ARHS) recognized fifteen of these aptitudes as exhibited by Akereja (2011) these abilities are: perception, estimating, arrangement, testing controlling of mechanical assembly, correspondence recording, Foreseeing, deriving, tallying numbering, utilizing space time relationship, survey, controlling factors,

conjecturing, characterizing operationally, detailing models, deciphering information and marking.

2.1.6 Mental Ability in Biology Concepts

Adetoro (2014) states that mathematics ability is related to mental perception, capacity for abstract thinking and capacity to recognize patterns in things. It is also related to sequence and order of nature, and ability to do logic and interpret data, culminating in the production of useful information. She further affirmed that different topics in science and mathematics require different abilities such as:

i. Ability to perceive formalized mathematical materials;
ii. Ability to relate general modes of description to concrete situations;
iii. Spatial ability;
iv. Ability to comprehend and construct complex structure;
v. Ability to perceive details embedded in irrelevant material ‘‘perceptional speed’’,
vi. Ability to get information and understand the properties of given objects cognition;
vii. Ability to arrange element in visual structure;
viii. Ability to draw conclusion to reason logically;
ix. Ability to form mathematical gestalts,
x. Ability to perceive a problem as a generation of a problem already solved;
xi. Ability to decode on how given information should be treated ‘‘evaluated’’,
xii. Ability to synthesize or separate data- globalization;
xiii. Ability to assess adequately varied information.

All these skills are necessary for students for positive developmental outcomes. Thus, for effective understanding of various topics or concepts, mental abilities listed above are quite essential. Abimbade (2007) and Orukotan (2006) are of the view that mental ability has the capability of categorise between high and low ability learners.

Sangodoyin (2011) found students mental ability to be very noteworthy and impactful on academic attainment in biology in a study that was carried out to check the influence of the subject matter. The researcher further explained, as students with high mental ability performed better than those with low mental ability. Among all the variable that was used to checked if they were effective or not in the study, mental ability alone was found to have momentous indication of direct link in improving

participant academic ability. This suggests cerebral capability is a concept that cannot be left behind in helping learners to build and developed their ability most especially when it comes to science oriented subjects.

Learners are expected to possess the ability to carry out a whole range of useful physical tasks through a variety of mental activities, as they begin with the basic rudiments of motor skill to the perfection of a complex skill. Learning motor skills involves repetition and skills are perfected by doing. The skills are transferable and need to be practical to maintain good performance. The basic skills in practical work include performing, investigation and reasoning (National Science Board, 2008). Skills in practical skills are inter-woven, embracing both physical and mental tasks. In addition, science experiments require the exhibition of certain important skills, which students gradually develop through appropriate practice. These skills are paramount to practical work and students must possess the knowledge, understanding and training to perform the activities which include:

i. Always indicating the magnification of every drawing.
ii. Presenting neat, clear and well-labelled drawings
iii. Lines of drawing should be clear, unbroken and uncrossed.
iv. Handling materials, samples and specimens with care and caution.
v. Giving drawings relevant, meaningful and unambiguous title.

Olatoye and Aderogba (2011) chose the activity of learners' verbal and numerical limits on the display of senior assistant school science tutees in bowed tests. 200 senior assistant school science tutees were involvedusing three affirmed inquire about instruments to accumulate data and backslide assessment gadget for data examination. Revelations revealed the nearness of a strong association between students' numerical or mental limit and general learners' accomplishment.

Oyedeyi (2011) examined the prescient impacts of arithmetic abilities on student's accomplishment in science in junior optional school. An example of 500 understudies was haphazardly chosen from 10 junior optional schools (JSS 3) in Benin City, Edo state, Nigeria. The examination embraced an arithmetic test titled trial of arithmetic abilities and the subjects, more scores in science and the relapse investigation uncovered critical connections between the arithmetic aptitudes and science accomplishment.

2.1.7 Learning Styles in Biology

Students gain from different perspectives, every individual has a stand-out style of assimilating information, and this is known as their learning style. Our learning styles are as individual and extraordinary as our traits. Various students are oblivious of having a learning style let alone getting a handle on it. The primary purpose of this style is to show how learners adjust to beat position of learning. At the completion of the VARK review, students get a feedback on their learning activities and evaluate themselves on their best performance.

By and large psychology, enthusiasm for learning styles returns to in any event the 1920s when Carl Jung proposed the theory of mental sorts (Sternberg and Grigorenko, 1997). In the field of education, the learning style idea has been perceived since at any rate the mid-1970s (Griffiths, 2012). In this way, a wide range of measurements of learning styles have been explored both conceptually and empirically, and various speculations and numerous taxonomies endeavoring to portray how individuals think and learn have been proposed, often classifying people into unmistakable gatherings (for instance visual versus auditory, global versus analytic, inductive versus deductive). Moreover, different learning style instruments have been created for both research and educational purposes (for a basic audit of probably the most persuasive models and instruments, (Coffield, Moseley, Hall, and Ecclestone, 2004). Sternberg and Grigorenko (1997) distinguish 3 standard motivations that develops learner's eagerness for the exploration of styles in assimilations (learning style):

i. Providing a connection among discernment and character;
ii. Understanding, foreseeing, and improving instructive accomplishment; and
iii. Improving professional determination, direction, and conceivably, and position.

Supporters of learning styles assessment in course recognize that learning styles can be evaluated and utilized as a noteworthy demonstrating gadgets inside the study hall (Sternberg, Grigorenko, and Zhang, 2008). As exhibited by these masters, by diagnosing students' learning styles and arranging them to demonstrating frameworks (for instance for a 'visual student', indicating data through pictorial depictions), learning can be amazingly refreshed. Besides, paying little respect to the manner in

which that people may have some solid style propensities and tendencies, learning styles are not fixed systems for direct, and, thinking about various conditions and assignments, styles can be expanded and changed (Reid, 1987; Oxford, 2011). Thus expect their nonattendance of comprehension in a class is only a direct result of their nonappearance of information or obsession as approved by their teachers and guidance. It is noteworthy that we choose the prerequisite for the insistence of learning styles in our instruction framework (Connerr, 2008).

2.2 Theoretical Framework

2.2.1 Social Constructivist Theory

The theoretical establishment whereupon this investigation is fabricated can be found in constructivism. Constructivism follows its root through Piaget, Dewey and Vygotsky. Constructivist theory connotes that knowledge is a social advancement where children construct understanding by consolidating language, valid conditions, correspondence and encouraged effort among peers, people around and things they can relate with in their environment. The students are viewed as focal in the learning technique. Major principle that influence learning is individual characteristic which comprises of person encounters, environment both physical and mental improvement. At the point when roused, the student practices his will, assurance, and activity to assemble specific information, convert it, define speculations, test these suppositions by means of uses, communications or encounters, and to make evident inferences. At the same time, learners are not mere absorbers of knowledge rather they are active participants in constructing their own meaning on the basis of strongly held perceptors (Larcohelle and Desautels, 2009). The constructivists, according to Mahoney (2004), believe that learning is infinite and not subject to scientific or other measures. He said that learning that occurs in isolation is inert.

In the present study, information technology have found to be the act of constructivism where learners construct knowledge through information. In constructivist classroom, rather than the conventional educator, where the teacher acting as facilitator and a guide, instructors would be the one to who plans, makes, controls, and offers headings to the student, who is subject for his own stand-apart

stand-isolated learning. Constructivism includes a working activity for students in their learning framework (Glasserfield, 1995). It likewise raises joint effort with others to assist students with stirring up different points of view that can be utilized together to manage issues (Matthew, 2003). Teachers give necessary assistants to learners by means of systematically organised practicable learning tasks that help students in critical thinking, which promote their creativities and construction of learning information. Students in group activities cooperatively solve learning task easily, discovered solutions to major problems, this along so many things that help learning condition of students. Rubric for evaluation in constructivist study room is not a test, rather it is meant for learners to understand their learning progress in other to be able to work on weak area and improve on their learning style

The two scholar (Jean Piaget and Lev Vygotsky) are of the opinion that leaning condition should be constructivist, in essence, there are guideline that constructivist must follow most especially when it is being done in the classroom environment. This theory (constructivist) allow students ability to develop a positive interest in natural, innovative and synergistic activities during information development (Kim and Bonk, 2006). The researcher acknowledge that while watching others, one structures contemplations in regards to how new lead are performed and this idea fills in as a guide for movement in later occasions (Adetoro, 2014). The importance of these theory stays in progression of participatory and dynamic adapting similarly as the effects of people and things in nature of the student which put obligation on the instructor to utilize appropriate academic methods prepared for making students get the right information, show reasonable disposition and charming helpful capacities in their methodology of relationship in the examination lobby and the overall population free to move around at will. Collectively, instructors acknowledge the progression of capacities should be an essential objective of training (Pithers and Soden, 2000).

Piaget's Constructivism

The world of Piaget (1896-1980) can't be overlooked for his wide investigations on developmental psychology research, which give an understanding on arrangement of learning by plans, adjustment and disguise (changing existing plans or making new ones). The researcher built up that students develop learning through these three point referenced previously. Furthermore, when learners are exploring their

environment, interact with things that are real this could be consider as enthusiasm that drive students to learn and construct knowing. Students develops understanding from existing ideas, not only that, they build and create new concepts from old ones. Clear relationship among existing plans, sponsorship, settlement and concordance would follow learning a fair way. Piaget investigates four uncommon events of the psychological improvement of the criticising mentees also view instructors should consider these important stages of learning process.

According to researcher, child mental ability development start at tender age, this could be termed as from conceptual age 0-2 verifiable encounters and motor takes a shot at bearing. High level of assimilating information in a kid start from age 2, while comprehension of ideas, relate and development of information through mental depiction begin at the level that children start create mind of themselves which can be classify from second year of a child to the level of age 7, at this point children are beginning the solid operational stage up to the age of eleven years old. At this point they realise understanding is subject to solid references. However, the next stage of child development according to scholar, is formal operational stage (following 11 years of age) at this point children outstanding thinking beginnings and the learners begin to give consideration to things they learn within their environment, give probabilities in decision making , having affiliations in their relationship and analogies.

Scholar's developmental study of learning and constructivism rely upon introduction as showed up by his constructivist hypothesis, so as to give a perfect learning condition, adolescents should be permitted to make information that is fundamental for them. Piaget recognizes that a constructivist study hall must give a blend of activities to move learners to perceive singular differentiations, increment their status to learn, find new thoughts, and amass their own uncommon information. Correspondingly, utilization of video players, D-ROMs and propagation programming have improve level of digestion by students, however multimedia communication gadgets, such as cloud-based broadcasting in an internet community settings. In other word the framework influencing the social improvement of information.

Learners can arrange cooperative exercises, which may come as a filtered through making experience that interfaces with them to get and give immediate

reactions. In a focal Piagetian indicative room, solid learning experiences, for example, drawing, sensation, model structure similarly as taking mentees for excursions that grant hand-on-realizing which their ability to view things, hear sound, have contact with things around them also be able to taste and perceived aroma are very essential to learning constructions. These early activities and the usage of clear manipulative and visual accomplices fill in as building upsets for sensibly current assignments, for instance, getting understanding

Vygotsky's Constructivism (1896-1934)

The researcher was recognised to be the founder of social constructivism, which have faith in knowledge of assimilation and growth is a cooperative task also young children are cerebrally developed within the knowing and socialisation environment. According to the study children thoughtfulness and remembrance abilities are change by vigorous reasoning devices make available through culture, for instance society tradition, language and religion to mention but a few. However, before knowing can take place, little children would in the first place get in touch with or familiar with their environment and therefore internalize this experience. Moreover, it has been observed that previous knowledge of a child have a way of influencing the current experience which the child would now build a fresh concepts on.

In a Vygotsky study-room, dynamic guide and mindful direction are given essentially reliant on the learners needs, at any rate no will or weight is coordinated. Scholars are revealed to dialogs, examine joint efforts, computerized data assets, and undertaking organizations that work on inconvenience examination. A maritime science class could see records on city water satisfactory and chat with mentees in various schools. The multiculturalism student can expand on line genograms (family trees), and purchase in to genogram databases in examine for loved ones and the foundation of their establishments. The researcher study is recognised as social constructivism as a result of noteworthy of values as well as social settings. The study emphasized the zone of proximal development, in other word, the gap between the real change of a child as necessitate through difficult explanation guided by higher knowledgeable other or through interaction with their age grade. Nevertheless, the study indicated that social relations, for example parental or guidance support, learners

may know how to conceptualised knowing that ordinarily it may not possible for them to achieved by themselves.

The Vygotsky Classroom

A Vygotsky stress one's ability to develop own thoughts or idea also assist them to be able to use their personal idea to generate information. This implies that study within the school occur in a very unique setting, as well make learning in that regards to be more understandable and real not virtual or imaginary concepts to the learners. As observed before in the Piagetian examination hall, this model in like way advances the dynamic endeavor and made effort out of explicit learners. The Vygotsky classroom stresses helped presentation through teacher- tutees and student connection. A piece of the psychological systems that party individuals bring into the assessment passageway are tending to, interrogative, guessing, brief and illustrative.

In the scholar's classroom, dynamic help and kind direction are given dependent on the student's needs, however no will is directed. Learners are presented to dialogs, investigate composed endeavors, electronic information resources, and assignment packs that work on issue examination. A few instances of study campaign rehearses that may be utilized in a beneficial report hall are as indicated by the going with the following: A political science learners may know how to make use of system replication (simulation) to adopt a general matters as representative of United Nations. Similarly, student of geography in another country can with the help of simulation take a virtual trip of tourist to a far distance. More so, the news agents could make public an information to general populate through cloud media, uses of soft materials of checked photos, expels from the press and graphs about a ceaseless encounter to space. Even, instructors of final year grade 6 learners of history may dispatch her learners' media introductions of urban establishments that predominant in Southern America. Students of aquatic study through the help of technology can witness information on what related issues pertaining their study as well make contact with their study mate from different location. This connotes, learners can create a network channel via online also provide a deep research for more understanding of their subject matters.

Conclusion

Both Piaget and Vygotsky regarded the representation of building makes and concealing the learning given, as opposed to bearing the data as showed up through excess memory. Constructivist learning conditions raise the learner to gather, channel, discrete, and consider the information offered and to remark on this learning with the target that it will accomplish individualized affirmation and private learning. This sort of get-together learning will decrease the dispersing of fake information, inclination, and barbarities among arranged parties and help build up a good, relentless, information society in the new thousand years. Be it developmental or social as proposed by Piaget and Vygotsky autonomously, learning is the central headway for individuals in search for understanding the conditions and last consequences of standard contemplates, the advancement of get-togethers, and the significance of life. Utilizing a learning approach like this assistance to presented youngsters to comprehend their condition better.

Constructivism in Relation to Project-based Learning and Self-regulatory Strategies

Project-Based Learning Strategy is established in a constructivist hypothesis of schooling and goes back to John Dewey in the last part of the 1800s and mid 1900s. The understudies learn best when "wholeheartedness of direction is available". The advancement of this type of training was a reaction against the unbending, educator focused methodology that arose because of the modern transformation. According to constructivist hypothesis, PBL strategy have various capacities and can too give so numerous occasion to make over examination room into enthusiastic learning place, all in all, the methodology offer possibility of transforming showing space into a genuine learning exercises whereby students would relate with things they can instruct, feel and hear this would assist them with disguising and furthermore comprehend their surroundings. For this situation, Students' examinations are orchestrated and work around certain assertions improvement addresses that would drive the reason for student’s examination, this exertion have all the earmarks of being valid and incorporates significant substance of topic, since students are presented to hypothetical ideas alone as well as managing genuine item and circumstance. In endeavors to give answer for issue addresses that educators created for investigation,

schoolchildren cooperate to shape a group, interface socially and connect with higher proficient request around them, this would assist them with having the option to deliver bundle or item. Essentially, with the utilization of creative gadgets since PB guidance involves extensive changes in study hall rehearses, we detail related difficulties in establishment. Gotten from the educator advancement writing, our model for supporting instructor centers around a dynamic exchange of coordinated effort, order, and reflection.

Dewey (1897) supported a kid focused methodology in which social advancement outweighed psychological turn of events, underscoring learning to thoroughly consider learning what to think (Darrin, 2015). He likewise preferred a coordinated educational program that was not compartmentalized. Dewey (1938) was notable reformer and is frequently credited as the author of Project-based Learning and an advocate of reformist schooling. Dewey (1897) delineated his instructive way of thinking, and coming up next were a portion of his key convictions which structure the establishment for Project-based Learning (Dewey, 1897).

i. Activity is fundamental for learning and should be for significance, purposeful, and not erratic. To use the movement, it should harmonize with the interests of the understudy or grating and disintegration of the student's nature will result.

ii. The instructor is capable to take advantage of the students' sense and indicated wants so that education can be lifelong. The instructor is fit not to constrain certain contemplations or penchants in the learners, rather should pick the effects which will impact the student.

iii. The focus of learning for the students is engagement and not subjects. Learning should be dynamic and not aloof. At the point when learners are in detached learning mode, they just assimilate data, which conflicts with the characteristic law.

iv. Abruptly acquainting the student with studies, for example, perusing, composing, and geology at a pre-decided time is an infringement of the learners' inclination and can be detrimental to the drawn out instructive achievement of the student.

By engaging students in Project-based learning and Self-regulatory strategies on variety of activities, students develop and apply practical skills. It has also been

discovered that student's sense of reality is based on their interactions with the environment and material in it (Piaget, 1954), that is the reason for innovative learning where materials and objects from the children's environment enable them to recognize, verify and store experiences future. Just as the acquisition and recall of basic knowledge remains important, the development of Project-based and Self-regulatory learning have emerged equally important and the strategies find balance to facilitate the acquisition of basic knowledge in order to develop and nurture critical thinking in education which is pivot to the acquisition of great achievement, right attitude and practical skills in Biology.

2.2.2 Fleming's VARK Learning Style Model

Neil. D. Flemings VARK Model (VAK) of 1995 which was set up upon before neuro-phonetic programming (VARK) Models: visual learners, sound-related students, investigating making inclination and kinaesthetic students. As showed by Flemings, as an educator, ones best choice is to utilize an assortment of instructing methodologies to give all students the most-clear opportunity to succeed. Further, most students have a staggering or upheld learning style, regardless a few mentees have blended and comparatively adjusted mix of the four sorts: visual, sound-related, looking at and framing, and kinaesthetic (Fleming, 1995).

Visual (V)

This propensity recalls the delineation of data for maps, 8-legged animal plots, follows, traces, stream charts, stepped diagrams, and all the specialist shocks, circles, dynamic structures and different gadgets that individuals use to address what could have been exhibited in words. This mode could have been called Graphic (G) as that better clarifies what it covers. It rejects still pictures or photos of this present reality, movies, narratives or PowerPoint. It wires structures, whitespace, models, shapes and the various philosophies that are utilized to highlight information. Right when a whiteboard is utilized to draw a diagram with gigantic pictures for the association between various things that will be huge for those with a visual tendency. It must be more than insignificant words in boxes that would be vital to the people who have a researched and make propensity. Seeing contains the accompanying properties mind a part of the time strays during verbal activities; watch, rather than talks or acts, may

quiet normally, sifted through in way to deal with oversee tasks; likes to look at; regularly a nice speller; recollects by making mental pictures; thinks in pictures; effectively put off by visual interferences; finds verbal orientation irksome; reviews faces; strong on early presentations; likes drawing and doodling, may have incredible penmanship; values utilizing concealing; sees detail; oftentimes a snappy scholar; may concentrate on the comprehensive view and use course of action early.

Aural / Auditory (A)

This perceptual mode depicts an inclination for data that is "heard or spoken." Learners who have this as their principle inclination report that they gain best from instructors, peer-learning, radio, email, utilizing cell phones, talking, web-visit and talking things through. The Aural tendency joins talking for all to hear in like way as visiting with oneself. As frequently as potential students that falls into the classifications of this tendency are relied upon to be screen by talking first, as opposed to through assessment and at some point later talking. Hearing includes the accompanying characteristics: discusses self-so anyone might hear; cordial commonly; murmurs to self while perusing , may murmur or sing while at the same time working; likes to be perused to ; might be explicit about the distinct determination of words; retains by steps in a gathering; extremely aware of musicality; adequately occupied by uproars; may encounter issues with made directions; recollects names; may overview people by the sound of their voice; acknowledges music and traces of words; values talking and listening ; can recall and frequently imitate talk by getting rhythm of the sentence; may expect time to think (look at it with myself); and may assess a situation on how it sounds' to them.

Read/Write (R)

This propensity is for data showed up as words. As anyone would expect, different instructors and mentees have a solid inclination for this mode. Having the decision to make well and read extensively are characteristics scanned for by associations of graduates. This propensity loads content based information and yield looking at and writing in the total of its structures in any case particularly manuals, reports, articles and assignments. Individuals who incline toward this way of thinking are reliably liable to PowerPoint, the Internet, records, journals, vocabularies, thesauri, references and words. Note that most PowerPoint introductions and the Internet,

Google, and Wikipedia are basically fit to those with this inclination as there is simply, as it were, a sound-related channel or an introduction that utilizations visual pictures. The perusing and composing a gathering of students who adapt best by taking notes during talks or perusing composed or printed writings. The perusing and composing students like to learn showed as words.

Kinaesthetic (K)

This framework prescribes the perceptual proclivity related to the usage of appreciation and practice (copied or ensured). It joins showings, grows, records and films of certified articles, nearly as basic assessments, presentations and coordination of theoretical information into reasonable conditions. Individuals with this as a strong inclining toward movement from the experience of achieving something and they respect their very own exceptional stand-out establishment of meetings and less all things considered, the chance meeting of others. Nevertheless, it is imaginable to make or talk kinaesthetically if the subject is solidly separated through as a last resort. In this regards, any task that demands the specific information of individual that would attempt also considering time to do the activities, is fit to those with this affection, like a trustworthy appraisal or a working event of what is standard or proposed.

Characteristics involves: moving when in doubt/on edge; amicable basically; gives feelings by physical methodologies; taps pencil or foot with objects while examining; scrutinizing isn't a need; may find spelling badly designed; likes to manage issues by physically working through them; generally exceptional body control, uncommon arranging and reflexes; is affected by contact or nonappearance of it; appreciates physical prizes; reviews what they have done rather than seen /heard; may evaluate individuals and conditions by what feels right; values dealing with articles; values doing works out; likes to utilize banner and contact individuals while talking with them ; may anticipate that time should think (process the activities being referred to); and will try new things-like to get included.

The researcher study identify learners that are connected with visual understanding have an inclination to sight things they can remember or recall, ability to view objects they can easily relate with (visual colleagues that address contemplations using systems other than words, e.g., design, structures, formats, and

pictures) moreover, sound-related learners; as matter of fact comprehend in a most unique way by tuning in and pay attention to (talks, trades, and tapes). Conversely, material/kinaesthetic learner, this categories of learners prefer to assimilate knowing by structures for experience-moving, things they can practice as they are learning, in other words practice by doing is very comfortable for them to comprehend (dynamic evaluation of the world; science endeavors; investigate, and so on). All these attribute are allow in instruction process whereby teachers would have to make provisions by preparing for class in other to address those aforementioned areas. Interestingly, this approach in particularly in science subject like biology. In the same vain, learners do make the most of this system to uncover the most helpful learning style that suit them and update their learning by concentrating on the particular ones that is of best interesting and most useful to them. On this note, the current study watched out for the concepts of learning style (Fleming, 1995). Fleming VARK learning style theory got a handle on different factors that can overhaul tutees technique for acknowledging which are incredibly pertinent to this assessment. The fundamental pieces of this theory which are visual, sound-related, scrutinizing making, and kinaesthetic have direct relationship with different components set to be dissected in this examination.

The VARK model perceives that students framework information in an astounding way, suggested as favored learning modes. This through and through impacts the students' capacity to gather and scatter information and ought to be created with suitable learning strategies. Right when that is done fittingly, students demonstrate stretched out capacity to get it, use it, and relate it to other information. The intention of VARK is to kick-start a narrative on what types of learning styles that is most useful for learners themselves in other to become better and relevant by accommodating conditions that guild instruction. VARK should be used attentively for learning, not for interruption or slackening up. Some in like manner mess up tendencies for most remote point or attributes.

EDUCATIONAL APPLICATIONS

The possibility of individual learning styles is so well known in light of the fact that it bodes well. We see it in real life. We notice it in ourselves. Learning styles hypothesis is supported by 93 percent of the general population and 76 percent of teachers. Twenty-four percent of instructors don't think it exists? Here's the means by

which actualizing the consequences of the VARK survey would glance in training biological system:

(i) Teachers comprehend why understudies don\'t generally comprehend their well-developed exercise plans.

(ii) Teachers start to introduce materials in numerous manners, knowing that students learn.

(iii) Educators enable learners to finish their work in manners that work for them, as long as what they do fulfills exercise objectives.

(iv) When educating, Gardner prescribes two stages: Individualize instructing for learners, and pluralize educating to incorporate however many of the insights as could reasonably be expected.

(v) When instructing keyboarding, educators play music so tutees can take on a steady speed with the beat.

(vi) Rather than agendas, instructors use conceptualizing and mind maps to assist
learners with sorting out their thoughts.

2.3 Empirical Review of Literature

For the past decades, few researches on various aspects of Project-based learning and Self-regulatory Strategies have contributed to our knowledge of them. Within these bodies of research, the impact of the use of PBL and SRS on test-performance of learners, disposition to, and practical skills in Biology concepts has received more attention.

2.3.1 Project-based learning Strategy and Students' Achievement in Biology

Project-based learning strategy explores what is meant by group learning. Students have knowledge of concept related, views and experiences to share that are valuable and worthy of consideration among themselves. Furthermore, PBL is a concepts that opening up learning situations to the voices of learners in the sense that help in sending a very powerful signal to them as it is through dialogue with others, collaborate with their peers as well as articulation of view point and identification of concerns that students are enabled to make sense of new information which also help

them to create and come up with fresh idea of new understanding. Moreover, this connotes that this concept trigger human-to-human interaction that provides the most effective teaching - learning experiences and outcomes (Adedeji and Adepoju, 2000; Agbi, 2006; Adepoju, 2008).

Guven, Yurdatapan and Sahin (2014) studied, the impact of science projects to the scientific literacy level of primary school pupils was analyzed. The examination was structured by the experimental research model of pretest-posttest plan, with a control group. The example of the exploration comprises of an aggregate of 32 pupils from the 2nd grade of a primary school in Istanbul. An aggregate of six project groups with a few individuals were shaped from the class. The control group of the examination was framed by different individuals from the class, who didn't take an interest in the application. Articles from scientific magazines by the analysts were referenced, and a Scientific Literacy Test (SLT), to measure the scientific literacy of the primary school pupils, was set up under the instances of the Program for International Student Assessment questions (PISA). SLT was applied to all groups when the project applications. The study was conducted under the guidance of analysts by a sum of six project groups with six project themes controlled by the scientists. At the point when the scientific literacy purposes of the 2nd grade pupils were looked at by the Mann-Whitney U test, a noteworthy distinction was found for the experimental group. This result shows that the project studies are fundamentally powerful in expanding the scientific literacy of 2nd grade pupils.

Demirel et al. (2000) additionally found by inquire about examination that there is no key contrasts in students execution test both test and control gathering. Concerning aura to language subject, it was uncovered major separation between the preliminary and control gatherings. As showed in the pretest revelations of English exercise mentality of students. The outcomes of the investigation uncovered a report of the participants that was exposed to the experimental section out-performed in a very fundamental manner than counterpart in the control group by the time the information gathered was analysed for post-test.

Holmes and (2016) researched the effects of undertaking project-based learning in optional arithmetic students' scholarly fitness progress and roused techniques for learning. Within was scholarly attitude improvement and various fragments identified with optional number juggling learning, with equivalent standard

high scholars filling in as the benchmark group. Results showed that in danger and minority learners benefitted out and out from Project- Based Learning Framework in learning math. The scholarly presentation hole was open yet its width diminished fundamentally. Project-based learning system students were much more normally prodded, exhibited basically higher fundamental reasoning capacities and recognized buddy learning.

Bilgin, Karakuyu, and Ay (2015) examined the impacts of the PBL with respect to students' accomplishment, the study also check the relationship that could exist between learners self-viability feelings on biology instructing and learners academic assessments using PBL. The example of the examination comprised of two arbitrarily picked classes from the game plan of seven classes assumed the science showing the division of a state college in turkey. The treatment gathering (n=33) was told dependent on project based learning methodology and the conventional group (n=33) was told using customary instructing. The outcomes exhibited that learners in the treatment group created better execution and furthermore conveyed generally positive sentiments about the utilization of PBL technique. In essence, it was clear that the strategy is very impactful and useful in helping learners to practices and master science skills, because during the study it was observed that the participant could lay hands on equipment’s and developed a model. This suggest that they were able to create a new knowledge which change their attitudes towards learning.

Han, Capraro, and Capraro (2015) contemplated how science, innovation, and arithmetic (STEM) venture based learning (PBL) influences high, center, and low achievers in an unexpected way. Teachers in 3 auxiliary school went to proceeded with capable headways gave by 1 STEM center arranged in a south western school. The individuals were 836 optional school learners in these 3 schools, and had scores in any occasion in the hidden year. The consequences of the examination suggested that STEM PBLs guidance affected student accomplishment in arithmetic and profited low performing understudies to a more noteworthy degree and diminished the accomplishment hole.

Hung, Hwang and Huang (2012) contemplated the effect of a task based learning procedure advanced narrating approach for improving students' learning inspiration, critical thinking skill and learning accomplishment. With a semi explore, a sum of 117 evaluation 5 tutees in a grade school in southern Taiwan were doled out to a trial gathering (N=60) and a benchmark group (N=57) to contrast the exhibition of

the methodology and that of regular undertaking based learning procedure. The trial results show that the undertaking PBL with computerized narrating could viably improve the learners' science learning inspiration, critical thinking ability, and learning accomplishment.

Advocates of Project-based learning system guarantees that student achieve an increasingly significant comprehension of the ideas and standards, while building crucial working environment abilities. Cases are additionally made that project-based learning methodology enables learners to address network issues, research professions, connect with grown-up mentor, use technology and present their work to accomplish beyond the classroom. Project-based methodology advocates believes it's motivate learners who may by one way or another discover school exhausting or aimless (Buck Institute of Education, 2011).

2.3.2 Project-based Learning Strategy and Students' Attitude to Biology

Timur and Bülent (2014) examined the impact of the Task put together learning methodology with respect to eighth-grade students' attitude towards estimations. With this point, a state of mind scale towards bits of information was made. Semi-exploratory research model was utilized in this appraisal. According to the study, the strategy was partially applied to participants in control group however, it was later adapted in the standardized way to show bits of information though in the intercession group of PBL approach was also scrutinise. The style adopted towards encounters was applied as pretest and posttests of 70 learners from 2 different schools in Trabzon. The deferred outcomes of the evaluation uncovered that the PBL extended students' state of mind towards bits of information in the intervention gathering. Everything considered, the utilization of the procedure was used in mathematics classes. This could also be as a result of new way the learners experience in study.

Kafi and Motallebzadeh (2014) finished an examination on a flipped homeroom PBLS and 21st century abilities in the English section, Islamic Azad Institution, Iran. As a result of the unmistakable quality of applying 21st century abilities in homerooms in persistent decades by strategies for explicit undertakings conveyed the authorities with doing a semi-preliminary examination with a model masses of 50 Iranian. The examination included both male and female members, 25 in each group, whose age ran from 15 to 18. Moreover, their local language was Farsi, and they were picked arbitrarily from Zabansara Language School, Mashhad, Iran.

Additionally, the exploration contained a PBL alongside relational and true basic intuition aptitudes as two of the significant 21st century abilities. An adjusted related poll just as an organized meeting were used by the scientists to assemble the necessary subjective and quantitative information. Likewise, the genuine class venture which was applied during the investigation contained a bit of the standards of Place-Based Education, the model of the examination. The aftermaths of the project-research concealed that the members in the experimental group achieved higher than the post-test. All things considered, the educational plan architects and the service of instruction can give the instructive framework just as the students with the chance of having a couple of courses through which the necessary skills can be progressed.

One of the variable that affect disposition of learners towards assimilation is attitudes, these can be developed in students behaviour through learning and can be changed through impact using social occasion of theory. Despite the way that, temper changes continually, individuals reliably structure new impressions also fine-tune themselves to ancient characters, more so when they are acquainted with new information around them or be intend with new idea and encounters with unfamiliar environment (Adeoye, 2011). Disposition towards science is relentlessly identified with execution in science (Jegede, 2007). Elevating mood may incite better in Science frame of mind with its intellectual, emotional and conduct measurements is a mental develop viewed as a basic indicator of conduct of an individual (Babajide and Ngurukwen, 2013). The investigations by Olagunju and Babayemi, (2014) on impacts of upgraded unequivocal instructing procedure on tutees' demeanor and accomplishment in science show that the most assumption of the adjustment in educating is the adjustment in learners' frame of mind. Ogundiwin, (2013) and Fasasi, (2014) inferred that for science instruction, one of the obstacle is the negative frame of mind towards science. Demeanor can contort the view of data and influence the level of their maintenance (Festus and Ekpett, 2012).

Science instructors have agreed that the advancement of a positive air (demeanor) towards science ought to be a noteworthy goal of the school instructive program. Despite the path that, there is a wide degree of attitudes' definitions, every one of them concur that a temper is the inclination to think, feel, or act unequivocally or oppositely toward objects in our condition. Social specialists have since a long time prior believed mindsets to have three sections: the abstract, the full of feeling, and the

conduct. The passionate (emotional) part is a ton of sentiments about the qualities of the article and its examination is performed using paper-and-pencil tests (surveys). The passionate portion consolidates emotions about thing and its assessment is performed using mental records (beat). At long last, the lead part identifies with the way where individuals act toward the thing and its evaluation is performed with plainly watched practices.

Disposition towards science might be viewed as an academic tendency to survey in explicit habits, things, people, and exercises. It was observed as an academic, positive, or negative tendency about science that fills in as an accommodating once-over of a wide moved feelings about science. Proclamations, for instance, "I like science," or "I don't care for science," are seen as verbalizations of demeanor toward science since they connote a general positive or negative tendency toward the best possible examination of science. The frame of mind of learners toward science have been broadly analyzed. Mentees' mentality is likewise characterized as learners' inclinations to react or respond in their relational connections, especially in interfacing with educators and the mentees. Thusly, Inspirational mentality/positive disposition may prompt noteworthy/better in science. The frame of mind of the educators, to an enormous degree, influences the information and demeanor of learners in science. Adesoji (2008) attested that various elements have been distinguished as identified with students' frame of mind to science. Such factors incorporate showing strategies, instructors' frame of mind, and impact of guardians. One of the objectives of science instructing specifically is to assist understudies with creating good frame of mind toward science and biosocial issues. Inquires about throughout the years have set up the way that in spite of all endeavors to improve educating learning process, learners' mentality still stay negative, (Okafor, 2006). A non-challant mentality of certain understudies has been ascribed to poor scholastic execution of students.

2.3.3 Project-based Learning Strategy and Students' Practical Skills

The study of Meyer (1997) on 4^{th} -6^{th} degree of secondary school learners, using project-based strategy on mathematics instruction. The study identify 5 points of educational hazard taking, achievement objective, self-viability, volition, and impact. As indicated by the results gained both from the related writing and this investigation, it is contemplated that the strategy increased the learners' academic achievement levels

earnestly. In addition, students' learning outcomes should fall within the cognitive, affective and psychomotor domains which include:

i. Promoting long time memory in students
ii. Training the mind in the understanding of the world.
iii. Stimulating students' interest.
iv. Enabling the evaluation of students learning (Animasahun, 2006).

As indicated by this classification, the fundamental learners' functional aptitudes include Inducing, watching, estimating, imparting, ordering, foreseeing. The incorporated science process abilities included controlling factors, essential science down to earth aptitudes are : portrayal, watching, utilization of five faculties to determine qualities of living creatures Deriving, clarification of perceptions and information, estimating, utilizing standard and non-standard measures to depict measurements, imparting, utilizing words or images to depict an activity, item or occasion , ordering, arranging, gathering and organizing based likenesses and, contrasts anticipating expressing the result of a future occasion dependent on an example of proof.

Ukaegbu (2003) reported that the poor achievement are total negligence of practical skills by teachers, poor use of Biology terminologies, poor diagrams, careless drawings and labeling, incompetence and laziness on the part of teachers. Teaching a practical skill four staged approach; demonstrate the skill with no words; demonstrate and explain what you are doing; the learner explains what you should do as you follow their instructions; the learner perform the skill whilst explaining to you what they are doing (educational solutions for workforce development). Researchers such as Adedapo (1976), Abdullahi (1989), Okwu (1984) and Millar, Tiberghien and LeMarechal (2002) unanimously agree that acquisition of practical skills is important to higher achievement. But recent studies have shown that Biology is often taught mainly by lecture and sometimes demonstration methods in most Nigerian secondary schools (Laoye, 1995) and Bilesanmi-Awoderu (2012).

Okebukola (1994) in a study carried out on teachers and learners about mode of impacting practical skills, suggested that if science teachers desire the acquisition of positive attitude towards laboratory work and high acquisition of practical skills in schoolchildren they must allow learners to have access to where they would be able to lay hand on the materials that would make them to practice what they have been taught

theoretically. Also, instructors have to make available students with the opportunity to exhibit such behaviour as manipulating equipment and observing experiments in progress during laboratory activities. This approach is expected to build in the student enough self-confidence to face practical examination as against the current practice in the school in which Biology teachers often teach and rehearse live practical examination questions, leaving students to only recall what the teacher had rehearsed with them in class (Odukoya, 1995).

Project to instructors gives a chance to educators to build up an alternate and conceivably progressively positive and profitable association with their students. On the off chance that frequently includes learners cooperating with peers. Truth be told, the elements and interrelationship created while working in gatherings can impact how students create abilities forever. Natural experience gives one of only a handful scarcely any spots in a science educational program where students truly watch this present reality and use it as the reason for logical enquiry. Science is a wide and different subject, which is getting progressively divided as new trains develop. Wellington (1994, 2000), revealed that authentic learning activities must be researched and learners should compel to participate. Wellington additionally featured three components of examinations as:

I. Asking questions, anticipating and conjecturing
II. Observing, estimating and controlling factors
III. Interpreting results and assessing logical confirmations.

Practical skills empowers students obey instructions, mention exact objective facts and drawing (Alebiosu, 2000). In fact, while it is firmly difficult to show the full extent of useful aptitudes in science the every business and advance training association needs, empowering learners to increase perception of a sensible number of focus on Hands-on abilities will totally profit them undeniably more than not aware or not been expose to such wonderful understanding.

2.3.4 Self-regulatory Strategy and Students' Achievement in Biology

It have been observed that students don't think about what they learn during instructional process which is the one of difficult experience that learners enchanter in teaching and learning process. Recently drove examinations in instructive settings offer need to how students learn and revolve around singular contrasts. As needs be,

explaining explicit strategies that students use to spur and control their very own learning has picked up criticalness in investigate thinks about (Zimmerman, 2000). Zimmerman (2000) developed a model and characterized self-regulation as "self-generated considerations, feelings, and exercises that are orchestrated and reliably got to the accomplishment of individual objectives" (Zimmerman, 2000, p.14).

Sun, Xie and Anderman (2017) contemplated the job of self-administrative learning system in students' achievement in flipped undergrad math courses dependent on the self-administrative learning hypothesis. The investigation analyzed the connections between scholastic accomplishment and three key self-administrative develops - earlier area information, self-adequacy, and the utilization of learning procedures - in two flipped undergrad math courses. Basic condition demonstrating was utilized as the essential technique to break down the connections in both the pre-class and in-class learning situations of the flipped courses. The consequences of the investigation demonstrated that students' self-adequacy in learning math and the utilization of help looking for procedures were all fundamentally decidedly related with scholastic accomplishment in both pre-class and in-class learning conditions. Likewise, students' self-adequacy in collective learning positively affected their utilization of help looking for systems during in-class learning.

Self-regulatory strategy is the procedure that enable learners to be responsible for their own learning, it encourage them to monitor, the process of their learning conduct, supervising learners learning progress by themselves and make corrections where necessary or build on students strength areas (Koivuniemi, Panadero, Malmberg, and Jarvela, 2017). It's the change of thought into intentional activity.

Gidalevich and Kramarski (2019) studied Self-Regulatory Strategy (SRS) on fourth graders' mathematical problem solving. Findings supported the integration of the strategy into teaching, as it's confirmed that SRS improved learner's self-development also improved cognitive aspect of student, most especially long-term retention effect. The study indicated also that SRS enhances learning outcomes. According to Magno and Cayado (2018) self-regulatory strategy is a powerful mental resource that helps students learn. Cleary and Platten (2017) the researchers did an investigation on SRS using participants of some empowerment activities that comprises of JSS learners, while conducting the study, they make use of some variable

that have to do with the strategy which are intentional abilities, self-efficacy and mathematics academic performance.

Zhu, Au, and Yates (2016) investigated the influence of self-control and self-regulatory learning strategy on a gathering of tertiary students' learning results in a mixed learning condition. In this undertaking, 74 second-year students who were taken a crack at a mixed course of ICT in Education finished a poll study on self-control and self-controlled learning aptitudes toward the beginning of the course and week by week reports about their learning encounters during the course. It was discovered that self-control and self-regulatory learning would anticipate the participants' course results that were indexed by their final evaluations in the course. The effect of self-control on the participants' learning results was interceded through their self-regulatory learning and course cooperation.

Dignath (2018) well thought-out of teachers' prompt and roaming movement of self-coordinated education in foundational level of education as well as secondary school science classes, encounters from video-based investigation corridor perceptions and educator consultations. From the scholar premeditated, it was discovered that self-administrative learning methodology emphatically impacts academic outcomes; nevertheless, almost no investigations have been done about usage of this technique by instructors in the classes of various instructive levels. Also, Video-based study hall recognitions were utilized as treatment to explore essential and optional school information on math, straightforwardly and by implication guidance of self-administrative learning (SRL). Educators' certain and unequivocal direction of these strategies and the learning condition they made were assessed by the way that they were so useful for self-rule. Additionally, semi-structure survey were utilized with the optional school educators to choose learners understanding into their passionate points of view on SRL.

Regardless of the way that the educators' instructional practices could support SRL, teachers contributed little vitality unequivocally training SRL procedures. They appeared generally educated philosophies and relatively few metacognitive systems. Clearly the results of the examination was increasingly vigorous communicated and drilled at the essential level than optional degree of instruction. Grade school teachers gave learning conditions accommodating for self-rule more as often more possible than auxiliary school educators. The meetings uncovered that the educators needed

information about metacognition as a significant part of SRL and were somewhat hesitant to advance it; in any case, the vast majority of them esteemed subjective and inspirational segments of SRL. In this regards basic educational level and higher school educators need preparing to improve their immediate and aberrant guidance of the strategy. They could profit specifically from learning about express guidance of SRL techniques and metacognition.

Magno and Cayado (2018) expressed that self-regulatory strategy is a ground-breaking mental asset that enables learners to learn. Gidalevich and Kramarski (2019) carried out a research on students' achievement and faded self-regulatory learning scaffolds on grade 4 cognitive. The investigation embraced Semi trial technique, with 134 in populace, sexual orientation of the objective populace were likewise considered to decide the probability of metacognitive self-question prompts in an student application versus blurred platforms model during masterminding, checking and reflection stages, on the help of learners' SRS (metacognition, modification of conviction judgment, motivation). Discoveries bolstered the hypothetical cases relating the job of SRS to expand understudies' independent and enhancements in sense making, especially on the long haul maintenance impact. Likewise demonstrated that SRS improves learning results.

Cleary, Velardi and Schnaidman (2017) investigated the consequences of self-regulatory empowerment program (SREP) on centre schoolchildren key aptitudes, self-adequacy and mathematics achievement. Self-report questionnaires was utilized. The outcomes demonstrated that the SREP gathering showed a measurably noteworthy and progressively positive pattern in achievement scores more than two years in center school. At long last, SREP understudies and mentors detailed SREP to be a socially-valid intercession, regarding adequacy and significance. Kitsantas, Steen and Huie (2017) inspected self-regulatory strategy and objective direction in foreseeing scholarly achievement of elementary school kids. Eighty one (n=81) of grade 5 partakers were use with the instruments of 2 scales. It was tested that learners accomplishment, utilization of self-guideline methodologies and objective direction. Results indicated that earlier achievement and utilization of self-regulatory strategy represented a lot of difference in students' scholastic achievement. Therefore, the strategy was so useful in improving academic success of students.

Hung (2016) conducted a studied on self-regulatory using flipped classroom approach way to deal with method of increasing and civilising students' learning performance in a mathematics course. The study was carried out using a quasi-experimental research method with elementary school mathematics. The outcome of the research indicated that, post-test score of the group exposed to the treatment was significantly higher than that of the control group. To summarize, the discoveries of the study demonstrate that coordinating the self-regulatory strategy into learning can improve mentees' self-adequacy just as their procedures of arranging and utilizing study time, and consequently they can adapt viably and better learning achievements. Students are expected to make use of self-regulate approaches, because it aid learning and make teaching and learning more interesting than talk and chalk method. Exceptionally, this strategy enable student's ability to take note methodologies that impact their learning and ready to utilize these systems to accomplish scholarly objectives (Zimmerman, 2000).

Self-regulatory strategy is a framework to guide the wellbeing of students living in affliction (Zumbrunn, Tadlock and Danielle, 2011). This procedure expects students to independently plan, screen, and assess their learning. Be that as it may, not many students normally do this well. A clarification of the connection between self-regulation and attitude in the classroom; obvious Self-regulatory strategy for secondary school learners use a method that encourage Self-regulation and give room for discussion between learners and teachers in area of difficulties learners and instructors may experience while teaching students to act naturally managed, life-long learners. However, Self-regulatory procedure can assist students with creating better learning propensities and encourage students research skills (Wolters, 2011), as well as, assess their scholastic progress (De Bruin, Thiede and Camp, 2011). Teachers therefore need to get used to the variables that influence a student's capacity to self-manage (self-regulated) and the procedures they can use to recognize and advance self-regulation in their classrooms. Notwithstanding Self-regulatory procedure, motivation can pivotally affect students' academic results (Zimmerman, 2008).

More so, self-report questionnaires was used to gather information on this strategy. However, the results showed that group exhibited a very good statistically noteworthy and more positive trend in achievement scores over two years on learners

of middle school used for the study. This implies that, the strategy is an intervention in which students learn to monitor their own behaviours, offers learners methods to manage and take control of their own behaviours more so, help them to discover themselves and their ability level which the learners would now build-on (Karabenick and Gonida, 2018). Self-regulatory strategy offers many benefits for students in that it provides students with a more accurate picture of the behaviours or progress; provides students with immediate feedback, and facilitates better communication between teacher and student due to students recognizing their progress.

The beauty of Self-Regulatory Strategy include the following; Self-regulatory strategy will foster individual accountability in a context of self-observation, self-reaction, self-judgement, and self-evaluation in which students discover information, also revealed such materials to their mate by teaching each order, explain the concept to one another also collaborate in group and perhaps to the class as a whole (Panadero and Jarvela, 2015). The use of Self-regulatory strategy will lead to an improvement of student learning. It will also enhance elaborative thinking, and focus on immediate problems. According to Koivuniemi *et al*., (2017) Self-regulatory Strategy is promising new educational approach. Evidences from research works in Nigeria indicated that very little research efforts had been directed towards it. This, therefore, tends to suggest that as most teachers are not sensitized on the benefits of the use of Self-regulatory Strategy, it is believed that the manner in which most schooling occurs may not be teaching students to become aware of their own learning, to think critically and to derive their own pattern of thought and meaning from content presented through interaction. As such, there will be the need to introduce modern teaching approach such as Self-regulatory strategy that do not only enhance their achievement but boost their development and morale. Self-regulated learners, believes in opportunities to take challenging tasks, practice their learning, develop a deep understanding of subject matter and to exert effort that will give rise to academic success. Therefore, the use of Self-regulatory strategy will lead to improvement of student learning outcomes, especially when student variables like mental ability and learning style are taken into consideration.

2.3.5 Self-regulatory Strategy and Students' Attitude to Biology

Tella (2017) examined self-administrative learning technique as indicators of Science mentees disposition Science (chemistry) senior schools in Ondo State. The exploration received study look into structure. 400 students were utilized for the examination work which was drawn arbitrarily utilizing basic arbitrary inspecting system. The examination instruments for the investigation were SRLS survey containing 10 things on every one of the segment and understudies' mentality to Science (SATC) poll with 25 things. After the study, the result of the investigation suggested to recommend that students should be encouraged to develop enough self-regulated learning strategies that will facilitates their learning while Government should supply new materials like Chemistry textbooks so that students would be exposed to more facts about Chemistry and teachers on their part should improve themselves academically whenever such opportunity are available so that they can get better.

The origin of Self-regulatory Learning Methodology originates from social psychological theory which explains human functioning through equivalent interactions among individual techniques, biological components, and practices (Bandura, 1986). Bandura portrays human capacities as symbolizing, planning elective strategies (forethought), and learning through vicarious experience, self-regulation and self-reflection. Concerning this view, the student settles on their own decisions and continues their learning as for these decisions in request to accomplish their objectives. Despite the fact that the self-frameworks (self-observation, self-judgment, self-reaction, and self-efficacy) have a key job on self-regulation, advancement of self-regulatory abilities initially happens through social interaction and modeling, at that point the student internalizes them and utilizations these aptitudes in new circumstances all alone (Schunk and Zimmerman, 1997).

In this triadic model of corresponding determinism, individual, behaviour and regular components are viewed as secluded at this point associated sources that impact each other bi-directionally (Bandura, 1997). Likewise, these elements influence each other in a reciprocal way. For instance, the influence of student's self-efficacy convictions on his/her achievement practices, for example, task decision, effort and

determination in a task is a model that explains the influence of personal factors on social ones. Another reciprocal interaction exists among natural and conduct factors. After an unordinary boost (natural factor), the tutees coordinates his/her consideration towards it (conduct factor). Then again, if an educator feels that the students are baffled after his/her instruction (social factor), at that point she/he reteaches the concept (natural factor). One more interaction exists among personal and natural elements. The students with high self-efficacy attempt to increase his focus (personal factor) to decrease the interruptions originate from nature. Reciprocally the educator's criticism (natural factor) to the understudy influences his/her self-efficacy convictions.

Self-regulatory learning is a repeating procedure since individual, social, and natural components are continually elements, anyway students need to move understanding from the field of taking in or what they gain from their condition into their present endeavors (Zimmerman, 1990). Zimmerman (2002) explains the limit of self-administrative strategies in learning with three cyclic stages. These systems help learners with convincing and guide their own special learning. The essential stage, thinking ahead stage, fuses structures preparing learners for learning. In the wake of surveying their fundamental level, tutees set their own learning goals and make sense of which system to use. The consequent one, execution stage, fuses the use of approachs for learning and watching their accuracy.

Indeed, Zimmerman (1990) ponders that there is a self-organized input in self-regulatory learning. Self-coordinated (regulatory) students make modifications thinking about changes in close to home, direct and environmental elements. In summary, self-controlled students choose and use self-managed learning procedures to achieve needed academic outcomes based on criticism about learning thinking and skills (Zimmerman, 1990). Self-regulated strategy is seen as a huge indicator of students insightful (scholastic) inspiration and accomplishment. This strategy anticipates that students should autonomously plan, screen, and evaluate their learning. Be that as it may, hardly any students normally do this well. A clarification of the connection between Self-regulation and attitude in the classroom; explicit self-regulated methodology for learners use approaches for encouraging understudy Self-regulation and a dialog of difficulties instructors may experience while teaching students to act naturally directed, life-long learners.

Leidinger and Perels (2012) made arithmetic learning materials as a result of Zimmerman, (2008) self-directed learning model. The purpose behind the materials is to make center subjective, meta-cognitive and motivational parts of self-managed learning inside a trademark discretionary school learning condition. Evaluation of the Self-guideline materials depends on a quasi-exploratory pre-test post-test control bundle structure with a period course of action plan. The evaluation reveals that students are given these SRS materials in standard activities, they can keep up their self-point by point self-controlled learning practices for the 12-weeks preparing phase, yet for the next year. Regardless, students who didn't get the preparation materials demonstrated an immense decrease in their SRS-practices between the pretest-posttest. Despite a couple of limitations, the examination traces that self-directed learning framework can be coordinated in schools by requesting that teachers use SRL materials in their standard science works out.

Attitude can be seen as huge piece of preparing learners ability or disposition towards learning, before schoolchildren could assimilate and comprehend what the instructors introducing to them level of behavioural intention must be properly prepare (Nelson, 2011). Consequently, learners frame of mind (attitude) are gotten from impacting knowledge from higher knowledge person or learning from their contemporaries also can be changed by impression of using different kind of methodologies. Despite the way that, mentality changes a little bit at a time, people consistently structure new attitudes and modify outdated ones when they are exhibited to new information and new experiences (Adeoye, 2011). Mood towards science is solidly related to execution in science (Jegede, 2007). Uplifting attitude may prompt better in Science. Disposition with its subjective, full of feeling and social measurements is a mental develop viewed as a basic indicator of conduct of an individual (Babajide and Ngurukwen, 2013). The investigations completed by Olagunju and Babayemi (2014) on impacts of improved unequivocal encouraging technique on learners' disposition and accomplishment in science show that the most assumption of the adjustment in instructing is the adjustment in understudies' frame of mind.

2.3.6 Self-regulatory Strategy and Students' Practical Skills

Self-regulation is not a mental ability or academic performance skill, rather it is the self-directive process by which learners transform their mental abilities into academic skills. In essences, it is a means by which schoolchildren make use of their cerebral capability to develop and improve intellectual strength that help their academic acquisition and accomplishment. Profoundly, learners that are self-controlled are the ones who know about the procedures that impact their learning, system that are best suit the way of by which they understand concepts and ready to utilize these techniques to accomplish scholastic objectives (Zimmerman, 2001). Self-regulatory Learning Strategy refer to actions directed at acquiring information or skill that involve agency, purpose (goals), and instrumentality self-perceptions by a learner (Zimmerman and Martinez-Pons, 1986).

Self-regulated Methodology improves students reading, vocabulary, and multiplication certainties. In light of this, learners anti-social practices don't enable them to realize, which may bother the conduct issue or make them drop out of school, consequently worsening the issue. They discovered that the students indicated less intense outrage in circumstances that occurred during the remainder of the educational time self-administrative training works best when students of various ability levels cooperate. It assists students with having higher scholastic achievement, improved associations with one another, improved personal and social advancement, and increase motivation. The educator at that point has greater open door for individualized instruction and increased help of inclusion and chances to diminish anti-social practices (Topping, 2008). Roelle (2013) examined the utilization of tackled model issues for fostering systems of self-regulated learning. It can successfully strengthen students in overcoming shortages in their Self-regulated Technique.

Wibrowski, Matthews, Kitsantas (2017) deliberately did an examination on SRS, the reason for their exploration was to found the impact of the Aptitudes Learning self-directed learning (SLSL), likewise, determine to help grade one secondary school students' persuasive convictions, usage of SRS and insightful achievement. In this study of the researcher, it was concentrated on involved 137 participants from nearby social condition from various foundation who required

education, counselling and financial assistance. Discoveries uncovered that learners who got together with SLSP low down continuously basic degrees of enthusiasm as well as moderate capacities from the initial test to the posttest evaluations given to them to test the effect of the instrument. In like manner, mentees endeavored the program demonstrated degrees of scholarly accomplishment like or higher than routinely yielded school green bean during their first year and as they pushed toward graduation. For any circumstance, these qualifications in the two get-togethers decreased when learners graduated. These disclosures may have essential positive repercussions for teachers, tutees as well as school heads in the sense that teachers would discover the weakling point of learners and help them to come out of it. Similarly, the participants of the study would also be able to build on their area of strength, this actually would be a plus for academic success on the side of school administrators.

Ewijk and Werf (2012) investigated teachers' convictions, information, and conduct with regards to self-regulatory training in schools. The advocates assessed optional teachers' information and convictions regarding two aspects of promoting SRS. The teachers addressed open-finished inquiries regarding their understanding of SRS and on their usage of SR in their classrooms. Nonetheless, instructor convictions towards SRS are the main predictor of educator conduct. The outcomes show how educator instruction can bolster teachers in learning how to elevate SRS successfully to their students. . Various research discoveries from Akubuilo (2004), Akpan (2008) and Ajaja (2011) show that few elements are answerable for the poor accomplishment of learners in science subjects, for example, holding fast to directions, intersection of rules in drawings, naming, treatment of hardware resembles pipettes, burettes for doing certain estimations. Even more seriously is the discovery that practical skills in the Nigerian secondary schools are hardly measured at all by teachers (Adedeji, 2007; Ajaja, 2011).The target is always the end result rather than exposing the students to tasks to see them display their practical skills (Njelita, 2008).

2.3.7 Mental Ability (MA) and Students' Achievement in Biology

The impact of previous knowing of learners social objective on mathematics performance of elevated as well as lower mental capability of students in Imo-state Nigeria was done by Osuafor and Njoku (2016). The research study which was

implemented with 2 research questions as well as null hypotheses, the study was a quasi-experimental type in nature have a control group alongside to determine the effect of the strategy. The after-wards of the investigation indicated that learners with elevated mental capability that already been exposed to the concept had a robust performance compare with their counterpart with lower capability who did not have initial idea of behavioural objective. As a result of this discovery, the strategy was recommended for use in other to improve self-learning control and mental capability to learn.

Olatoye and Aderogba (2011), in their study the performance of learners was decided open in terms of verbal and numerical capacities on execution of science students in propensity tests. 200 senior optional school science students took an interest in the examination utilizing three approved research instruments to gather information and relapse investigation device for information investigation. Discoveries uncovered a presence of solid connection between learners' psychological capacity and by and large tutees' presentation. Oyedeyi (2011) studied the predictive effects of mathematics skills on students' achievement in science in junior secondary school. A sample of 500 students was randomly selected from 10 junior secondary schools (JSS 3) in Benin metropolis, Edo state, Nigeria. The research adopted a mathematics test titled: ''test of mathematics skills'' and the subjects' more scores in science and the regression analysis revealed significant correlations between the mathematics skills and science achievement. This connotes that learners' ability when they have early understanding would go a long way to improved their performance most especially in science oriented subjects.

Pamela, Gardner, Debbie, Hutchinson, Whiteley (2011) inspected the long term effects of mental capacity and characteristic passionate insight on academic performance for English among students. The model adopted in the exploration comprises of 413 schoolchildren taking from 3 colleague schools in the North-West of Britain. Learners that were found to have finalized preliminary of capacity enthusiastic knowledge, characteristic passionate insight, character, and psychological capacity in age 7. Essential Condition Showing investigated the longitudinal associations between inert elements of these manufactures. Results show that the importance of mental capability insight lives in the manner that it coordinates the effect of intellectual capacity on execution in year 11. Attribute emotional quotient influences year 11

execution for youths specifically. This proposes exercises that help to make capacity enthusiastic knowledge and addition attribute passionate insight offer teachers' opportunities to improve educational achievement.

Akinlana (2013) considered the comparative and combined augumentation of the manipulated variables of pedagogic positivity, pedagogic enthusiasm and mental capacity to senior optional school learners' scholarly accomplishment in Ogun east senatorial zone, Nigeria. The examination utilized the elucidating research plan of ex-post facto type. 500 and eighty-eight members chose through the multi-arrange stratified divergent sample method, were utilized for the investigation. The facts gathered were processed utilizing numerous reverting investigation. The outcomes uncovered that intellectuality was the most efficient out of the indicator parameters (B = .052; t = 6.729; p<.05).

L"eson, Clarrochi and Heaven (2008) correlated mental ability, personality and academic performance in adolescents, adopted path analysis design, involving six hundred and thirty nine high school students in a longitudinal study. Three validated research instrument were used for data collection while collected data were subjected to structural equation model (SEM). The results indicated significant paths from mental ability on student academic performance. Aremu and Tella (2009) investigated the relationship between gender, age, mental ability, anxiety, mathematics self-efficacy and achievement in secondary school mathematics, adopted an ex-post facto study involving 1099, SS2 students in the research, five validated questionnaire for information gathering were. The result of the study indicated a very insignificant and low progressive association between students' mental ability and achievement in secondary school mathematics.

Veltmann, Raudfepp and Pullmann (2011) predicted general mental ability on achievement in mathematics adopting an export factor design involving 969 adolescents in the study and two validated research instruments. The collected data were analysed using spearman rank order correlation, regression analysis. Results revealed that mental ability correlated significantly with students' achievement in mathematics and that general mental ability predicted significantly adolescents' achievement in mathematics. Vock, Preckel and Holling (2011) determined relationship between mental abilities and school achievement adopting

path analysis design, involving 1135 adolescents in grades seven to ten, administered a comprehensive test battery on the subject of the study, the structural equation modelling was used for data analysis. The results showed that mental speed and short-term memory as ability factors reflecting basic cognitive processes exert an indirect significant on academic achievement by affecting reasoning and divergent thinking and that short term memory also directly affects students achievement. In the same vain, Sangodoyin (2011) discovered from a study conducted on subject matter that students' intellectual capability have a remarkable consequence on achievement in Biology as students with high mental ability performed better than those their counterpart with average mental ability.

Similarly, Banglog and Tabords (2010) carefully worked on influence of scientific proficiency, mental ability and experience in procedural programming on the progressive performance of students in object-oriented programming (Java). Among every one of the factors in the research, mental capacity (ability) alone was found to have critical association with the performance of the respondents. This connotes, cerebral capability found capable of impacting learners accomplishment in mathematics and science concepts.

Another variable that consider to have an impact on students' learning outcomes both theoretical and practical learning activities is learning style of learners (Dekker, Lee, Howard-jones, and Jolles 2012). According to Ferrero, Garaizar, and Vadillo (2016) students' performance can be enhanced when material is delivered in the individual's preferred learning style. Pinpointing how a student learn best can dramatically affect their ability to connect with the topics, as well as how they participate in the classroom (Elrick, 2018). Students learn best by seeing the value and importance of the information presented in the classroom. In order to achieve the ultimate goal of student learning it is important to use a combination of teaching methods and to make the classroom environment as stimulating and interactive as possible. Learning takes different forms. Four of the most popular ones are visual, auditory, reading-writing, and kinaesthetic in which learners take information. These four most popular learning styles were built on Flemings (2015) VARK model. These are very relevant to this study because some students are visual learners, while others are auditory, reading-writing, and kinaesthetic learners. Visual learners learn visually by graphs, and pictures. Auditory learners learn by listening to lectures. Reading and

writing learners learn by reading printed materials. Kinaesthetic learners learn by doing.

Husmann and O'Loughlin (2019) studied disparities among undergraduate anatomy students' reported VARK learning styles, achievement, and study strategies. The result of the study revealed that the study strategies with VARK learning style results had no correlation with students' achievement. Papadatou-pastou, Gritzali, and Barrable (2018) studied students' learning styles, self-assessment, and teachers' judgments. Fifth and sixth grade students were used. The result of the findings indicated that there is no relationship between students' learning style and achievement. Rogowsky, Calhoun, and Tallal (2015) investigated the effect of learning style preference in text comprehension. The findings revealed that there is no statistical relationship between learning style preference, mode of delivery, and achievement. Rato, Aberu, and Castro (2013) reported significant correlation between students' learning style and academic achievement.

Rohrer (2008), Zhang and Sternberg, (2005) reported that there is no significant correlation between students' learning style and learning outcomes. Previous studies on the relationship between learning style and students' academic performance have shown conflicting results (Ong, Rajendram, and Yusof, 2006).

Olatoye and Aderogba (2011) considered the influence of student's verbal and numerical capacities on accomplishment of learners in proficiency tests. 200 science students joined in the analysis utilizing three verified research instruments to gather information and regression analysis tool for data analysis. Discoveries uncovered a presence of a significant relationship between learners' numerical or mental capacity and in general students' presentation. In other words, mental ability of learners has influence on their performance positively among other ways of modalities that help students to improve in learning proceses. Olagunju, Duyilemi and Adesina (2013) in an ex-post facto study that tested the connection between students-teachers' attitudes, self-concept, mathematics mental ability and knowledge of agricultural economics. The enquiry involved one hundred and fifty 200 Level Agricultural Education students selected through stratified random sampling technique. Four validated research instruments and linear regression analysis was also used for data analysis. The results showed that mental ability predicted significantly the pre-service teachers' knowledge of agricultural economics. Duyilemi, Olagunju and Adesina

(2014) conducted a study on pre-service teachers' variables as determinants of their skills in agricultural economics, the results showed that the pre-service teachers' mental ability significantly predicted the students' agricultural economics skills.

2.3.8 Mental Ability and Students' Attitude towards Biology

Dada (2015) found that mental ability had effects on the students' attitude. Morribend (2004) concluded from his study that mental ability had significant effect on students' attitude. Mental capacity has additionally been found to impact learning of secondary school students in science (Olagunju and Chukwuka, 2008).

Castro, Prenda, Laguador and Pesigan (2015) inspected mental capacity, work conduct and quality overview of high and low performing first year digital programming student. Clear sort of research was used in the examination. Result demonstrated that high performing learners have essentially higher constancy in doing their work and they have fundamentally better standards of constructive outcome from accomplishment situated movement than low performing learners. Krapp (2002) positive learners' attitude are major to learners' academic progress. Okafor (2006) likewise acknowledge that significant levels of learning happen and students like themselves and the materials they are taught when educators utilize instructional time proficiently. The manner in which educators interface with learners impacts their disposition toward school and their pedagogic accomplishment. How learners observe their instructor's view to educate in the study hall is profoundly fundamental and identified with learners' scholastic accomplishment, (Maldonaldo, 2005).

Several research findings have also reported that students in high schools have negative attitude towards science, (Ajayi, 2007). From learning theory perspective, students with negative attitude to science will lack the motivation to persist and do better in this field (Adeoye, 2007). The deterioration in knowledge and poor attitude has been attributed to inappropriate teaching strategies (Daramola, 2010). Attitude with its cognitive, affective and behavioural dimensions is a psychological construct considered to be a critical predictor of behaviour of an individual (Babajide and Ngurukwen, 2013). The studies carried out by Olagunju and Babayemi, (2014) on effects of enhanced explicit teaching strategy on students' attitude and achievement in science show that the most presumption of the change in teaching is the change in students' attitude. Ogundiwin, (2013) and Fasasi (2014) concluded that for science

education, one of the critical problem is the negative attitude towards science. Attitude can distort the perception of information and affect the degree of their retention (Festus and Ekpett, 2012).

Hussain, Alam, Bukhari, and Ahmad (2011) designed a study to investigate the adequacy of scientific attitude toward astrophysics learning through inquiry method versus conventional teaching method for female student in secondary school level in Pakistan. The experimental group demonstrate better scientific attitude to physics than the control group. Additionally, Olasehinde and Olatoye (2014) analyzed realistic view, mentality to science and science accomplishment of senior optional school students in Kastina State, Nigeria receiving the enlightening study inquire about structure. Irregular examining system was used to pick 204 senior optional school from the three senatorial districts of the state. Three affirmed instruments through: Logical Frame of mind Poll (SAQ); Mentality to Science Survey (ASQ) and Science Execution Test (SPT) were used for data combination. Data were processed employing diverse reversion, progressive backslide, (PPMC) and t-test. Discoveries revealed that logical disposition justify to 0.06% of absolute difference in logical accomplishment.

Muckhopadyay (2014) reviewed literature on scientific attitude some psychometric consideration identifying scientific attitude as an important factor among several determinants of achievement in science. The study did contextual difference between attitude to science and scientific attitude using the various operational dimensions of the constructs with reference to detailed review of related literature emphasising on scientific attitude of secondary school learners and different available validated tools to measure scientific attitude with sound psychometric basis and suitable for further research were identified. Statement of the Problem Baseline data revealed that pre-service teachers in colleges of education have low level of achievement in Basic General Mathematics in Oyo State, Nigeria.

2.3.9 Mental Ability and Students' Practical Skills

Olatoye and Aderogba (2011) determined the role of students' mental ability on performance of science students in aptitude tests. Two hundred senior secondary school science students participated in the study using three validated research instruments to collect data and regression analysis tool for data analysis. Findings revealed an existence of strong correlation between students' mental ability and overall students' performance. (2007; Olagunju and Chukwuka, 2008 and Aina 2006) found a very high relationship with students' mental ability and performance in science related courses.

Chen (2012) studied the influence of mental ability, academic achievement and academic self-concepts in Taiwan. Tenth grade respondents were used. The results of study indicated that there is no correlation between students' mental ability and achievement. Vock, Preckel and Holling (2011) determined relationship between mental ability and achievement adopting path analysis design, involving 1135 students in grades seven to ten. The outcome of the study reflected that mental capability influence learning behaviour.

Mental ability as genetic, cognitive, physiological, nutritional and social factor as well as acquisition of skills all taken together to decide ability (Yoloye, 2004).

Chebii, Wachanga and Kiboss (2012) studied the effectiveness of Science Process Skills Mastery Learning Approach (SPROSMALEA) on students' acquisition of chemistry practical skills in school. The study was carried out in Koibatek District, Kenya where there has been persistent low achievement in the subject. 160 form two students from four co-educational schools, purposively selected from the District were taught the same course content on salts for a period of four weeks. The experimental group received their instructions through use of SPROSMALEA approach and control groups using the conventional teaching method. The researcher trained the teachers in the experimental groups on the technique of SPROSMALEA before the treatment. Science process skills performance test and classroom observation schedule were used for data collection. The results of the study indicated that students in the experimental groups outperformed the control groups in the acquisition of selected chemistry practical skills. Practical skills are not confined to science. There are a number of other subjects where practical skills is assessed including geography, music, design/

technology, and modern foreign languages. Practical skills helps in enhancing students' awareness of practical technique involved, focusing on the quality of data collected and making them aware of the risk and necessary safety precautions.

2.3.10 Learning Styles and Students' Achievement in Biology

Huertas, Lopez and Sanabria (2017) considered the effect of LS on academic success in science using scaffolding approach to implement the study. The research make used of 104 participants from a school in Bogota, Colombia. The appraisal was semi test and was formed with three tenth grade parties, which worked with three stage elucidations. The exposures award to reason that the field opportunity students showed better scholarly introductions inside observing a fixed scaffolding when looked at the performance of their counterpart that are not exposed to the approached used in the study. However, the investigation also conclude that learning style should is important to enhance learners assimilation, therefore, this is very impactful on instructive achievement of students.

Rahman and Ahmar (2017) investigated the relationship between learning styles and learning achievement in mathematics based on genders. It was a descriptive study using cross sectional design. The aims were to examine the relationship between learning styles and learning outcomes by gender. The population in the study were all students in 1st year of SMAN 1 Galesong Selatan, Indonesia, in the 2014/2015 academic year. The instruments used was the test of modalities learning styles (TMLS), to determine whether the students' learning styles are visual, auditory and kinaesthetic (VAK), and documentation. The relationship between learning styles and learning outcomes were analysed with the chi-square test and two-way ANOVA. The results showed that: the learning styles of visual and auditory learning styles is dominated by women; and there is no relationship between the variables of learning styles, genders and interaction of learning styles with genders to learning achievement.

Özerem and Akkoyunlu (2015) researched learning surroundings structured by learning styles and its impacts on science (mathematic) accomplishment. Fifty-five (55) seventh grade students and seven (7) overseers comprised the exploration test. The information was gathered through an open-finished poll; a Science Accomplishment Test, and Pat Wyman Individual Learning Style Stock were utilized

as information assortment devices. Since the gathering comprised of under 30 members, the Wilcoxon Marked Position Test for Combined Examples was utilized. The outcomes showed the distinction of pre-post-test consequences of visual sound-related students, sound-related sensation students, and visual-sound-related students are factually huge. At the point when the positioned normal of various evaluations and their aggregates are considered, the watched contrast is in positive positioning, which means it is supportive of post-test results. As indicated by these outcomes, distinctive learning conditions intended for visual-sound-related sensation students positively affect student grades. Most of the tutees expressed that the previously mentioned exercises utilized in the science exercise could likewise be utilized in other school subjects. Student's reactions underlined that learning conditions ought to be planned by learners learning styles. Planners underlined that learning styles planned by students' singular learning styles may expand mentees achievement. What's more, reviewers believed that a portion of the upsides of structuring learning conditions as indicated by students' learning styles incorporated a chance to adapt genuinely, an expansion in learners' inspiration towards the exercise, and empowering students to learn at their very own pace.

Chen (2015) studied linking learning styles and learning on mobile Facebook, with proceeded with advancement of related technologies, Web 2.0 has become a significant webpage of learning development. Specifically, a wide-range of interpersonal message delivery with the help of cloud-based technology, for example, media-platforms, which have gotten prominent, can possibly work as an instructive device empowering peer criticism, cooperation, and learning in a social setting. Getting ready fitting situations for students with various needs is fundamental to learning by and large and internet learning specifically. However, so as to make such learning conditions, teachers must comprehend contrasts in schoolchildren learning pattern.

Cuevas (2015) in a convincing distribution of data, a congregation of psychological therapists revealed that there was a nonappearance of trial verification supporting learning styles-based direction and offered rules to the sort of research plan imperative to check the learning styles speculation. It broke down the composition since 2009 to decide if the void has been filled by exhaustive examinations proposed to test the organizing theory and recognize joint effort impacts. Correlational and trial

inquire about on learning styles is investigated, close by an appraisal of how the subject is delineated in instructor guidance works. Results revealed that the more methodologically stable assessments have would all in all negate the speculation and that a significant parcel continues existing, with learning styles direction getting a charge out of wide affirmation basically, however the greater part of research confirmation suggesting that it has no advantage to learners picking up, broadening request in regards to its authenticity (Cuevas, 2015)

Surjono (2015) analyzed the impacts of mixed media inclinations and learning style on learners' accomplishment in online hardware program at the one of State higher degree school in Indonesia. The discoveries indicated that tutees where their media inclinations and learning style coordinated with the manner in which the material exhibited in online hardware course have higher scores fundamentally contrasted with those in which their learning mode were intersected, similarly, the research results revealed that paying attention to individual differences and learning styles of learners by teachers and other instructional team had an important role in improving quality of learning and increase academic achievement of students (Safe, 2008; Tella and Adeniyi, 2009).

2.3.11 Learning Styles (LS) and Students' Attitude to Biology

For instruction to be compelling, the strategy utilized should make arrangement for personal student's favored learning style. Wong and Nunan (2011) explored the LS and systems of viable and inadequate language students. Subjects for the examination were one hundred and ten (110) undergrad college learners in Hong Kong. They were ordered as 'increasingly powerful' or 'less successful' students, based on their scores on an institutionalized open English assessment regulated toward the finish of higher education. The study revealed key differences in learning strategy preferences, learning styles and patterns of language use.

Teaching strategy on students' attitude and achievement in science show that the most presumption of the change in teaching Biology is the change in students' attitude. Ogundiwin, (2013) and Fasasi, (2014) concluded that almost all researchers agreed that for science education, one of the critical problem is the negative attitude towards science. The attitude of a learner to learning is a key to academic achievement

without which low performance in the learner is inevitable. The approach of positive attitudes towards high acquisition of practical skills in students is expected to build in the student enough self-confidence to face practical examination as against the current practice in the schools in which teachers often teach and rehearse ‘‘live’’ practical examination questions, leaving students to recall what the teacher had rehearsed with them in class (Odukoya, 1995).

The Nigerian council on science education as reported by the National Science Board (2008) noted that many schools teaches without practical skills except few practical works carried out in the final year which reveals a great disparity between the intention of the curriculum developers and actual classroom implementation. Attitude towards science may be view as an educated inclination to assess in specific manners, articles, individuals, and activities. It was sees additionally as a scholarly, positive, or negative inclination about science that fills in as a helpful synopsis of a wide differed convictions about science. It is significant on the grounds that it allows the forecast of science related conduct. Articulations, for example, "I like science," or "I despise science," are viewed as articulations of dispositions toward science since they mean a general positive or negative inclination toward the proper investigation of science. The mentalities of students toward science have been broadly examined. Students' mentality is additionally characterized as students' inclinations to react or respond in their relational connections, especially in collaborating with instructors and the students.

In this manner, virtues are acquired through learning and can be changed through impact using a combination of frameworks. Helpful disposition may provoke better in science. The virtues of the instructors, to a tremendous degree, impacts the data and virtues of learners in science. Adesoji (2008) expressed that different segments have been perceived as related to student’s outlook to science. Such factors fuse demonstrating techniques, instructors' mood, and effect of watchmen. One of the destinations of science educating explicitly is to help mentees with making extraordinary attitude towards biosocial issues. Explores throughout the years have built up the way that in spite of all endeavors to improve instructing learning process in science, learners' view still stay negative, (Okafor, 2006). A non-challant frame of

mind of certain students has been credited to poor scholarly accomplishment of learners.

2.3.12 Learning Styles and Students' Practical Skills

At first, learners must be detached into groups reliant on their learning styles however, in a brief timeframe, later students from every section should be abstractly choose to get one of different instructional systems. Next, students should then sit for a last test that is the corresponding for all of them. At long last, so as to show that ideal learning necessitates that learners get guidance customized to their accepted learning style, the analysis must uncover a particular sort of collaboration between learning style and instructional strategy: Students with one learning style accomplish the best instructive result when given an instructional technique that contrasts from the instructional strategy delivering the best result for learners with an alternate learning style. As it were, the instructional strategy that demonstrates best for learners with one learning style isn't the best technique for student with an alternate learning style. The perspectives and assessments of science teachers on the significance of down to earth abilities in science are irreputable (Gangoli, 1995; Gerard and Gerard, 1995; Bajah, 1998). Woolnough (1994) pushed that there are two elements of common sense exercises.

According to him, they are useful in consolidating theoretical understanding and secondly they help in developing confidence at, and confidence in, practical science problem-solving. Practical work sets science apart from most school subjects (Kok-Aun Toh and Woolnough, 1990; Nundy, 2001; Millar, Tieberghien and LeMarechal, 2002). For effectiveness in teaching and learning, students should always be actively involved in adequate practical exercises. Practical skill is the backbone of effective teaching and learning. It has been repeatedly emphasized that scientific enterprise is an activity-packed-one, involving continuous exploration and verification of facts (Alebiosu, 2000).

2.4 Appraisal of Literature Reviewed

From the reviewed literature, it is clear that there have been several attempts made both within and outside Nigeria towards tackling poor performance of student's in Biology. Some have shown significant effect of mental ability and learning style on learning outcomes while some could not establish this. In view of this assertion,

appraisals of some instructional strategies currently used by Biology teacher were examined. Existing literature also revealed that mental ability of the learners is very important in learning; it plays a major role in determining an individual's performance.

Furthermore, review of literature showed that students' mental ability associated with Biology appears to affect student's attitude and achievement, and this can affect students' practical skills. Thus, there is need for further studies to establish the appropriate instructional strategies for both high and low learning styles of students with different mental ability levels in Biology. Previous research on utilisation of PBL and SRS did not concentrate on the directing impacts of mental capacity and learning style on senior optional schools students. The two procedures have been utilized independently and in various subjects. None of the scientists examined the joined impacts of the two techniques on Biology. Here are the gaps which this investigation will fill. The presents study along these lines received Project-based learning and Self-regulatory Strategies mulling over the students psychological capacity and learning style and their consequences for learners accomplishment, attitude and practical skills in Biology Concepts.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter explains the methodology employed to execute this investigation. The chapter presents research design, sampling technique and sample size. Other aspects include research instruments, method used in gathering information and the analysis of data collected.

3.1 Research design

The investigation embraced the pretest-posttest control group quasi experimental design using a 3x2x4 factorial matrix. It examined possible impacts of Project-based Learning and Self-regulatory Strategies, mental ability and learning style on students' achievement, attitude and practical skills in biology concepts. The design is demonstrated as follows:

Experimental Group 1	O_1	X_1	O_4
Experimental Group 2	O_2	X_2	O_5
Conventional strategy	O_3	X_3	O_6

Where O_1, O_2, and O_3-represent the pretest observation for the three groups (two treatment groups and the control group).

And O_4, O_5, and O_6 are the posttest observation for three groups (two treatment groups and the control group respectively).

X_1 is Experimental treatment for group 1: Project-based Learning Strategy

X_2 is Experimental treatment for group 2: Self-regulatory Strategy.

X_3 is Conventional strategy: Conventional Strategy.

Table 3.1: Schematic Representation of the Matrix 3x2x4 Factorial Matrix

Treatment	**Learning Style**	**Mental Ability**	
		Low	High
Project-based Learning Strategy	Visual		
	Auditory		
	Reading/ Writing		
	Kinaesthetic		
Self-regulatory Strategy	Visual		
	Auditory		
	Reading/ Writing		
	Kinaesthetic		
Conventional Strategy	Visual		
	Auditory		
	Reading/ Writing		
	Kinaesthetic		

3.2 Variables of the Study

3.2.1 Independent variables: **-** manipulated at three levels:

Project-based learning

Self-regulatory Strategy

Conventional method

3.2.2 Moderator variables: **-** These are

Mental ability at two levels; Low and High.

Learning style at four levels; Visual, Auditory, Reading-Writing, and Kinaesthetic

3.2.3 Dependent variables: **-** These are students' learning outcomes

Achievement in Biology

Attitude towards Biology

Practical Skills in Biology

3.3 Sample Selection and Sampling Techniques

3.3.1 Selection of Participants

Out of 11 Local Government Areas within Ibadan, three were selected. Akinyele, Ibadan North and Ibadan North East were randomly selected. Two schools were randomly selected from each of the three local government Area under study, two schools each for the experimental groups and two schools for the control group. A total of six randomly selected schools were used for the study. Intact classes were used for this study in which all classes were randomly selected from each school, totalling 303 students. The schools were assigned to PLS (106), SS (100) and control (97) groups. The criteria for selecting the schools as sample are as follows:-

Evidence of the school having good and standardized Biology laboratory

Readiness of teaching staff of the school and students to participate in the study

Evidence of the school having Biology textbooks

Presence of qualified Biology teachers

The school being a co-educational institution

3.4 Selection of Concepts

Pollination in Flowering Plants

Types of Pollination: Self-pollination and Cross pollination-

Features favouring Self-pollination: Homogamy and Cleistogamy Features favouring Cross Pollination: Unisexuality, Dichogamy and Self-incompatibility

Pollination and Pollinating Agents:

Wind, Water, Insects and Other animals, such as birds, squirrels, bats and snails.

Differences between Insect-pollinated and Wind-pollinated flowers

Reproductive System in Flowering plants

Flower structure- the modified leaves consist of four whorls:

Sepals, Petals, Stamens and Carpels.

Types of flower and the position of the ovary.

Sexes in Plants

Structure of Some Common Flowers

3.5 Research Instruments

The following research instruments were used for the study

(i) Biology Achievement Test (BAT)

(ii) Biology Attitude Questionnaire (BAQ)

(iii) Biology Practical Skills Rating Scale (BPSRS)

(iv) Student Mental Ability Test (SMAT)

(v) Student Learning Styles Questionnaire (SLSQ

(vi) Teachers' Instructional Guides

a) Teachers' Instructional Guide for Project-Based learning Strategy (TIGPBLS).

b) Teachers' Instructional Guide for Self-regulatory Strategy (TIGSRS)

c) Teachers' Instructional Guide for the Conventional Strategy (TIGCS).

(vii) Evaluation Sheet for Assessing Teachers' Performance on

a) Project-Based learning Strategy on pollination and reproduction in plants (ESATPPBLS).

b) Self-regulatory Strategy on pollination and reproduction in plants (ESATPSRS).

c) Conventional Strategy on pollination and reproduction in plants (ESATPCS).

3.5.1 Biology Achievement Test (BAT):

The test was self-constructed by the researcher. The instrument was designed to measure the students' achievement in pollination and reproductive system in flowering plants. The test consisted of 45 multiple choice objective tests, which covers the topic taught during the treatment period in Biology at the secondary school two levels. It has two sections A and B. Section A contained the demographic variables (personal data of the respondents) while section B contained the test items. The options ranged from A to D. The table of specification for students' Biology Achievement Test (BAT) is shown

Table of Specification for Students' BAT

Topic	**Level of Cognitive development**						**Total**
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	
Reproductive system	1,6,7,35,36	3,4,10,11,16,20 ,31,32, 37	2,22,33,34	12,13, 23,26	Nil	Nil	22
Placentation	28, 29	25,27,30	Nil	Nil	Nil	Nil	5
Pollination	9,19,21	39	40	8, 18,24	Nil	Nil	8
Agents of Pollination	41,42	43	Nil	Nil	Nil	44,45	5
Total	12	14	5	7	0	2	40

This instrument was subjected to face and content validity by giving its copies to experts in educational evaluation, and science education with bias in Biology Education. These experts determine its suitability for the target population in terms of clarity, breath and language of presentation. After this was done, out of the 60 items, only 45 items survived scrutiny. The average difficulty index of 0.7 and discriminating indices of 0.4 to 0.7 was determined after the instrument was trial tested on 20 students' in a separate school. The reliability coefficient of 0.816 was obtained using Kuder-Richardson Scale (KR 20).

3.5.2 Biology Attitude Questionnaire (BAQ)

The instrument was adapted from Zubair and Nasir (2011) and modified by the researcher to measure the student's affective learning outcome. Section A- consists of the personal data of the respondents in terms of gender, and location of the school. Section B- assessed students' attitude towards Biology concepts. It consisted of twenty items covering the usefulness of the subject. The items was placed on a 4-point likert type ordinal scale ranging from Strongly Agreed (SA) Agreed (A) Disagreed (D) and Strongly Disagreed (SD).

For validation, the instrument containing 25 items initially was given to experts in Biology education and more particularly Biology teachers in secondary schools in Oyo state. Copies were also given to English teachers and finally my supervisor so as to make to determine its suitability in term of clarity of ideas, language of presentation, class levels, coverage, relevance, and adaptation to the study. The items was reduced to 20 items which was used for trial-testing. Cronbach alpha co-efficient of 0.802 was obtained. Therefore the instrument was considered suitable to be used for the study.

3.5.3 Biology Practical Skills Rating Scale (BPSRS)

The instrument was adapted from Awolere (2015) by the researcher to investigate students' practical task based on direct observation during their laboratory activities. The Biology Practical Skills Rating Scale (BPSRS) was used to determine students' ability to manipulate, observe, record, label, classify and draw in practical class.

Section A- the aspect contain background information of the respondents in terms of gender, location of the school and name of respondent. Section B- was a six - point

continuum that ranged from zero (0) for total inability to exhibit the skills (Very Poor), to five (5) at the extreme for full exhibition of the skills (Excellence).

Scoring of Biology Practical Skills Rating Scale.

30% was considered highest pass mark for each learners, therefore students that obtained the following:

0 -5% = **0** (Very Poor), 6% -10% = 1 (Poor), 11% - 15% = **2** (Average), 16% - 20% = **3** (Good), 21% - 25% = **4** (Very Good), and 26% - 30% = **5** (Excellent)

The face validity of SBPRS was done by showing the items to three science educators with bias in Biology to determine its suitability in term of clarity of ideas, language of presentation, class levels, coverage, relevance, and adaptation to the study. For carrying out practical activities things needed are dissecting needle or seeker for separating parts, fine (pointed) forceps, small pointed sharp dissecting scissors, single-edged (safety) razor blade, tile or cutting mat, containers (jam- jar) for students to put their specimen, and at least 2 flower per student.

Out of the 6 items with sub-sections, only 4 items survive scrutiny, the instrument had been trial tested on 45 students in separate school and the scores was analysed for their reliability. A reliability coefficient of 0.812 was obtained using Cronbach alpha measure. Therefore the research instrument was considered appropriate to be used for gathering facts for the study.

3.5.4 Students Mental Ability Test (SMAT):

The instrument was adapted from OTIS-LENON (1967) mental ability test used by Aina (2006). The instrument was a 40-item multiple choice with 4 options. This instrument verified the mental ability of the learners before they would be exposure to treatment for the period of eight weeks. The test was observed to have capacity in discriminating between high and low level of participants. SMAT comprised of two sections A and B. Section A comprised of the demographic information about the respondent, such as Name of school, Local Government Area, Group (Experimental or Control). Section B contained forty (40)-items with multiple-choice response lettered (a)-(d) which tested students' ability in English vocabularies, mathematics, grammar and spellings in different technical arrangements.

Scoring of SMAT

100% is considered excellent for a participant, but learner that obtained 50% and beyond were designated to high mental ability group; however students who scored 49% and below were assigned to low mental ability group.

The face validity of student mental ability test (SMAT) was done by showing the items to three science educators with bias in Biology to determine its suitability in term of clarity of ideas, language of presentation, class levels, coverage, relevance, and adaptation to the study. Out of the 50 items, only 40 survive scrutiny, the instrument had been trial tested on 45 students in separate school and the scores was analysed using Kuder-Richardson formula 20 (KR 20) for their reliability. A reliability coefficient of 0.821 was obtained.

3.5.5 Student Learning Style Questionnaire (SLSQ):

The student learning style questionnaire was the 40 items students scale adopted from O'Brien (1985) to measure the learning styles of selected students. All choices correspond to the four sensory modalities which are measured by VARK (visual, aural/auditory, read/write, and kinaesthetic).

Ten out of the 50 items that were not relevant to Biology were discarded, hence the student learning style questionnaire contained 40 items. There were two sections; section A sought for demographic data of students, while section B consisted of 40 items which students responded to by expressing their level of agreement.

Scoring of SLSI

The maximum score a student can obtain is 30%. The modality type with the highest score indicates your preferred learning style. The higher the score, the stronger the preference. If you have relatively high scores in two or more sections, you probably have more than one strength. If the scores in the sections are roughly equal, you probably do not have a preferred learning style; you are a multi-sensory learner.

The questionnaire was presented to experts in science and mathematics department and finally the researcher's supervisor to determine the suitability for the target population in terms of clarity of ideas, breadth, language, relevance and application to the study. Out of 50 items, only 40 items survived scrutiny and was trial tested by administering it to thirty students from intact class of co-educational senior

secondary school two(SS II) different from the selected school of the main study. The reliability of the instrument was determined by using Cronbach alpha coefficient which was found to be 0.89.

3.5.6 Teachers' Instructional Guide for Project-Based Learning Strategy (TIGPBLS) This serve as guide for the research assistants, it involve steps of presenting the course in PBLS class for experimental group 1. It was used in the training of teachers to allow uniformity in the teaching strategy, it lasted for the period of eight weeks. The trained teacher arranges the students in groups at the beginning to facilitate learning. The trained teacher determines the necessary approaches to learning for student success. Pace material according to students' ability. Recognized and encouraged all points on pollination in plants. Promote discussion by using open ended questions. The students engage in practical activities that generated ideas, such as observation, recording drawing, labelling and classification. The students give insights, feedback and comments gained during the teaching. The students evaluate the solution and make modification. The students carry out a task to consolidate learning

TIGCPBLS was given to experienced Science instructors in senior optional school and College speakers in Division of Science and Innovation Training to look at its substance and face legitimacy. Similarly, inter-rater dependability was then assessed utilizing Scott's π factual measure. However, the value unwavering quality file was resolved as 0.83.

3.5.7 Teachers' Instructional Guide for Self-regulatory Strategy (TIGSRS)

This is an instructional guide for teachers participating in the experimental group. It contains the statement of topic, objectives and the procedures expected to be followed by teacher in the teaching of topic under consideration using self-regulatory strategy. This prepared guide was used in the training of teacher to allow uniformity in the teaching strategy. The instructional guide was adopted from Zimmerman (2001) and was used for teaching of treatment group two.

The trained teacher introduce the task and objectives of learning. The students set goals and task ahead of them. This step involves strategic planning. The teacher supplied all necessary materials and assigned students to specific tasks to be performed. The students were involved in performing diverse activities by following some procedural steps. The students self-evaluate the result of the activities performed.

The student introduced their abridged outcome to the class. Likewise, they were required to apply the new information procured to other comparable or related circumstance with the help of the facilitator. The educator gives right solutions to their misconception where appropriate. The instrument was validated using the Scott's π statistical measure. The reliability coefficient of 0.824 was obtained.

3.5.8 Teachers' Instructional Guide for Conventional Strategy (TIGCS)

The instrument was use as instructional guide for the research assistants participating in the classroom using conventional strategy. Training of research assistants (teachers) to allow uniformity in the teaching strategy was also used with TIGCS. The trained teacher presents the lesson in the form of lecture, discusses the content of the lesson, solicits questions from the class and gives class work. The instrument was validated using the Scott's π statistical measure. The reliability coefficient of 0.802 was obtained.

3.5.9 Evaluation Sheet for Assessing Teachers' Performance (ESATP)

The (ESATP) comprised two sections A and B. Section A contained some demographic information about the research assistants. Section B contained items to monitor and measure the adherence and ability of each research assistant to follow the steps. The instrument revealed their presentation of concepts, mastery of the topics, use of materials and directed activities, and how effective their presentation was for the mastery of the concepts by the students using Project-based learning Strategy (PBLS), Self-regulatory Strategy (SRS), and Conventional strategy (CS).

3.6 Research Procedure

Work Schedule for the Period of Data Collection

Data collection was conducted over a period of twelve (12) weeks as follows:

2 weeks for training of research assistant on the use of the instructional guides

1 week for Pretest (first SMAT and SLSQ, followed by BAQ, BAT, and BPSRS)

8 weeks for Treatment (using TIGPBL, TIGSRS and TIGCS)

1 week for Posttest (BAQ, BAT, and BPSRS)

3.6.1 Pre-Experimental Activities

The researcher collected a letter of introduction from the Head of Department of Science and Technology Education. Copies were issued to each principal of the six selected schools in Akinyele, Ibadan North East, and Ibadan North local government areas for acceptance and for cooperation by Biology teachers and students throughout the duration of data collection. The researcher solicited for cooperation of Biology teachers and students in SSII Biology classes in all the six selected schools.

3.6.2 Training of Research Assistants

The research assistant were place under training for 2 weeks. The researcher explained the purpose and procedure for the study to them. The research assistants in the experimental groups were exposed to the use of the instructional strategy by the researcher after which they were allowed to use it in order to assess their competence. The objectives and content of each topic was given to each of them.

3.6.3 Administration of Pretest

After the training of the research assistants, the participants in each group were asked to allow students to fill the mental ability questionnaire and the learning style questionnaire in order to categorise them according to their mental ability and learning style group. This was followed by the administration of: Biology Attitude Questionnaire (BAQ), Biology Achievement Test (BAT), and Biology Practical Skills Rating Scale (BPSRS)

3.6.4 Treatment Procedure

The participating teacher administered the treatments in all groups for a period of eight weeks. Steps are as follow

Experimental Group 1: Steps followed as it is written in the Project-based learning

1. **Arrangement of Students**

   Step I: the students were arranged at the beginning to facilities learning.

2. **Students Working in Groups**

   Step II: students worked in groups of five based on their performance in the learning style and mental ability test administer before treatment.

3. **Teachers Instruction and Experimentation**

   Step III: the teacher pointed out the major whorls of a flowering plant

   Step IV: the teacher provided a clear instruction

4. **Student Participation**

   Step V: the students observed the events that took place during experimentation

   Step VI: the students raised points on pollination in flowering plant

   Step VII: the students' points were encouraged

5. **Teachers Encouragement**

   Step VIII: the teacher recognized value diversity and encourage the students

6. **Students Questions and Discussions**

   Step IX: the students' curiosity and passion in learning are enhanced by asking questions

   Step X: the students discussion were promoted by using open ended questions

7. **Students Practical Activities**

   Step XI: the students engaged in practical activities

   Step XII: the students' ability to observe, record, draw, label and classify were tested.

   Step XIII: the students described the content of pollination in flowering plants

8. **Students Feedback and Comments**

   Step XIV: the students gave insights, feedback and comments gained during teaching

Experimental Group 2: Steps followed as it is written in the Self-regulatory Strategy Guide.

1. **Teachers Introduction and Instruction**

   Step I: the teacher introduced the task and objectives of learning

   Step II: the teacher familiarized students with the processes.

   Step III: the students were exposed to concepts to be learnt

2. **Students Practical Activities**

   Step IV: the students were assigned to the specific task to be performed

   Step V: the students sets goals and task ahead of them

   Step VI: the students were involved in performing practical activities

STEP VII: the students followed some procedural steps provided by the teacher

3. **Students Self-Evaluation**

   Step VIII: the students self-evaluated the result of the activities performed

4. **Students Presentation**

   Step XIX: the students presented their summarized result to the class.

5. **Students Application**

   Step X: the students applied the new knowledge acquired to related situation

6. **Student Modification**

   Step XI: the students evaluated and made modification

7. **Teachers Correct Answers**

   Step XII: the teacher provided correct answers to their misconceptions where applicable.

Control Group: Steps followed in the control group as it is written in the Conventional Strategy Guide.

1. **Teachers Introduction, Question, and Discussion**

Step 1: Teacher introduced the lesson by asking questions based on prior knowledge

Step 2: The teacher discussed the content of the lesson.

2. **Student Jotting**

   Step 3 the student wrote down the board summaries in their notebooks.

3. **Teachers Questions and Classwork**

   Step 4: the teacher solicited questions from the class and gave class work.

4. **Teachers Feedback, Questions, and Assignment**

   Step 5: The teacher marked students' work.

   Step 6: The teacher evaluated by asking questions and giving home assignment.

3.6.5 Administration of Posttest

It was administered on the twelfth week. Senior Secondary II learners in all selected school across groups. The posttest administered were BAQ, ATQ and Biology Practical Skills Rating Scale (BPSRS) were administered.

3.7 Methods of Data Analysis

The quantitative data collected were analysed using inferential statistics of Analysis of Covariance (ANCOVA) to determine the significant main and interaction effects with the pretest scores as covariates to test the hypotheses. ANCOVA was utilized to single out the underlying differences in the group. The Estimated Marginal Mean (EMM) of different groups was used to detect the magnitude and direction of differences. Bonferroni post-hoc test was used where significant main effects were obtained. All null hypotheses were tested at $P<0.05$ level of significance. Tables, and figures were also used to interpret data and relevant interaction effects of variables of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The section of this chapter offering the outcomes and discussions of research impact of project-based learning and self-regulatory strategies as determinants of students' achievement, attitude to and practical skills in biology concepts in Ibadan. The analysis show the background data of the participant, this are secondary school students from three Local Government Areas in Ibadan, Nigeria. However, the result of the hypotheses generated from the study are presented as follows

Presentation of Demographic Data of the Participants

Groups	**Frequency**	**Percentages**
Project-based Learning Strategy	106	38%
Self-Regulatory Strategy	100	33%
Conventional Strategy	97	32%
Total	303	100%
Gender	**Frequency**	**Percentage**
Female	204	67.5%
Male	99	32.5%
Total	303	100%

Table 4. indicates the allocation of the participant according to treatment groups: 106 (38%) students were exposed to Project-Based Learning, while, 100 (33%) students were allocated to Self-Regulatory Strategy. The conventional strategy were 97 (32%). It also shows that 204 (67.5%) of the learners were female while 99 (32.5%) pupils were male.

4.1: Results

4.1.1 Testing the Null Hypotheses

Ho1a: There is no significant main effect of treatment (Project-based Learning and Self-regulatory Strategies) on students' achievement in Biology

Table 4.1: Analysis of Covariance (ANCOVA) of Post-Achievement Score by Treatment, Learning style and Mental Ability

Source	Type III Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3283.872	24	136.828	5.171	0.000	0.309
Intercept	11739.099	1	11739.099	443.660	0.000	0.615
PreAchievement	248.171	1	248.171	9.379	0.002	0.033
Treatment	849.148	2	424.574	16.046	0.000*	0.103
Learning style	48.891	3	16.297	0.616	0.605	0.007
Mental ability	.553	1	0.553	0.021	0.885	0.000
Treatment x Learning style	86.501	6	14.417	0.545	0.774	0.012
Treatment x Mental ability	59.609	2	29.804	1.126	0.326	0.008
Learning style x Mental ability	97.498	3	32.499	1.228	0.300	0.013
Treatment x Learning style x Mental ability	61.430	6	10.238	.387	0.887	0.008
Error	7355.798	278	26.460			
Total	226640.000	303				
Corrected Total	10639.670	302				

R Squared = 0.31 (Adjusted R Squared = 0.25) *denotes significant $p<0.05$

The table indicated that there is a significant main effect of treatment (project-based and self-regulatory strategies) on students' achievement in Biology ($F_{(2,278)} = 16.05$; $p<0.05$, partial $\eta^2 =0.10$). The effect is 10.0%. This indicates that 10.0% difference in students' achievement in Biological science was due to the significant main effect of the treatment. Hence, hypothesis 1a was rejected. To explore the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups were carried out and the result is presented in Table 4.2.

Table 4.2: Estimated Marginal Means for Post-Achievement by Treatment and Control Group

Treatment	Mean	Std. Error
Project-based Learning Strategy (PBLS)	28.44	0.69
Self-regulatory Strategy (SRS)	28.75	0.64
Conventional Strategy (CS)	22.45	0.95

Table 4.2 reveals that senior secondary school students exposed to SRS treatment outperformed their counterpart in PBS adjusted post -achievement mean score in Biology (28.75), (28.44), and control group (22.45). This order is represented as SRS>PBS>CS. In order to determine which of the groups caused this significant main effect, the Bonferroni post-hoc analysis was carried out across the treatment groups this can be seen in Table 4.3

Table 4.3: Bonferroni Post-hoc Analysis of Post-Achievement by Treatment and Control Group

Treatment	Mean	PBS	SRS	CS
Project-based Learning Strategy (PBS)	28.44			*
Self- regulatory Strategy (SRS)	28.75			*
Conventional Strategy (CS)	22.45	*	*	

Table 4.3 shows that the post-achievement mean score in Biology of senior secondary school students taught with Self-regulatory strategy (SRS) was not significantly different from their counterparts taught using Project-based learning Strategy (PBLS) but significantly different from those exposed to Conventional Strategy (CS). Also, the post-achievement mean score of the students exposed to project-based strategy was significantly different from their counterparts exposed to the conventional strategy. This implies that the significant difference revealed by the ANCOVA was as the result of difference between the treatment groups (Project-based and Self-regulatory strategies) and the control group (Conventional strategy) but not between the two treatment groups as students' post-achievement in Biology is concerned.

$H_0$1b: There is no significant main effect of treatment (Project-based Learning and Self-regulatory Strategies) on students' attitude to Biology

Table 4.4: Analysis of Covariance (ANCOVA) of Post-Attitude by Treatment, Learning style and Mental ability

Source	Type III Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3864.708	24	161.029	1.374	0.118	0.106
Intercept	27513.465	1	27513.465	234.825	0.000	0.458
PostAttitude	118.119	1	118.119	1.008	0.316	0.004
Treatment	421.594	2	210.797	1.799	0.167	0.013
Learning style	122.071	3	40.690	0.347	0.791	0.004
Mental ability	83.733	1	83.733	0.715	0.399	0.003
Treatment x Learning style	451.388	6	75.231	0.642	0.696	0.014
Treatment x Mental ability	247.416	2	123.708	1.056	0.349	0.008
Learning style x Mental ability	613.846	3	204.615	1.746	0.158	0.018
Treatment x Learning style x Mental ability	642.847	6	107.141	0.914	0.485	0.019
Error	32572.150	278	117.166			
Total	940624.000	303				
Corrected Total	36436.858	302				

Table 4.4 indicates that there is no significant main effect of treatment (Project-based Learning and Self-regulatory strategies) on students' attitude to Biology ($F_{(2,278)}$ = 1.80; P>0.05, partial η^2 =0.01). This shows that there was no significant difference in students' attitude to Biology when the main effect of the treatment is tested. Thus, hypothesis 1b was not rejected. To determine the extent of differences across the treatment groups, the estimated marginal means of the treatment groups were carried out and the result is presented in Table 4.5.

Table 4.5: Estimated Marginal Means for Post-Attitude by Treatment and Control Group

Treatment	Mean	Std. Error
Project-based Learning Strategy (PBLS)	56.12	1.40
Self-regulatory Strategy (SRS)	56.94	1.33
Conventional Strategy (CS)	52.56	1.93

Table 4.5 indicates that senior secondary school students taught using Self-regulatory Strategy (SRS) had the highest adjusted post-attitudinal mean score in Biology (56.94) followed by Project-based Strategy (PBS) group (56.12) and the control group (52.56).

H_o1c: There is no significant main effect of treatment (Project-based Learning and Self-regulatory Strategies) on students' practical skills in Biology.

Table 4.6: Analysis of Covariance (ANCOVA) of Post-Practical skills by Treatment, Learning style and Mental ability

Source	Type III Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2036.859	24	84.869	8.175	0.000	0.414
Intercept	3404.280	1	3404.280	327.922	0.000	0.541
PrePractical skills	908.337	1	908.337	87.497	0.000	0.239
Treatment	164.986	2	82.493	7.946	0.000*	0.054
Learning style	8.436	3	2.812	0.271	0.846	0.003
Mental ability	1.949	1	1.949	0.188	0.665	0.001
Treatment x Learning style	24.793	6	4.132	0.398	0.880	0.009
Treatment x Mental ability	46.261	2	23.130	2.228	0.110	0.016
Learning style x Mental ability	6.056	3	2.019	0.194	0.900	0.002
Treatment x Learning style x Mental ability	29.629	6	4.938	0.476	0.826	0.010
Error	2886.019	278	10.381			
Total	121292.000	303				
Corrected Total	4922.878	302				

R Squared = 0.41 (Adjusted R Squared = 0.36) *denotes significant p <0.05

Table 4.6 shows that there is a significant main effect of treatment (Project-based Learning and Self-regulatory strategies) on students' practical skills in Biology ($F_{(2,278)}$ = 7. 95; P<0.05, Partial η^2 = 0.05). The effect is 5.0%. This implies that 5.0% variation in students, practical skills in Biology was due to the significant main effect of treatment. Hence, hypothesis 1c was rejected. To determine the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups were carried out and the result is presented in Table 4.7.

Table 4.7: Estimated Marginal Means for Post-Practical Skills by Treatment and Control group

Treatment	Mean	Std. Error
Project-based Learning Strategy (PBLS)	20.80	0.42
Self-regulatory Strategy(SRS)	19.80	0.40
Conventional Strategy(CS)	17.88	0.59

Table 4.7 indicates the senior secondary school students taught with Project-based strategy (PBLS) treatment group 1 had the highest adjusted post-practical skills mean score in Biology (20.80) followed by their counterparts exposed to the Self-regulatory strategy (SRS) treatment group 2 (19.80), while the Conventional Strategy (CS) Control group (17.88) had the least adjusted post-practical skills mean score in Biology. This order is represented as PBS>SRS>CS. In order to explore which of the treatment groups caused this significant main effect, the Bonferroni post-hoc analysis was carried out across the treatment group and the result is presented in Table 4.8.

Table 4.8: Bonferroni Post-hoc Analysis of Post-Practical skills by Treatment and Control Group

Treatment	Mean	PBS	SRS	CS
Project-based Learning Strategy (PBLS)	20.80			*
Self –regulatory Strategy(SRS)	19.80			*
Conventional Strategy(CS)	17.88	*	*	

Table 4.8 shows that the post-practical skills mean of senior secondary school students in Biology exposed to the Project-based Strategy (PBS) was not significantly different from their counterparts taught with the Self-regulatory Strategy (SRS) but was significantly different from those exposed to Conventional Strategy (CS). Furthermore, the post-practical skills mean score of students exposed to the Project-based strategy was significantly different from their counterparts taught with the conventional strategy. This implies that the significant difference revealed by the ANCOVA was as the result of difference between the treatment groups (Project-based and Self-regulatory Strategies) and the Control group (Conventional Strategy) but not between the two treatment groups as students' post-practical skills in Biology is concerned.

However, the result indicated that hypotheses 2a, b and c showed no significant main effect of learning style on students' achievement in, attitude to and practical skills in Biology. This means that learning style had no effect on senior secondary school students' achievement, attitude and practical skills in Biology. Thus, hypotheses were not rejected. Likewise, hypotheses 3a, b and c displayed no significant main effects of mental ability on learners' achievement, attitude to and practical skills in Biology. Hence the null hypotheses were not rejected. In the same vain, hypotheses 4a, b and c shows that there was no significant interaction effect of treatments and learning style of learners' achievement in Biology, attitude to and practical skills in biology.

Research result also showed that hypotheses 5a, b and c have no significant main effect of treatment and mental ability on learners' academic achievement in Biology, attitude to and practical skills in Biology. Furthermore, hypotheses 6a, b and c designated that effect of learning style and mental ability on students' academic achievement, attitude to and practical skills in Biology were not significant. Hence, the treatment have no significant effect on all variables. Thus, hypotheses were not rejected. This connotes that learning style and mental ability had no impact on students learning outcomes. On hypotheses 7a, b and c also revealed that no significant main effect of treatments, learning style and mental ability on learners achievement in, attitude to, and practical skills in Biology. This revealed that the three-way interaction

effect had no significant effect on learners' achievement, attitude and practical skills Biology. Therefore the hypotheses were not rejected.

4.2 Discussion of Findings

4.2.1 Main Effect of Treatment on Students' Achievement in Biology

The findings of the study revealed noteworthy disparities in learners' performance score in the subject concepts across the two levels of experimental groups. The findings of the study revealed that students exposed to the Project-based Learning and Self-regulatory Strategies had higher achievement scores than their counterparts in the control group. Students introduced to SRS according to the result found to have had the most maximum (28.75) adjusted mean score also their counterpart in other group introduced to Project-based Learning strategy (28.44) and lastly followed by the students' in the control group (22.45). The discoveries indicated an improvement in the presentation of students in the post-accomplishment trial of Biology ideas with treatment. This suggests Project-based Learning and Self-regulatory Strategies are more successful than customary procedure in improving learners' accomplishment in Biology. The discoveries concurs with Bilgin, Karakuyu, and Ay (2015) whose review uncovered that learners in the treatment bunch created better potential and furthermore communicated positive views about the utilization of Project-based learning strategy in science instructing.

The study also corroborates the findings of Thomas, (2000); Gultekin, (2005); Condliffe et al., (2016) whose study revealed that Project-based Learning Strategy is a student-centered approach that has been shown to be effective in some situations, where they saw students progressed through authentic content, cooperative learning, and understood topics in greater depth. The noteworthy consequence of treatment on mentees achievement could also have been caused by the fact that PBLS enhances retention, give room for learners to interact with external idea and internalised knowledge gaining in other to apply it to real situation. Zimmerman (1990) established in line with the earlier report that there is an association between use of Self-regulated Strategy and academic achievement.

The study uncovered that PBL learners were more encouraged, which translate to great fundamental reasoning potential and acknowledged in a collaborative learning style among secondary learners. This discoveries is in consonance with the investigation of Afriana, Permanasari and Fitriani (2016) who detailed that learners presented to Project-based learning technique to upgrade primary school learners

logical education, got noteworthy encounters and lift their learning results. This backings the discoveries of Han, Capraro, and Capraro (2015) whose review set up that Project-based Learning impacts student achievement in mathematics and profited low performing students to a more prominent degree and decreased the achievement gap.

Similarly, Bas (2014) whose study uncovered that PBL was progressively viable in the good and impactive improvement learners' academic performance grade in arithmetic. Moreover, this has additionally uncovered that the students who were taught by PBLS was progressively fruitful also established great and good disposition towards the exercise than their partners presented to instruction based on student textbooks. The discovering likewise concurs with the attestations of teachers, John Dewey who announced the advantages of experiential, hands-on, student coordinated learning. The outcome lines up with the discoveries of Timur and Bülent (2014) whose review set up that the Project-based Learning methodology with respect to eighth grade students' towards measurements could adequately improve the learners learning and problem-solving competence.

The outcomes of this investigation additionally goes in the direction of Wolters and Hussain (2015) exploration which revealed a momentous indication of correlation between schoolchildren SRL and academic achievement. In another word, self-structured learning have a strong link of progress with learners success, this implies that when learners are self-developed it would influence their academic progress. This does not insist the discoveries of Baris (2015) whose review built up that there was no relationship between scholarly accomplishment and Self-regulatory Learning. This findings supports the assertions of Sun, Xie and Anderman (2017) whose study revealed that the use of help seeking strategies were all significantly related to academic achievement in learning environments. This result is in tandem with the findings of Zhu, Au, and Yates (2016) whose study established that self-control and self-regulatory learning would predict the students' achievement. Sletten (2017) research indicated that learner's takes ownership in the active learning sessions through constructivist teaching methods. In another words, learning in via constructivist approach is a learners centred whereby students determine what to learn and create a new understanding by their interaction with things around them or through peer collaboration. The findings is in line with assertions of Mutawah,

Thomas, and Khine, (2017) who revealed that self-regulated strategy has a positive correlation with academic achievement of students.

The result also lend credence to the claims of Çırak (2006) whose study established that Project-based Learning Strategy enhances student performance in an elementary English lesson, learners exposed to experimental groups performed wonderfully than their colleague exposed to conventional way of teaching. This findings align with the study outcomes of Magno and Cayado (2018) whose study established that Project-based learning is a process whereby students explore and learn content via authentic, projects essential to the curriculum. The study established that Self-regulatory learning strategy group exhibited a statistically noteworthy differences and more positive trend in achievement scores, therefore the strategy was suggested to have a very good impact on learners academic realisation when it is adequately considered. Furthermore, the finding is in line with assertions of Kitsantas, Steen and Huie (2017) that previous achievement of learners that was exposed to other forms of learning approaches cannot be compare with the use of Self-regulatory strategy, because it found to have been accounted for a huge amount of variance in students' academic achievement in a very positive direction. More so, the aftermath of the research is in consonance with Hung and Hwang (2016) whose study reported that integrating Self-regulatory Strategy into learning can improve students' self-efficacy as well as their strategies of planning and using study time, and hence students can learn effectively and enhance achievement. Besides, this findings uncovered that profoundly self-regulated students have ability to discover themselves and right choice of teaching method that best suit them very well, in that regards, these set of learners make use of this skill to developed their capability and manner of assimilation which invariably help them to accomplish scholarly objectives (Zimmerman, 2000). This discovering support with the investigation results of Ibe and Meduabum (2011) that teaching strategies adopted by educators always determine the progress report of learners.

This backings the attestations of Bas and Beyhab (2017) whose findings uncovered that the learners presented to project-based learning strategy in English exercise are progressively fruitful and have a higher motivation level than their partners presented to ordinary methodology. The critical impact of learners' performance in treatment groups is in concurrence with the discoveries of Holmes and Hwang (2016) whose review set up that learners profited extraordinarily from PBLS in

learning optional arithmetic instruction. This examination has uncovered that Project-Based Learning students were all the more naturally roused most especially group collaboration effort.

This study is in support of the finding of Adedeji and Adepoju, (2000); Agbi, (2006); Adepoju, (2008) who reported that human-to-human interaction provides the most effective teaching and learning experiences and outcomes. In the same vain, the findings is tune with the findings of Guven, Yurdatapan and Sahin (2014) who reported that PBL are significantly effective in increasing the scientific literacy of pupils from the 2nd grade of an elementary school in Istanbul. They revealed that a critical contrast was found for the test gathering. This result moreover supports Yavuz and Dinçer (2015) whose audit set up that assignment to assemble a framework regarding students' achievement in a science and development course, in a PC course in seventh grade tutees from organization. esref bitlis primary school in Istanbul, the scores of the preliminary pack were basically higher than that of the benchmark gathering. This result shows that the learning gains are higher when the direction is given by PBS than by the conventional procedure.

However, the findings also negate the study of Demirel et al., (2000) whose review detailed that no fundamental effect of learners' performance grade in language test, this reflect on both treatment and control groups that were examined in the study. This could be as a result of nature of course used in the study as well as student already familiar with traditional way of teaching and learning, this could also be as a result of nature of science subject which basically centre on acquisition skills by hand-on learning. The result also lends credence to the claims of Hung, Hwang and Huang (2012) whose study reported that project-based learning strategy with digital storytelling could effectively enhance the students' in 5th grade science learning motivation, problem-solving competence, and learning achievement in an elementary school in Southern Taiwan.

This findings corroborates Kafi and Motallebzadeh (2014) whose study reported that the participants in the experimental group outperform the participants in the control group on the post-test in English department, Islamic Azad University, Iran. The study is in support of Dignath (2018) whose study revealed that Self-regulatory learning Strategy has a positive effect on academic outcomes in mathematics. The result also lend credence to the claims of (Pape and Wang, 2003; Pintrich 2000; Sperling, Howard, Staley, and DuBois, 2004; that strategy use is related

to and predictive of academic performance. In the same vain, Pintrich (2000) also, established the report of the study that students use of SRS such as goal setting, planning, and effort management was the best predictor of their actual performance in grade 7th level of education in both science and humanities studies subjects.

This findings is in consonance with Leidinger and Perels (2012) whose study established that students given SRS materials in regular lessons in mathematics, maintained their self-reported self-regulated learning activities, however, students who did not receive the training materials demonstrated a significant decline in their SRS-activities between the pretest-posttest. This result is in connection with the findings of Cleary, Velardi and Schnaidman (2017) who established that participant that got introduce to Self-regulatory displayed a statistical major inferential and further progressive in a positive way of achievement scores. More so, Tella (2017), discovered in the study that there was that there was major link between goal setting ($r = 0.063$; $P>0.05$) and students' achievement in Chemistry in senior secondary schools in Ondo State.

This result is in connection with the findings of Wibrowski, Matthews, Kitsantas (2017) who reported that SRS indicated wide level of motivation and numerous skills in learning style. This study is in support of Kadioglu, Uzuntiryaki, and Aydin (2007) who reported that self-regulatory strategy is a valid and reliable tool for studying high school students' in chemistry Ankara in Turkey. Similarly, this finding is in line with assertions of Cleary and Platten (2013) whom affirmed a very notable correlation between SRL and academic achievement in Biology.

On the contrary, students tend to perform poorly in Biology when the teacher does not expose them to instructional strategies that could enhance learning. This statement is in line with the study outcomes of Orji and Ebele (2006) that poor achievement could be attributed majorly to ineffective instructional strategies adopted by teachers in teaching. This finding aligns with the study outcomes of Ibe and Meduabum (2011) that teaching strategies adopted by teachers determines the academic performance of student

4.2.2 Main Effect of Treatment on Students' Attitude to Biology

According to the report of the research outcomes, it was revealed certainly not notable main effect of PBL and SRS on learners' assertiveness to Biology. This does

not affirm the findings of Jegede, (2007) whose study established learners' attitude to learning was very intimate with learners' performance in science. Ajayi (2007) research indicated that student's bad attitudes to science make students perform poorly in science subjects. This study negates the findings of Nelson, (2011) whose study established that attitudes tend to influence behaviour, and therefore can be seen as important aspect of education. The result is not surprising because change of attitude is a gradual process.

This study negates the submission of Hakes (2008) whose study established relationship between teaching strategies and students' attitude. Hakes reported that teaching strategies that combined passive and active teaching promote interactive engagement which produces dramatic student gains. This study contradicts the findings of Emerick (2004) and Doyle (2008) whose study established that treatment can influence students' attitude.

Moreover, when learners have access to learning they obtained and developed a kind of assertiveness. Moreover, attitude of learners can be influence when instructors introduce new method of instruction to learners. The result is not surprising because change of attitude is a gradual process. This does not affirm the findings of Hussain, Alam, Bukhari, Ahmad (2011), Olagunju, Duyilemi and Adesina (2013), Okebukola (2013), Duyilemi, Olagunju and Adesina (2014); Babayemi (2014), Olasehinde and olatoye (2014), Muckhopadyay (2014), Adesina (2015), Bolaji (2015) whose study stipulated that in other to improve on making the method of instruction as well as knowledge of science to be more attractive and be internalised by students, therefore, learners need to be encouraged and be exposed to friendly learning environment in other to realised good disposition and right behaviour towards learning.

4.2.3 Main Effect of Treatment on Students' Practical Skills in Biology

The findings of the study revealed that there is a significant main effect of treatment on students' practical skills in Biology concepts. Learners that were introduced to PBLS was recorded to have utmost scores (20.80) when conducted post-test to respondents in biology practical skills acquisition, SRS learners were considered to be second in ranking (19.80) , while the participants that were introduced to traditional settings were the least (17.88). The result lends credence to

the claims of Jegede et al., (2013) whose study advocated for practical focused approaches in the instruction.

The critical principle impact of PBLS with respect to students' acquisition of practical skills is in concurrence with the discoveries of Yavuz and Dinçer (2015) whose review set up that application of Project-based guidance improved learners performance in science and innovative studies, because students would be exposed to practical situations that would help them to understand the concept also allow the learners to easily applied the knowledge to real life situation. This discoveries confirms (Buck Institute of Education, 2011; Edutopia 2008; Hmelo-silver, 2004; Moursund, 1999; Thomas and Mergendoller, 2000) whose review revealed that Project-based Learning Strategy spurs study who may somehow or another discover school exhausting or good for nothing. Dickinson et al., (1998) investigation showed that PBLS helped learners to be exposed to wide range of better disposition to learning and high rate of learning capabilities, for instance, coordinated effort, venture arranging, basic leadership, and time the executives through project based learning. This subsequently clarifies Project-based Learning expands the evaluation of students that develops for the most part from the collaboration between the instructors and learners, where students are effectively included into singular phases of the educating and learning process. Conceivable explanation behind this might be a direct result of the dynamic association of students in their learning procedure, which the fundamental suspicion of constructivist is learning hypothesis on Project-based Strategy is based.

The result also lends credence to the claims of Sams (2010), Nguyen et al., (2012), Jason (2012), Brame, (2013) and Miles, (2015) who revealed that students always enjoy support from each other which is not always available whenever the lesson is teacher dominated. Therefore, when peer assistance and support in a practical lesson, mastery of skills are likely to be more than when it is teacher mediated. From the discoveries of this investigation, it might in this way be sensible to infer that the utilization of instructional techniques that are focused on constructivist learning theory which effectively include the students in their learning procedure would go far in upgrading their cognizance and maintenance of the content in this way prompting obvious and noteworthy improvement of learners authority of reasonable attitude. The discoveries of the investigation indicated that the elevated level of instructor-to-student and student-to-students collaboration in Biology viable study hall is another

conceivable purpose behind the huge improvement in the down to earth aptitudes procured by learners in this findings.

This result aligns with the findings of Afolabi and Akinbobola (2010) whose research study gave evidence that hand-on activities performance of learners is the proof of teaching methodology instructors adopted when teaching and engaging learners most especially in science oriented subjects. This study is in support of Gacheri and Ndege (2014) who reported that practical skills are mental and physical abilities which serve as tools needed for effective study. This result also supports Alebiosu (2000) whose study established that practical skills enables students obey instructions, make accurate observations and drawing. Chebii, Wachanga and Kiboss (2012) also reported that students' in experimental groups outperformed the control groups in the acquisition of selected chemistry practical skills in Koibatek District, Kenya.

The outcome additionally lend confidence to the cases of Amunga, et al., (2011a) whose review uncovered that practical work makes the learners pay attention to learning science, because through practical work in sciences, students developed science skills and talents therefore improve their academic achievement. The discovering is in accordance with the investigation results of Lunetta et al., (2007) that taking part in science practical work gives reproduction encounters which arrange learners learning in conditions of request that require elevated mental and physical commitment. This commitment prompts better understanding and improved performance.

4.2.4 Main Effect of Mental Ability on Students' Achievement, Attitude and Practical Skills in Biology

Discoveries from the research investigated indicated that there is no critical primary impact of mental ability on students' achievement in Biology across the groups. This does not insist the discoveries of Olagunju and Abiona (2004) whose review set up that psychological capacity have been found to impact students learning. In the same vain the investigation is in opposition to the discoveries of Blessing (2014) and Babayemi (2014) whose review detailed that psychological capacity significantly affects accomplishment. However, the discoveries is in accordance with the declarations of Aremu and Tella (2009) whose review established that mental ability has no significant effect on achievement. This does not corroborate the discoveries of

Banglog and Tabords (2010) whose review established that learners' psychological capacity in object-situated programming (java), have critical association with performance.

This does not uphold the findings of Sangodoyin (2011) whose study established that student's mental ability have significant impact on performance of students in all ramification. This finding is not in line with the study conducted by a researcher who reported that mathematics ability is related to mental perception, capacity for abstract thinking and capacity to recognize patterns in things. The non-significant effect of mental ability on achievement in this study could be attributed to the mode of conduct of the test and the classroom environmental condition which might have one way or the other interfere with students' concentration. The result is contrary to the assertion of Olatoye and Aderogba (2011) that there is an existence of strong correlation between students' mental ability and academic performance. This does not affirm the findings of Raimi (2003) whose study established that students of different kind of mental ability status performance are varies as a result of series of learning resource available and type of teaching technique adopted in engaging students (Okafor, 2009).

Nonetheless, it was discovered that the result negates the investigation of Osuafor and Njoku (2016) who reported that student mental ability in Mathematics test is of a great noteworthy. This could be as a result of mental alertness and logic that involved in arithmetic's, more so, learners are expected to demonstrate the principle acquired theoretically. This does not uphold the findings of Oyedeyi (2011) who reported that student mental ability in Mathematics in has significant correlations with academic achievement. This does not uphold the findings of Kuncel, Crede and Thomas (2005) who reported that student mental ability in Mathematics indicated existence of strong correlation with students' academic performance. This does not uphold the findings of Pamela, Gardner, Debbie, Hutchinson, Whiteley (2011) whose study established that mental ability have been found to influence students learning. However, the study did not agree with Vocka, Preckelb and Hollingc (2011) also Akinlana (2013) that mental ability was found not to influence students learning, this could be as result of environment and participant characteristic.

This finding is not in line with the study conducted by Babayemi and Akinsola (2014) whose study reported that mental ability had notable key consequence on

academic success in basic science (F (2, 389) =5.04; p<0.05; ŋ2=.03). This does not uphold the findings of Bolaji (2015) who reported that mental ability clearly in good shape with learners' attainment in fundamental science. This finding is not in line with the study conducted by Castro, Prenda, Laguador and Pesigan (2015) who reported that high mental ability students have significantly higher persistence in doing their work and they have significantly higher expectations of positive effect from achievement-oriented activity than those low mental ability.

This does not affirm the findings of Duyilemi, Olagunju and Adesina (2014) who established that mental ability significantly predicted the students' agricultural economics skills. This does not uphold the findings of Veltmann, Raudfepp and Pullmann (2011) who reported that mental ability correlated as well as predicted significantly with students' achievement in mathematics. This implies that strategy found to have been more productive in anticipated learners educational progress. The study was also in contrary to the work of Aina (2006), outcome emphasize that there is slit link between mental ability and achievement in senior secondary physics. Similarly, Olagunju and Chukwuka, (2008) revealed, intellectual capabilities of learners have found to be affecting students learning in science innovation. However, the researched also upholds Chen (2012) investigation who reported that there is no relationship between students' mental aptitude and progress report academically. This study does not affirm the findings of L"eson, Clarrochi and Heaven (2008) who reported significant paths from mental ability on student academic performance.

4.2.5 Main Effect of Learning Style on Students' Achievement, Attitude, and Practical Skills in Biology

Findings from this study revealed that there is no significant main effect of learning style on students' achievement in Biology. This result is in tandem with the findings of Rohrer (2008), Zhang and Sternberg, (2005) who reported that there is no significant correlation between students' learning styles and learning outcomes. This study negates the findings of Zhang and Sternberg, (2005) whose review built up that there is a critical relationship between's understudies' learning style and learning results. This outcomes is regarding the discoveries of Castro and Peck (2005) who announced that learners' learning style didn't moderately added to students' achievement. The investigation then again repudiates the discoveries of Dunn (2001) who announced that learners' learning style added to academic achievement. The study

of Miller (2008) negates the result of this study. This study negates the findings of Ferrero et al., (2016) whose study established that students' performance can be enhanced when material is delivered in the individual's preferred learning style.

This result is in tandem with the findings of Husmann and O'Loughlin, (2019) whose study established that learning styles had no correlation with students' achievement among undergraduate anatomy students. Additionally, it was shown that the result cooperate with the discoveries of Papadatou-pastou, Gritzali and Barrable, (2018) whose study revealed that there is no relationship between pupils' learning style and achievement. The result also lends credence to the claims of Rogowsky et al., (2015) whose study reported that no statistical significance was found in the relationship between learning style preference, and achievement in text comprehension.

This does not affirm the findings of Rato et al., (2013) whose study reported a significant correlation between students' learning style and academic achievement. This does not affirm the findings of Papadatou-pastou, Haliou, and Vlacho (2017) who reported significant correlation between students' learning style and learning outcomes. This study negates the findings of Deligiannidi and Howard-Jones, (2015) whose study reported significant correlation between students' learning style and achievement.

The findings is in line with the assertions of Ong, Rajendram and Yusuf, (2006) whose study established that previous studies on the relationship between learning style and students' academic performance have shown conflicting results. This result is in tandem with the findings of Rahman and Ahmar (2017) who reported that there is no relationship between students learning style and learning achievement in mathematics. This does not affirm the findings of Safe, (2008); Tella and Adeniyi, (2009) who reported that learning styles of learners had an important role in improving quality of learning and increase academic achievement of students.

This does not confirm the discoveries of Özerem and Akkoyunlu (2015) who revealed that a significant relationship between learners' learning style and academic performance in mathematics. This does not maintain the discoveries of Cheema and Kitsantas (2016) who detailed that style of learning determined the direction of process of learning science. This outcome is pair with the discoveries of Almigbal (2015) who detailed that student learning style inclinations are not identified with a students' academic achievement of medical students at King Saud University in

Riyadh, Kingdom of Saudi Arabia. Additionally, subsequent to being changed in accordance with other investigations' factors, the learning style inclinations were not identified with GPA.

This does not uphold the findings of Surjono (2015) who examined the effects of multimedia preferences and learning style on student achievement in online electronics course at the Yogyakarta State University Indonesia, and reported that students multimedia preferences and learning style matched with the way the material presented in online electronics course have higher scores significantly compared to those in which their learning mode were mismatched. This does not affirm the findings of Tulbure (2012) who reported that learning styles of learners had an important role in improving quality of learning and increase students' academic achievement.

4.2.6 Interaction Effect of Treatment, Mental ability and Learning Style on Students' Achievement, Attitude, and Practical Skills in Biology.

The research investigation revealed clearly that no outstanding contact effect of treatment, intellectual capabilities also learning style on secondary school students achievement in Biology. This implies that the treatment was able to improve the students' achievement irrespective of their mental ability and learning style. This finding negates the view of Bamidele (2000) whose study established that mental ability is a clear case of theoretical constructs replacing functions which are indirectly measurable through performance. This shows that PBL and SRS have a great impact on students' achievement. Wirkala and Kuhn (2011) research indicated that students have superior mastery when teaching and learning conditions are student-centered and the most effective way student learn is when they are actively engaged in hands-on activities.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.1 Summary

The summary of the findings are stated as follow

Impact of treatment on students' performance in Biology was significant. Students introduced to the Project-based Learning and Self-regulatory Strategies had higher achievement scores than their partners in the control group. The students' exposed to Self-regulatory Strategies had the most highest adjusted mean score followed by learners presented to Project-based Learning Strategy and lastly, followed by the students in the control group. Subsequently, the treatment are more compelling than conventional strategy in improving students' performance in Biology.

It was obviously indicated that research treatments have a great impact on learners' hand-on acquisition and capabilities in learning Biology. Learners in Project-based Learning treatment group had the most significant balanced post-practical skills mean score in Biology, trailed by learners in the Self-regulatory treatment group, while learners in the control group had the least adjusted post mean scores in Biology. There was elevated level of teachers-to-students and students-to-students interaction in Biology practical activities is another conceivable explanation behind the huge improvement in the science practical abilities acquired by students.

5.2 Conclusion

The results of the study had indicated that both Project-based learning and self-regulatory Strategies are more effective in enhancing students' level of achievement and practical skill in Biology than the Conventional Strategy. When secondary school students are exposed to strategies where experience/explorations are hands on, mind on, structured and are guided by the teacher, it fosters the scientific knowledge and skills of students better than conventional strategy.

The Project-based learning and Self-regulatory Strategies produced better achievement and better practical skill in Biology concepts than the conventional method. This means that the usual inability to cover the voluminous Biology topic/ contents in the stipulated time and the usual poor Biology practical skill resulting from insufficient practical resources which often lead to poor performance in Biology could be effectively tackled through the application of Project-based learning and Self-regulatory Strategies. The study also showed that learning carried out with students largely in charge of their learning can lead to greater academic achievement. In conclusion, teachers should endeavour to make classroom teaching and learning very effective by using instructional strategies such as PBL and SRS that can help in developing learners' performance in terms of academic test progress in Biology.

5.3 Contribution to Knowledge

The study has contributed to knowledge in the following ways:

1. Project-based Learning and Self-regulatory Strategies improved academic achievement, and fosters communication skills of students in Biology.
2. The study has revealed that practical activities encourages students to develop a balanced, diverse approach to solving problems, deepens their knowledge of scientific ideas, and enables them to engage in the processes of Biology.
3. The result obtained from this study can be regarded as an empirical evidence in subsequent research in aspect of Biology.

5.4 Educational Implications of Findings

Project based Learning and Self-regulatory Strategies have been found to emphatically influence the progress of academic performance of learners and practical skill in Biology. The finding in this investigation has along these lines uncovered the significance of utilizing instructional methodologies that are student focused to build the cooperation of students during teaching and learning forms; resulting into a long-lasting effect on cognitive outcomes. The students who were taught Biology with Project-based Learning and Self-regulatory Strategies encountered a greater activity based teaching and learning where student were dynamic, as a result of the learning tasks involved in the strategies. The teachers should try to utilize the dual periods in Biology to accomplish a comparable outcomes. The investigation likewise uncovered

the requirement for Project-based Learning and Self-regulatory Strategies to be consolidated into our educational system, as they are powerful tools in improving academic achievement and practical skills of students in Biology.

5.5 Recommendations

Based on the findings of this study the following recommendation were made

1. Teachers should expose students to varieties of practical experiences that can boost their mental ability and manipulative skill through strategies such as project-based and self-regulatory strategies because this would help to increase their retention capacity and improve achievement in Biology.
2. Teachers' training institutions should upgrade the curriculum of the pre-service teachers to ensure that adequate training is given to them in the area of these innovative strategies that is, PBL and SRS to enhance the competence and confidence of Biology teachers in order to improve the overall academic achievement of students in Biology.
3. The Stakeholders in Education should collaborate with bodies such as science teachers association of Nigeria (STAN), Nigeria Union of Teachers (NUT) and so on to organize in-service training for Biology and other subject teachers to acquire necessary and adequate knowledge need in the practice of instructional strategies such as Project-based Learning and Self-regulatory Strategies.
4. Curriculum planners and developers in science courses for secondary school should emphasize on the need to continuously use innovative strategies such as Project-based Learning and Self-regulatory Strategies to enhance science based instruction.
5. The Ministry of Education should put in place workshops, seminars and conferences for secondary school Biology teachers as yearly training programmes to introduce and demonstrate innovative teaching strategies.

5.6 Limitations of the Study

The findings, conclusions and generalization of this study may have been affected by a number of limiting factors. In the course of the study some other constraints encountered were:

i. The study is limited to learners in the Senior Secondary two (SS II) from schools in Ibadan, Oyo state, Nigeria.
ii. The study investigated Project-based learning, Self-regulatory Strategies and students' achievement, attitude and practical skills in Biology concepts in Ibadan, Nigeria.
iii. Only six functional aptitudes were tried out of the fifteen recognized by the American Association for the Advancement of Science, AAAS. In this way, the discoveries of this investigation may not be summed up.

5.7 Suggestions for Further Studies

In view of the limitations of the study the following suggestions are made for further research.

1. The study could also be replicated from secondary school level to tertiary institutions in order to broaden the generalization of research findings.
2. The study could be carried out in more public secondary schools in other local government areas of Oyo state, other states and other geo-political zones of Nigeria.
3. Further research could be conducted using other moderator variables not used in the study which could influence students learning outcomes such as cognitive ability, self-efficacy, multiple intelligence, verbal ability and test anxiety.
4. Inclusion of private secondary schools in such future researches should be considered.

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APPENDIX I

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION
UNIVERSITY OF IBADAN
BIOLOGY ACHIEVEMENT TEST

Instruction: Fill in the space below

Section A

Name of student…….

Name of school……

Sex: Male { } Female { }

Section B: Choose the correct option from the alternative A-D

1. A flower has……..Whorls. (a) 1 (b) 2 (c) 3 (d) 4.
2. A/an…….is a reproductive structure of flowering plants.(a)seed (b)flower (c)fruit (d)ovary.
3. Another name for flower stalk is …….. (a) Staminate (b) pedicel (c) anther (d) carpels.
4. A staminate flower is a male flower which contains only…….. (a) Stamens (b) pistils (c) anther (d) ovary.
5. A pistillate flower is a female flower which contains only…….(a) vacuole (b) pistils (c) anther (d) ovary.
6. Epigynous flower has an inferior ovary which is completely embedded in a fleshy receptacle so that all other flora parts are above it (a) true (b) false (c) all of the above (d) none of the above.
7. …… is a flower with a superior ovary, the flower parts arise from the receptacle at the same level as the ovary or below it. (a) epygynous (b) perigynous (c) hypogynous (d) epiderms.
8. The transfer of pollen grain from the anther to a receptive stigma is called (a) germination (b) production (c) pollination (d) fertilization.
9. There are …….Types of pollination (a) 4 (b) 3 (c) 2 (d) 1
10. Sepals are collectively called……. (a) petals (b) corolla (c) calyx (d) sepals.
11. Petals are collectively called …… (a) epicarpel (b) corolla (c) calyx (d) sepals.

12. The stamens and carpels are protected by…… in a flower. (a) Sepals (b) petals (c) ovary (d) anther.
13. The colour and scent of ……..attracts the pollinators (a) sepals (b) Petals (c) ovary (d) anther.
14. When both petals and sepals look alike they are collectively known as the ……. (a) corolla (b) perianth (c) corona (d) collection.
15. A group of stamens are collectively known as the …….. (a) Androecium (b) gynoecium (c) hydroecium (d) monoecium.
16. The stamen are flowers'…….reproductive organ (a) female (b) male (c) hermaphrodite (d) none of the above.
17. Most stamens have a/an…….and a/an…… (a) stalk/balls (b) filament/anther (c) seeds/seedling (d) red/green.
18. A pollen grain is composed of two coats, a though protective outer called ……and thin inner coat called……..(a) exime and intine (b)enzyme and cell (c) epidermis and dermis (d) nucleus and cell wall.
19. Carpels are collectively known as…….. (a) androecium (b) gynoecium (c) hydroecium (d) monoecium.
20. The carpels are the flowers'…….reproductive organs (a) female (b) male (c) hermaphrodite (d) none of the above.
21. An ovary, a style and a stigma forms a…… (a) Carpel (b) petal (c) ova (d) pedicel.
22. The pollen grain is received by the……. (a) Ovary (b) style (c) ova (d) stigma.
23. After fertilization an ovary develops into…… (a) Cell (b) egg (c) fruit (d) seed.
24. The ……. Function as the carrier of the male gametes to the egg cells in the ovary. (a) Anther (b) stigma (c) ovary (d) style.
25. The ovules are attached to the placentae by short stakes called……. (a) conjuction (b) joint (c) appendages (d) funicles.
26. After fertilization the ovule develops into…… (a) Seed (b) cell (c) fruit (d) egg.
27. The arrangement of the ovules in the ovary is called …… (a) Placenta (b) placentation (c) implantation (d) fusion.
28. The compartment in which the ovule lies is called…….. (a) loculus (b) space (c) positioning (d) gap.

29. The compartment in which the ovules lie is separated by a ……. (a) Separator (b) septa (c) placentation (d) axile.
30. An ovule contains a tiny opening called the …….. (a) Isle (b) pathway (c) micropile (d) marginal.
31. Male flower are staminate flowers which have only……. (a) Stamens (b) carpels (c) corolla (d) corolium.
32. Female flowers are pistillate flowers which have only…… (a) Stamens (b) carpels (c) corona (d) corolla.
33. When male and female flower are found in a plant, the plant are…… (a) monoecious (b) monocotyledon (c) dicotyledonous (d) dioecious.
34. When male and female flower are found on different plants, the plant are…….. …… (a) monoecious (b) monocotyledon (c) dicotyledonous (d) dioecious.
35. ……..is an example of dioecious plant. (a) Palm oil (b) pawpaw (c) maize (d) rice.
36. …… is an example of monoecious plant (a) cowpea (b) palm oil (c) groundnut (d) pawpaw.
37. A group of glandular cells at the base of the corolla or within the receptacle secrets a sugary liquid called……. (a) Sugar (b) nectar (c) honey (d) fluid.
38. Small leafy structure arising on any part of the pedicel is called……..... (a) Suckers (b) branches (c) leaves (d) bracteoles.
39. Self-pollination only occurs in…….flowers (a) bisexual (b) monossexual (c) monocot (d) dioecious.
40. ……..and……in a flower attract and guide insects to their food source within them. (a) Water and perfume (b) colour and scent (c) shape and colour (d) perfume and scent.
41. Insect pollinated flowers are called .....flowers (a) entomophilous (b) anemophilous (c)endomophilous (d) ectomophilous
42. Wind pollinated flowers are called ..... flowers (a) entomophilous (b) anemophilous (c)endomophilous (d) ectomophilous
43. Wind pollinated flowers do not have .....(a) water (b)perfume (c)scent (d)height
44. ..... is an example of wind pollinated flower (a) sugarcane (b) pawpaw (c) hibiscus (d) sunflower

45. ..... is an example of insect pollinated flower (a) Rattle box (b) sugarcane (c)wheat (d) rice

ANSWER TO STUDENTS' ACHIEVEMENT TEST IN POLLINATION AND REPRODUCTIVE SYSTEM IN FLOWERING PLANTS

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

APPENDIX II

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

BIOLOGY ATTITUDE QUESTIONNAIRE (BAQ)

INSTRUCTION: Answer all questions with honesty. Your response has nothing to do with you or your school but is meant for research. Strictly confidential.

SECTION A: Personal Data

Name of student…….

Name of school……

Sex: male { } female { }

Age: below 15 years { }, 15-18 years { }, above 18 years { }

Local government area…….

Section B

The following statements are developed to measure students' attitude towards biology, please tick the appropriate option that best reflect your agreement or disagreement.

S/N	ITEMS	SA	A	D	SD
1	Biology is of great interest to me				
2	I dislike some topics in biology				
3	I like biology because it involves practical activities				
4	I think biology make me feel more secured				
5	I believe I learn more in biology when I interact with others				
6	I think biology is too broad for me				
7	I have difficulties to understand what I was taught in class				
8	I don't like attending biology class				
9	The practical part of a biology lesson encouraged me to take it				
10	I learn best when am an active participant in the biology class				
11	I think I learn more from practical activities than teaching				
12	In biology class, I don't feel comfortable				

13	I assume biology makes me nervous even when carrying out experiments in laboratory				
14	I always have positive reaction towards Biology				
15	Biology is a challenging subject that is why I like it				
16	I like Biology because its knowledge improves quality of life				
17	I think I read Biology textbook as any other subject				
18	I considered taking Biology for future career				
19	It is complicated to make connections between different topics in Biology				
20	Having a good teacher persuades me to carry on with Biology				

APPENDIX IIIA

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION
UNIVERSITY OF IBADAN
BIOLOGY PRACTICAL QUESTION

Time Duration: 1hr

The practical questions consist of three questions with sub-sections for the students.

INSTRUCTION: Answer all questions in this section correctly.

Recording and Observation

1a. Identify Specimen A

b. Examine Specimen A, identify its floral parts.

c. Place it on the White tile and cut the floral part horizontally

d. Record the Observation of the floral whorls in a tabular form.

Classification and Manipulation of Apparatus

2. Identify specimen B

a. State two differences between specimen A and B

Observation, Drawing and Labeling

3. Make a drawing 6cm- 8cm long of Specimen A and label fully.

a. State one function each of any three parts labelled

b. Cut horizontally across the ovary, examine the section and draw the placentation of specimen A

c. Name one example of fruit with similar placentation as observed in the cut section of specimen A

ANSWERS TO BIOLOGY PRACTICAL

1a. Specimen A is Hibiscus flower

b. The floral parts are: Sepals, Petals, Stamens, and Carpels

c. Place on a white tile

d. Observation in tabular form

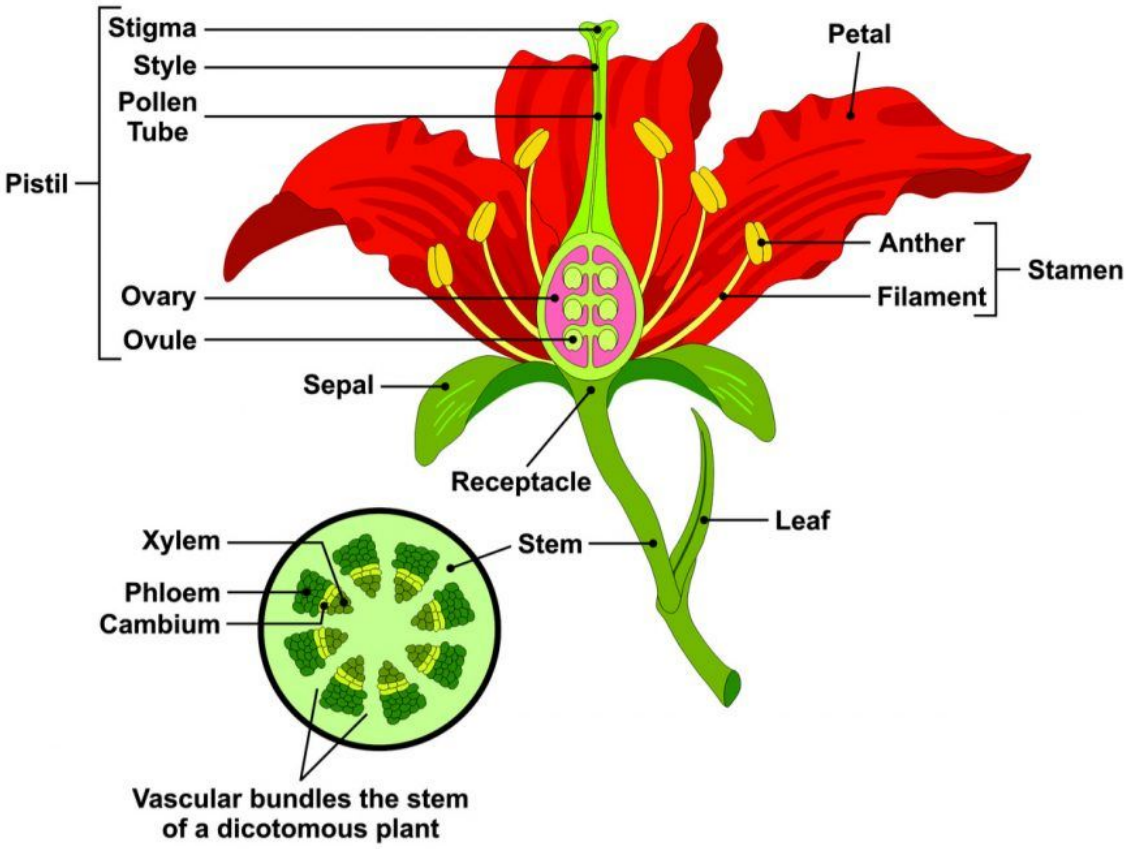
Part	**Number**	**Description**
Calyx	5 Sepals	Green
Corolla	5 Petals	Yellow with purple markings
Androceium	10 Stamens	Short filaments and elongated anthers
Gynoecium	1 Carpel	Ovary containing ovules

1 Specimen B is Rattlebox flower

Differences between specimen A and B

Specimen A	**Specimen B**
Two or more carpels fused to form a single structure	Just one carpel
Syncarpous	Monocarpous

DIAGRAM OF A WELL LABELLED HIBISCUS FLOWER



a. **Functions of the labelled parts.**

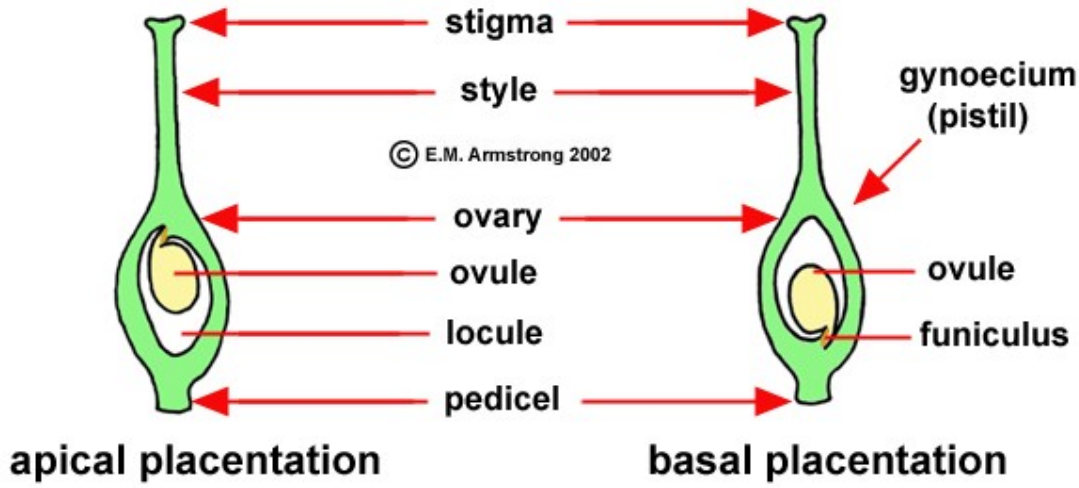
i. Sepals: the outermost whorl of a flower is made up of three to five sepals, collectively known as the calyx. The sepals are usually small and green; fused at bases to form a cup-shaped structure. They protect the essential parts of the flower.

ii. Petals: collectively known as the corolla, the petals form the second whorl, just inside the sepals. Generally, petals are brightly coloured or scented. The colour and scent attract pollen-transferring animals (pollinators).

iii. Stamens: the whorl just inside the petals is a group of stamens, collectively known as the androecium. The stamen are the flower's male reproductive organs. Most stamens have a long slender stalk, the filament; and a swollen end called the anther.

iv. Carpels: collectively known as the gynoecium, make up the central whorl of a flower. They are the flower's female reproductive organs. Most pistils have an ovary, styles and, stigma.

DIAGRAM OF A MAGNIFIED MICROSCOPIC SESSION SHOWING HIBISCUS FLOWER



C. One example of fruit with similar placentation as observed in the cut section of specimen A includes: Tomato, pawpaw,

APPENDIX IIIB

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

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BIOLOGY PRACTICAL SKILLS RATING SCALE (BPSRS)

This instrument is in two sections- A and B. Section A has to do with the personal data of the respondents while Section B intends to rate the students' practical skills in biology. The teacher is to rate the students in terms of Observation, Recording, Manipulation of Apparatus, Classification, Drawing, and Labeling.

SECTION A: PERSONAL DATA

Name of student.....

Name of school……

Local government area……

SECTION B

Instruction: Please use the following scale to rate the students' skill acquisition

Student's Name	Observation						Recording						Drawing						Labeling						Manipulation of Apparatus						Classification						Total
	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	

The maximum score a student can obtain is 30%. Students who score: 0 -5% = **0** (Very Poor) , 6% -10% = 1 (Poor) , 11% - 15% = **2** (Average) , 16% - 20% = **3** (Good) , 21% - 25% = **4** (Very Good), 26% - 30% = **5** (Excellent).

APPENDIX IV

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

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STUDENTS MENTAL ABILITY TEST

The purpose of this mental ability test is strictly for research. It has section A and B. Section A contains your demographic data and section B contains twenty (40) questions with options A-E. Choose the option that correctly corresponds to the questions

SECTION A

INSTRUCTION: Supply the required information in the given space. You have twenty (20) minutes to complete it.

Name of student…….

Name of School:.....

Class.....

SECTION B

INSTRUCTION: Read the following items and pick the correct answer from the given options

1. Write the number of the pair, the words of which do not have the same type of meaning as others.
(a) Shade and Colour (b) Drink and Sip (c) Short and Tall (d) Happy and Contented

2. Which of the following pair is odd one out?
(a) Love, Affection (b) Abundance, Scarcity (c) False, True (d) Sharp, Blunt

3. Complete the series: 1, 3, 10, 21, 64, 129,?, 777
(a) 356 (b) 259 (c) 388 (d) 144

4. It takes 2 minutes to boil a single egg. How many minutes will it take to boil 5 eggs together?
(a) 10 (b) 4 (c) 2 (d) 5

5. If fifth of the month falls two days after Monday, what day of the week will precede the 19^{th} of the month?
(a) Friday (b) Wednesday(c) Saturday (d) Tuesday

6. Select the correct word to fill in the blank: Gun is to Soldier as ..... is to Blacksmith.
(a) Nail (b) Blower (c) Hammer (d) Plane

7. If Land is to Train as Sky is to.....
(a) Pilot (b) Air (c) Aeroplane (d) Bird

8. Fill in the missing number to complete the series: 1 4 2 5 3 6 7.....,.....
(a) 6, 8 (b) 5, 8 (c) 9, 7 (d) 6, 9

9. If 2 × 3 = 812, 4 ×5 = 1620 then 6 × 7 =?
(a) 42 (b) 1214 (c) 2428 (d) 2442

10. If 5 boys write 5 pages in 5minutes, in how many minutes can one boy write one page?
(a) 1 minute (b) 15minute (c) 5 minute (d) 2.5 minutes

11. If Monday is to February, then Friday is to.....?
(a) July (b) June (c) May (d) August

12. If March is to August, then C is to.....
(a) G (b) I (c) H (d) J

13. An aeroplane files twice is fast than a train which covers 60 miles in 80 minutes. What distance will the aeroplane cover in 20 minutes?
(a) 30 miles (b) 50 miles (c) 35 miles (d) 40 miles

14. A lady is 5 years younger to her husband and he is 5 times as old as his daughter. If the daughter was 5 years old 3 years back, what is the present age of the lady?
(a) 25 (b) 45 (c) 35 (d) 30

15. If LPPHGLDWH means IMMEDIATE what does WRSVHFUHW stand for? (ABCDEFGHIJKLMNOPQRSTUVWXYZ) (a) MARINATED
(b) STRONGEST (c) TOPGRADED (d) TOPSECRET

Fill in the blanks with appropriate words from the four options:
16. Essence is to Flowers as ..... is to Oven.
(a) Vapour (b) Steam (c) Fire (d) Heat

17. Happy is to Sad as Straight is to.....
(a) Drawing (b) Curved (c) Rounded (d) Vertical

18. Candle is to Sun as ..... is to Sea.
(a) Lagoon (b) Boat (c) Pond (d) Puddle

Fill in the blank spaces in the series with appropriate choices:
19. 2, 6, 5, 9, 8, 12, 11, 15 .....,.....
(a) 13, 17 (b) 14, 18 (c) 19, 23 (d) 21, 25

20. 48, 45, 40, 33, 24 .....,.....
(a) 11, 12 (b) 12, 13
(c) 9, 11
(d) 13, 0

21. Point 'A' is located 8 miles South of B and C is located 6 miles West of A. what is the distance between C and B?
(a) 8 miles (b) 9 miles (c) 11 miles (d) 10 miles

Write the number of the pair which is different from other pairs:
22. (a) Head and Cap (b) Pen and Pencil (c) Ink and Inkpot (d) Oil and Lamp

23. (a) Culprit and Prison (b) Pupil and Teacher (c) Patient and Hospital
(d) Bird and Nest

24. Rs 2,000 amounts to Rs 2,226.05 in 2 years at compound interest. What will be the rate of interest?
(a) 5% (b) 5.25% (c) 5.5% (d) 6%

25. Write the number of the two words which have the same relationships as Comb and Hair.
(a) Toothache and Tooth brush (b) Paint and Wall (c) Boot and Brush
(d) Engine and Petrol

Fill in the blanks with appropriate choices:
26. Meat is to Vegetarian as ..... is to Teetotaler.
(a) Mutton (b) Chicken (c) Vegetables (d) Liquor

27..... is to Goat is Milk is to Child.
(a) Fodder (b) Graze (c) Shepherd (d) Grain

28. Soap is to Dirt as Petrol is to.....
(a) Dry Cleaner (b) Grease (c) Car (d) Clothes

29. A man travels 2 miles, turns left and travels 3 miles, turn left again and travel 6 miles. How far is he from the starting point?
(a) 4 miles (b) 7 miles (c) 5 miles (d) 9 miles

Choose the word, which is of a different class from the others in the following:
30. (a) Chinese (b) English (c) Bengali (d) Germany

31. (a) Triangle (b) Rectangle (c) Circle (d) Rhombus

32. If BAD is coded as YZW and FIGHT is coded as URTSG. How will you encode HIGH?
(a) TRST (b) SRTS (c) STSR (d) TSRT

33. If $9 \times 7 = 3545$ and $4 \times 3 = 1520$ then $6 \times 8 =$?
(a) 5040 (b) 6050 (c) 4030 (d) 3040

34. If CAFÉ is coded as 3165 and HIDE is coded as 8945, how will you encode HEAD?
(a) 8514 (b) 5816 (c) 9156 (d) 8154

Fill in the blanks:
35. 11::: 20 x : ..... 34 (a) 18x (b) 16x (c) 15x (d) 14x

36. 31::: 27y:.....42 (a) 21y (b) 16y (c) 12y (d) 14y

37. If 20 – 4 = 10 and 30 – 6 = 10 then 40 – 8 =?
(a) 30 (b) 24 (c) 10 (d) 28

38. If in a code, 52 – 36 = 97 and 46 – 78 = 1510, then how 53 – 62 can be encoded?
(a) 1520 (b) 88 (c) 2015 (d) 8800

39. A watch gains 12 seconds' every3 hours, what time will it show at 10 A.M. on Tuesday if the watch is set right at 3 A.M. on Sunday?
(a) 09 hrs 58 minutes (b) 09 hrs 57 minutes 8 seconds (c) 10 hrs 2 minutes
(d) 10 hrs 3 minutes 40 seconds

40. I bought a watch for Rs. 60. What will it fetch if I sell at a gain of 25%??
(a) Rs 72 (b) Rs 75 (c) Rs 77.50 (d) Rs 80

ANSWER TO STUDENTS' MENTAL ABILITY TEST

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

APPENDIX V

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

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STUDENT LEARNING STYLE QUESTIONNAIRE (SLSQ)

Answer all question with honesty. Your response has nothing to do with you or your school but is meant for research. Strictly confidential.

SECTION A: PERSONAL DATA

Name of student…….....

Name of school…….....

Local government area……

SECTION B

The following statements are developed to measure students' learning style, please tick the appropriate option that best reflect your agreement or disagreement.

S/N	ITEMS	SA	A	D	SD
1	**VISUAL** I appreciate doodling and indeed my notes have piles of pictures in them.				
2	I remember something better on the off chance that I record				
3	I get lost in the event that somebody reveals to me how to find a workable pace place.				
4	When attempting to recall somebody's name, or something new like that, it causes me to get an image of it in my psyche.				
5	On the off chance that I am stepping through an examination, I can "see" the reading material page and where the appropriate response is found.				
6	It encourages me to take a gander at the individual while tuning in; it keeps me centered.				
7	Utilizing cheat sheets encourages me to hold material for science tests				
8	It's difficult for me to comprehend what an individual is				

	stating when there are individuals talking or music playing				
9	It's difficult for me to comprehend a joke when somebody lets me know				
10	It is better for me to complete work in a peaceful spot.				
	AUDITORY				
11	My composed work doesn't look perfect to me. My papers have crossed-out words and eradications.				
12	It assists with utilizing my finger as a pointer when perusing to keep my place.				
13	Papers with little print, messy imitates or poor duplicates pummel me.				
14	I see how to accomplish something in the event that somebody lets me know, as opposed to perusing something very similar to myself				
15	I recall things that I hear, instead of things that I see or read				
16	Composing is tiring. I push down excessively hard with my pen or pencil.				
17	I don't record the headings.				
18	At the point when I read, I stir up words that copy, for example, "them" and "at that point," "awful" and "father."."				
19	It's difficult for me to peruse others' penmanship.				
20	On the off chance that I had the decision to adapt new data through a talk or course reading, I would decide to hear it as opposed to understand it.				
	READING/WRITING				
21	I take in new data best when I read the composed guidance				
22	At the point when I am giving bearings, I for the most part work out the headings				
23	I recollect headings best when I record them				
24	At the point when I don't know how to spell a word, I regularly find it in the lexicon				

25	To recollect and review an occasion, I would need to peruse a portrayal				
26	I appear to recollect protests better if a have found out about them				
27	When utilizing another gadget I would peruse the bearings that accompanied it				
28	I appreciate finding out about things that intrigue me				
29	I like to get some answers concerning something new by finding out about it				
30	I incline toward an instructor who uses hand outs in educating				
	KINESTHESTIC				
31	I don't prefer to understand headings; I'd preferably simply begin doing.				
32	I adapt best when I am told the best way to accomplish something, and I have the chance to do it.				
33	Learning at a work area isn't for me.				
34	I will in general take care of issues through a more experimentation approach, as opposed to from a bit by bit strategy.				
35	Before I follow bearings, it encourages me to see another person do it first.				
36	I don't turn out to be effectively lost, even in an abnormal environment.				
37	I think well when I have the opportunity to move around.				
38	I do not become easily lost, even in strange surroundings.				
39	I think well when I have the freedom to move around.				
40	At the point when I can't think about a particular word, I'll utilize my hands a ton				

APPENDIX VI A

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S INSTRUCTIONAL GUIDE FOR PROJECT-BASED LEARNING STRATEGY (PBLS)

Procedure for Use of Project Based Learning Strategy

The following steps guided the teacher in teaching the students using Project-based learning strategy.

1. **Arrangement of Students**

   Step I: the students were arranged at the beginning to facilities learning.

2. **Students Working in Groups**

   Step II: students worked in groups of five based on their performance in the learning style and mental ability test administer before treatment.

3. **Teachers Instruction and Experimentation**

   Step III: the teacher pointed out the major whorls of a flowering plant

   Step IV: the teacher provided a clear instruction

4. **Student Participation**

   Step V: the students observed the events that took place during experimentation

   Step VI: the students raised points on pollination in flowering plant

   Step VII: the students' points were enhanced

5. **Teachers Encouragement**

   Step VIII: the teacher recognized value diversity and encourage the students

6. **Students Questions and Discussions**

   Step IX: the students' curiosity and passion in learning are enhanced by asking questions

   Step X: the students discussion were promoted by using open ended questions

7. **Students Practical Activities**

   Step XI: the students engaged in practical activities

   Step XII: the students' ability to observe, record, draw, label and classify were tested.

   Step XIII: the students described the content of pollination in flowering plants

8. **Students Feedback and Comments**

Step XIV: the students gave insights, feedback and comments gained during teaching

APPENDIX VI B

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S INSTRUCTIONAL GUIDE FOR SELF-REGULATORY STRATEGY (SRS)

Procedure for use of SRS

The following steps guided the teacher in teaching the students using Self-regulatory Strategy

1. **Teachers Introduction and Instruction**

   Step I: the teacher introduced the task and objectives of learning

   Step II: the teacher familiarized students with the processes.

   Step III: the students were exposed to concepts to be learnt

2. **Students Practical Activities**

   Step IV: the students were assigned to the specific task to be performed

   Step V: the students sets goals and task ahead of them

   Step VI: the students were involved in performing practical activities

   STEP VII: the students followed some procedural steps provided by the teacher

3. **Students Self-Evaluation**

   Step VIII: the students self-evaluated the result of the activities performed

4. **Students Presentation**

   Step XIX: the students presented their summarized result to the class.

5. **Students Application**

   Step X: the students applied the new knowledge acquired to related situation

6. **Student Modification**

   Step XI: the students evaluated and made modification

7. **Teachers Correct Answers**

   Step XII: the teacher provided correct answers to their misconceptions where applicable.

APPENDIX VI C

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S INSTRUCTIONAL GUIDE FOR CONVENTIONAL STRATEGY (CS)

The following steps guided the teacher in encouraging the students utilizing Traditional method

1. **Teachers Introduction, Question, and Discussion**

   Step 1: Teacher introduced the lesson by asking questions based on prior knowledge

   Step 2: The teacher discussed the content of the lesson.

2. **Student Jotting**

   Step 3 the student wrote down the board summaries in their notebooks.

3. **Teachers Questions and Classwork**

   Step 4: the teacher solicited questions from the class and gave class work.

4. **Teachers Feedback, Questions, and Assignment**

   Step 5: The teacher marked students' work.

   Step 6: The teacher evaluated by asking questions and giving home assignment.

APPENDIX VII A

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S LESSON PLAN FOR TEACHING POLLINATION AND REPRODUCTIVE SYSTEM IN FLOWERING PLANTS USING PROJECT-BASED LEARNING STRATEGY IN EXPERIMENTAL GROUP 1

LESSON I

DATE:

CLASS: S S II.

SUBJECT: Biology

TOPIC: REPRODUCTIVE SYSTEMS IN FLOWERING PLANTS.

Sub topic: Structures and Functions of the Reproductive Organs of Plants and Arrangements of Reproductive Organs of Plants.

DURATION: 40 Minutes

REF, BOOK: Lucy I. Akunwa, J.B.C. Obidiwe (2013) Africana First Publishers Limited.

Modern Biology for Senior Secondary Schools, Revised Edition. Page 454-460.

TEACHING AIDS: Samples of Flowers and Ovaries of Pride of Barbados, Flamboyant Flowers and Sun Flower.

ENTRY BEHAVIOUR: Students are aware that plants reproduce flowers.

OBJECTIVES: At the end of the lesson students will be able to:

i. Identify reproductive organs in plants.
ii. Distinguish between the essential and non- essential parts of a flower.

PREVIOUS KNOWLEDGE: Students have already been taught that reproduction in flowering plants are vital process of nature. It is extremely important in food growing processes and without it, we could be in trouble.

INTRODUCTION: The teacher will introduce the lesson by asking questions from the students on what they already know about reproduction in flowering plants to discover their prior knowledge of the concepts and they will be allowed to reflect on their previous experience.

CONTENT

STEP 1

(i) The students were arranged in groups of five in the classroom.

(ii) The students were allowed to observe the parts of the flower.

(iii)The students were pointed out the ovary of the flower.

STEP II: The student observed reproductive organs of Hibiscus flower.

STEP III: The teacher will:

i. Explain and identify the four whorls of the flowering plants.

ii. Encouraged all points on pollination in flowering plants.

STEP IV:

The student draw a complete diagram of a hibiscus flower, showing the stamen and the carpel.

SUMMARY:

The teacher summarize the practical lesson by briefly giving hints to students on the importance of reproduction in flowering plants.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught:

i. The students gives a detail explanation of the reproductive organ of a flower
ii. The students draw and label a longitudinal section of generalized flower
iii. The students write short notes on the four whorls of a flowering plants
iv. The students differentiate between Staminate and Pistillate flowers

LESSON II

CLASS: S S II

SUBJECT: Biology

Topic: REPRODUCTIVE SYSTEM IN FLOWERING PLANTS

SUB TOPIC: Kinds of Placentation.

DURATION: 40 minutes

REF.BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised edition. Page 456-459.

TEACHING AIDS: transverse section of cowpea, pawpaw, tomato, garden egg, sunflower, water lily.

ENTRY BEHAVIOUR: Students have the idea that an ovary has ovule(s) arranged in different forms in it.

OBJECTIVES: At the end of the lesson students will be able to:

i. Describe the various reproductive organs of the flower
ii. Describe the different kinds of placentation in plants.
iii. Students will make observations and record and draw events as they carry out tasks.
iv. Students will make longitudinal drawing of the structure of the flower

PREVIOUS KNOWLEDGE: Students have already been taught that reproduction in flowering plants that pollination begins with flowers. Flowers have male and female parts that produce very small grains called pollen.

INTRODUCTION: The teacher will introduce the lesson by asking questions from the students on what they already know about reproduction in flowering plants to discover their prior knowledge of the concepts and they will be allowed to reflect on their previous experience.

CONTENT

STEP I:

i. The teacher arranges the students in groups of ten at the beginning to facilitate learning.
ii. The teacher determine the necessary approaches to learning for student success.

STEP II:

i. The students will explain the term; hypogenous and perigynous.
ii. The students will list the features of wind pollinated flowers.

STEP III:

Refer questions to students to encourage curiosity, interest and passion in learning.

STEP IV:

Promote discussion by using open ended question

STEP V:

i. The students engaged in activities that will generate investigation ideas.
ii. The students observed and recorded a complete diagram of a sunflower.

SUMMARY: The teacher will summarize the practical lesson by briefly giving hints to students on how to cut a flowering plant horizontally.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught:

i. The students unfold the content of reproductive organs in flowering plants.
ii. The students give insights, feedback and comments gained during the lesson.
iii. The student draw and label a longitudinal section of generalized flower

LESSON III

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: POLLINATION IN FLOWERING PLANTS

SUB TOPIC: Meaning, Types, and Features of Pollination.

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, one edged safety razor blade, dissecting needle, 2 flowers per students, dissecting scissors, pointed forceps.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

OBJECTIVES: At the end of the lesson students will be able to:

(i) Define pollination in flowering plants.

(ii) Name and describe the different types of pollination.

(iii) List the features of self- pollination and cross pollination

PREVIOUS KNOWLEDGE: Students have already been taught pollination as the transfer of pollen grain from the anther to the stigma. Flowers have male and female parts that produce very small grains called pollen.

INTRODUCTION: The teacher will introduce the lesson by asking questions from the students on what they already know about pollination in flowering plants to discover their prior knowledge of the concepts and they will be allowed to reflect on their previous experience.

CONTENT

STEP I:

(i) The teacher arranges the students in groups of five at the beginning to facilitate learning.

(ii) The students were allowed to record their observation.

(iii)The students draw and label the ovary of the flower.

STEP II:

(i) The students examined the pollen grains of the flower

(ii) The students observed and described each parts of the flower.

STEP III:

The teacher pace material according to students' ability.

STEP IV:

The students mention and explain the two types of pollination.

STEP V:

The students give insights, feedback and comments gained during the lesson.

STEP VI:

The students explain the stamen of a flowering plant

SUMMARY: The teacher summarizes the practical lesson by briefly giving hints to students on how to cut a flowering plant.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught:

(i) The student differentiated between staminate and pistillate flowers;

(ii) The students define features of animal pollinated flower;

(iii) The students lists and describe the four whorls of a flower

LESSON IV

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: Pollinators in flowering plants

SUB TOPIC: Agents of Pollination.

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) African First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, The school garden.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

OBJECTIVES: By the end of the lesson students will be able to:

(i) State the characteristics of wind and insect pollinated flowers.

(ii) State the agents of pollination.

PREVIOUS KNOWLEDGE: Students have already been taught pollinating agents that without the assistance of pollinators, most plants cannot reproduce fruits and seeds. Examples of crops that are pollinated include; apples, squash and almonds

INTRODUCTION: The teacher will introduce the lesson by asking questions from the students on what they already know on pollinators.

CONTENT

STEP I:

The teacher determine the necessary approaches to learning for student success.

STEP II:

The students will give example of pollinating agents

STEP III:

The students will make observations and record events as they carry out practical work.

STEP IV:

(i) The students will give the importance of pollinators in flowering plants.

(ii) The students will list five types of pollinators.

STEP V:

i. The students gives a detail explanation of pollination

ii. The students describe the economic importance of pollinators

EVALUATION: The teacher will ask the students the following questions based on what they were be taught:

(i) The students observed the structure of a flower;

(ii) The students define the process of cross pollination.

APPENDIX VII B

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S LESSON PLAN FOR TEACHING POLLINATION AND REPRODUCTIVE SYSTEM IN FLOWERING PLANTS USING SELF-REGULATORY STRATEGY IN EXPERIMENTAL GROUP 2

LESSON I

DATE:

CLASS: S S II.

SUBJECT: Biology

Topic: Reproductive Systems in Flowering Plants.

SUB TOPIC: Structures and Functions of the Reproductive Organs of Plants

DURATION: 40 Minutes

REF, BOOK: Lucy I. Akunwa, J.B.C. Obidiwe (2013) Africana First Publishers Limited.

Modern Biology for Senior Secondary Schools, Revised Edition. Page 454-460.

TEACHING AIDS: Samples of Flowers and Ovaries of Pride of Barbados, Flamboyant Flowers and Sun Flower.

ENTRY BEHAVIOUR: Students are aware that plants reproduce and produce flowers.

OBJECTIVES: At the end of the lesson students will be able to:

(i) Identify reproductive organs in flowering plants.

(ii) Distinguish between the essential and non- essential parts of a flower.

(iii) Prepare a longitudinal section of the reproductive organ

(iv) Define types of pollination

PREVIOUS KNOWLEDGE:

Students have already been taught that pea flowers contain both the male and female parts, called stamen and stigma, and usually self-pollinated.

INTRODUCTION:

The teacher will introduce and explain in details the concepts of self-pollination and cross pollination.

CONTENT

STEP I:

The teacher will ask students some guiding questions on what they already know about reproductive system in flowering plants.

STEP II:

(i) The students explain the sexes in plants;

(ii) The students prepare an annotated scientific drawing of the sepals and petals.

STEP III:

(i) The students explains with the aid of a diagram, the longitudinal section of a flower

(ii) The students visit the school garden and observe insects actively pollinated flowers.

STEP IV:

The students list five (5) the types of flowers in their environment

STEP V:

The students observe and record the position of the ovary.

SUMMARY: The teacher will summarize the practical lesson by briefly giving hints to students how the placentation of the ovules occur.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught:

(i) Discuss placentation in flowering plants.

(ii) The students writes a term paper on position of the ovary

LESSON II

CLASS: S S II

SUBJECT: Biology

Topic: REPRODUCTIVE SYSTEM IN FLOWERING PLANTS

SUB TOPIC: Arrangements of Reproductive Organs of Plants.

DURATION: 40 minutes

REF.BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 456-459.

TEACHING AIDS: Transverse Section of Cowpea, Pawpaw, Tomato, Garden Egg, Sunflower, and Water Lily.

ENTRY BEHAVIOUR: Students have the idea that an ovary has ovule(s) arranged in different forms in it.

OBJECTIVES: At the end of the lesson students will be able to:

(i) Describe the various reproductive organs of the flower

(ii) Describe the different kinds of placentation.

PREVIOUS KNOWLEDGE:

Students have already been taught that peas can be cross pollinated by hand , simply by opening the flower buds to remove their pollen producing stamen(and prevent self-pollination) and dusting pollen from one plant onto the stigma of another.

INTRODUCTION:

The teacher will introduce and explain in details the concept of reproductive organ

CONTENT

STEP I:

The students will give definition on reproduction in flowering plants

STEP II:

(i) The students will a chart to explain structure of some common flowers

STEP III:

(ii) The students will draw and label the stamen of a flowering plants

STEP IV:

(i) The students explains with the aid of a diagram, the longitudinal section of a flower

(ii) Discuss the relationship of stamen and stigma.

STEP V:

The students visit the school garden and observe insects actively pollinated flowers.

SUMMARY: The teacher will summarize the practical lesson by briefly giving hints to students how to dissect longitudinally in flowering plants.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught: The students are allowed to answer the following:-

(i) List the equipment needed for dissection of a flower.

(ii) The uses of the equipment.

LESSON III

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: POLLINATION IN FLOWERING PLANTS

SUB TOPIC: Meaning, Types, and Features of Pollination.

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, The school garden.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

INSTRUCTIONAL OBJECTIVES: At the end of the lesson students will be able to:

(i) Define pollination.

(ii) Name and describe the different types of pollination.

(iii) List the features of self- pollination and cross pollination

PREVIOUS KNOWLEDGE:

Students have already been taught how to dissect a flowering plants. The teacher also show them different types of flowers.

INTRODUCTION:

The teacher will introduce and explain in details the longitudinal dissection of a flower.

CONTENT

STEP I:

The teacher will give the student a task on pollination

STEP II:

The students will give definitions they already know about pollination

STEP III:

The students will explain with the aid of a diagram, the longitudinal section of a flower

STEP IV:

The students will explain the features of self-pollination and cross pollination.

SUMMARY: The teacher will summarize the practical lesson by briefly explaining to students how to dissect, record and observe a flowering plant

EVALUATION: The teacher will ask the students the following questions based on what they will be taught: The students are allowed to answer the following:-
State the importance of pollination to the economy.

LESSON IV

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: Pollination in Plants

SUB TOPIC: Features of Cross and Self-Pollinated Flowers and Agents of Pollination.

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, hand lens or magnifying lens.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

OBJECTIVES: At the end of the lesson students will be able to:

(i) State the characteristics of wind and insect pollinated flowers.

(ii) State the agents of pollination.

PREVIOUS KNOWLEDGE: students have already been taught Mendel's law of inheritance that Mendel studied inheritance in pea (*Pisum sativum*). He chose peas because they had been used for similar studies, are easy to grow and can be sown each year.

INTRODUCTION:

The teacher will introduce and explain in details how Mendel described each of the trait variant as dominant or recessive dominant traits, like purple flower colour, appeared in f1 hybrids, whereas recessive traits, like white flower colour, did not.

CONTENT

STEP I:

(i) The teacher will ask students some guiding questions on what they already know about Mendel's law.
(ii) The students give definition of Mendel's law of inheritance
(iii)The teacher will give correct definition of Mendel's law

STEP II:

The students will carry out practical task to show cross pollination by Mendel's

STEP III:

The students will cross breed pea with 7 pairs of pure bred traits.

STEP IV:

The students will outline the features of self-pollination and cross pollination.

SUMMARY: The teacher will summarize the practical lesson by briefly explaining to the students pea traits studied by Mendel.

EVALUATION: The teacher will ask the students the following questions based on what they will be taught:

(i) Define Mendel's law of inheritance
(ii) Explain the term dominant and recessive traits

APPENDIX VII C

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

UNIVERSITY OF IBADAN

TEACHER'S LESSON PLAN FOR TEACHING POLLINATION AND REPRODUCTIVE SYSTEM IN FLOWERING PLANTS USING CONVENTIONAL STRATEGY (CONTROL GROUP)

LESSON I

DATE:

CLASS: S S II.

SUBJECT: Biology

Topic: REPRODUCTIVE SYSTEMS IN FLOWERING PLANTS.

SUB TOPIC: Arrangements of Reproductive Organs of Plants.

DURATION: 40 Minutes

REF, BOOK: Lucy I. Akunwa, J.B.C. Obidiwe (2013) Africana First Publishers Limited.

Modern Biology for Senior Secondary Schools, Revised Edition. Page 454-460.

TEACHING AIDS: Samples of Flowers and Ovaries of Pride of Barbados, Flamboyant Flowers and Sun Flower.

ENTRY BEHAVIOUR: Students are aware that plants reproduce and produce flowers.

OBJECTIVES: At the end of the lesson students will be able to:

(i) Identify reproductive organs in plants.

(ii) State the differences between wind and insect pollinated flowers

PREVIOUS KNOWLEDGE: Students are aware that pollination begins with flower

INTRODUCTION:

The teacher will write the topic on the chalkboard and ask the student to:

(i) Define pollination

(ii) Mention two types of pollination

(iii) The agents of pollination

PRESENTATION: The teacher will connect the new topic with the previous lesson the students have been taught. The teacher will:

STEP I: Examines part of a flower provided and its functions or importance were explained.

STEP II: Describe each parts and points out the essential and non- essential parts of it.

STEP III: Explain the various reproductive organs of a flower and

STEP IV: The position of the ovary in each flower.

STEP V: Summarize the lesson

STEP VI: Write note on the chalk board

STEP V11: Ask questions from the students

GUIDED PRACTICE: The students copy notes into their notebooks and respond to teacher's questions.

EVALUATION: The teacher will ask the following questions as he or she goes around the class to see the students copy the note:

(i) Mention four parts of a flower?

(ii) Mention three non-essential part of a flower?

(iii)Mention four essential part of a flower?

(iv) Explain the term Hypogenous in flowering plant

ASSIGNMENT: The teacher will give assignment to students to study the kinds of placentation in flowering plants.

LESSON II

CLASS: S S II

SUBJECT: Biology

Topic: REPRODUCTIVE SYSTEM IN FLOWERING PLANTS

SUB TOPIC: Kinds of Placentation.

DURATION: 40 minutes

REF.BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 456-459.

TEACHING AIDS: Transverse Section of Cowpea, Pawpaw, Tomato, Garden egg, Sunflower, Water lily.

ENTRY BEHAVIOUR: Students have the idea that an ovary has ovule(s) arranged in different forms in it.

BEHAVIOURAL OBJECTIVES: At the end of the lesson students will be able to:

(i) Describe the various reproductive organs of the flower

(ii) List the different kinds of placentation.

PREVIOUS KNOWLEDGE: Students are aware that flowering plants are everywhere, providing food and shelter. The fruits and seeds of flowering plants are an important food source for people and wildlife.

INTRODUCTION: The teacher will write the topic on board and ask the students to:

(i) Define photosynthesis

(ii) Mention 3 pollinators

(iii) Characteristics of insect pollinated flowers

PRESENTATION: The teacher will connect the new topic with the previous lesson the students have been taught. The teacher will hang the chart on the wall for the students to observe as the discussion.

The teacher will:

STEP I:

Describes the various reproductive organs of a flower and the position of the ovary in each flower. i.e.

Is ovary at the same level- hypogynous

Is it that the outer floral is above the central ovary-perigynous

Is it that the ovary is completely embedded in a fleshly receptacle?

That other floral parts are above it- Epigynous

STEP II:

Compare the placentation diagrams with the aids provided in the class and identify the kind of placentation in the aids provided.

STEP III:

Write note on the chalkboard for the students

STEP IV:

Ask questions from the students

GUIDED PRACTICE: The student copy notes into their notebooks and respond to teacher's questions.

EVALUATION: The teacher will ask the following questions from the students,

(i) Define the following terms1) perigynous 2) epigynous 3) hypogynous

(ii) What kind of placentation do you see in the following fruits?

Mango, tomato, orange, pineapple and lemon

ASSIGNMENTS: The teacher will give assignment to the students to:

(i) Draw and label a longitudinal section of generalized flower.

(ii) Write short notes on the four whorls of a flower

(iii) Give 2 examples each of monocarpous placentation.

(iv) Differentiate between staminate and pistillate flowers.

LESSON III

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: POLLINATION IN FLOWERING PLANTS

SUB TOPIC: Meaning, Types, and Features of Pollination.

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Africana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, The school garden.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

BEHAVIOURAL OBJECTIVES: At the end of the lesson students will be able to:

(i) Define pollination.

(ii) Name and describe the different types of pollination.

(iii) List the features of self- pollination and cross pollination

PREVIOUS KNOWLEDGE: students have been taught reproductive organ in flowering plants.

INTRODUCTION: The teacher will write the topic on the chalkboard and ask the student to:

(i) Define recessive and dominant traits.

(ii) Explain Mendel's law of inheritance

PRESENTATION: The teacher will explain Mendel law of inheritance to the students as he or she shows the students the chart showing the diagram of recessive and dominant traits.

The teacher will:

STEP I: Define pollination as the transfer of pollen grains from an anther to receptive stigma.

STEP II: Name the type of pollination we have i.e. two types namely: - Self-pollination and Cross-pollination

STEP III: Explain the meaning and features of self-pollination and cross-pollination.

STEP IV: Write note on the chalkboard for students

STEP V: Ask questions from the students

GUIDED PRACTICE: The students copy notes into their notebooks and respond to teacher's questions.

EVALUATION: The teacher will ask the following questions

(i) What is pollination?

(ii) List and explain the two types of pollination.

In tabular form differentiate using features, the difference between self-pollination and cross-pollinated flowers.

ASSIGNMENT: The teacher will give assignment to students to draw the longitudinal section of a hibiscus flower or pride of Barbados.

LESSON IV

DATE

CLASS: S S II

SUBJECT: Biology

TOPIC: Pollination in Plants

SUB TOPIC: Features of Cross and Self-Pollinated Flowers

DURATION: 40 minutes

REF. BOOK: Lucy I. Akunwa, J.B.C Obidiwe (2013) Aficana First Publishers Limited. Modern Biology for Senior Secondary Schools, Revised Edition. Page 467-472.

TEACHING AIDS: Flower, Slide, Microscope, The school garden.

ENTRY BEHAVIOUR: Students have the idea of reproduction in flowering plants.

BEHAVIOURAL OBJECTIVES: At the end of the lesson students will be able to:

(i) State the characteristics of wind and insect pollinated flowers.

(ii) State the agents of pollination.

PREVIOUS KNOWLEDGE: Students have been taught the flowering plants undergo photosynthesis.

INTRODUCTION: The teacher will write the topic on the chalkboard and ask the students to:

(i) Mention the agents of pollination I.e. Water, Insect, Wind, Animals

(ii) State the characteristics of insect and wind pollinated flowers.

PRESENTATION: The teacher will explain dominant traits to the students as he or she shows the students the chart showing the diagram of recessive and dominant traits. The teacher will:

STEP I: define recessive traits in flowering plants

STEP II: characteristics of insect and wind pollinated flowers.

STEP III: longitudinal section of a flower and discuss the relationship of stamen and stigma.

STEP IV: Write note on the chalkboard for students

STEP V: Ask questions from the students

GUIDED PRACTICE: The students copy notes into their notebooks and respond to teacher's questions.

EVALUATION: The teacher will ask the following questions

(i) What is pollination?

(ii) List and explain the two types of pollination.

(iii) In tabular form differentiate between self and cross-pollinated flowers.

ASSIGNMENT: The teacher will give assignment to students explain in details the term pollination.

APPENDIX VIII A

EVALUATION SHEET FOR ASSESSING TEACHERS' PERFORMANCE ON PROJECT-BASED LEARNING STRATEGY

Name of Teacher: ----------

School: ----------

Date: ----------

S/N	Guidelines Involved	VG 5	G 4	AV 3	P 2	VP 1
1	The Teacher's ability to arranged the students in groups of ten at the beginning to facilitate learning					
2	Ability of the Teacher to ask the students to identify each parts and point out the essential and non-essential parts					
3	The Teacher's ability to pace the material according to students' ability.					
4	Ability of the Teacher to ask questions based on the differences and similarities between their previous and new experience					
5	The ability of the Teacher to students engage in activities that will generate ideas					
6	Ability of the Teacher consider the information the students already know					
7	Teacher's clarification of students view on content of pollination and reproduction in plants.					

KEY: Very Good=5, Good=4, Average=3, Poor=2, Very Poor=1

Name and Signature of Rater.....

APPENDIX VIII B

EVALUATION SHEET FOR ASSESSING TEACHERS' PERFORMANCE ON SELF-REGULATORY STRATEGY (ESATPSRS)

Name of Teacher: ----------

School: ----------

Date: ----------

Topic Taught.....

Guidelines Involved	V. Good 5	Good 4	Average 3	Poor 2	V. Poor 1
Teacher introduction of the lesson whether it is based on students previous Knowledge.					
Teacher's ability to give students the opportunity to answer the questions using their intuition.					
Teacher's ability to use the clues inside the pollination concept as guides in order to make students to both identify the concept and leading to the behavioural objective.					
Ability of the Teacher to make students to respond by allowing students to present their ideas with the aid of the diagram.					
Teacher clarification of students views on the concept using self-judgement as basis for clarification.					
Teacher's ability to assess students for more critical analysis on the content using self-evaluation.					

KEY: Very Good=5, Good=4, Average=3, Poor=2, Very Poor=1

Name and Signature of Rater.....

APPENDIX VIII C

EVALUATION SHEET FOR ASSESSING TEACHERS' PERFORMANCE ON CONVENTIONAL STRATEGY (ESATPCS)

Name of Teacher: ----------

School: ----------

Date: ----------

Topic Taught.....

Guidelines Involved	**V. Good 5**	**Good 4**	**Average 3**	**Poor 2**	**V. Poor 1**
Teacher's introduction of the lesson.					
Ability of the Teacher to discuss the content of the concepts.					
Ability of the Teacher to allow students to write the note.					
Teacher's ability to give an overview of the lesson.					
Teacher's oral questions in conformity with the concept.					
Teacher conclusion of the lesson.					
Teacher gives homework or assignment.					

KEY: Very Good=5, Good=4, Average=3, Poor=2, Very Poor=1

Name and Signature of Rater.....