

# EFFECT OF TWO INSTRUCTIONAL STRATEGIES ON STUDENTS SCIENCE PROCESS SKILLS IN SOME SELECTED ABSTRACT CONCEPTS IN BIOLOGY IN KWARA STATE, NIGERIA.

By

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## Abstract

*This study determined the effects two Instructional (project and inquiry) Strategies on students' science process skills in some selected abstract concepts in Biology. The study adopted the pretest-posttest control group, quasi-experimental design. 120 SS II Biology students from six co-educational schools in two Local Government Areas (LGAs) in Kwara State were randomly selected for the study. Participants were randomly assigned to treatments and control. The instruments used were: Student Acquisition of Science Process Skills scale ( $r=0.87$ ) and Teachers Instructional guides on Project and Inquiry strategies. Two hypotheses formulated and tested at 0.05 level of significance. The data collected were analysis using analysis of covariance, the treatment had significant main effect on students' science process skills on some selected abstract concepts in Biology ( $F_{(1, 107)} = 28.001$ ;  $p < 0.05$ , partial  $\eta^2 = 0.344$ ). The female Students showed greater improvements in mean gains of science process skills scores by 10.17 and male students by 9.88. Based on the findings, it is recommended that the biology teachers should employ Project and Inquiry strategies as commonly used strategies in teaching, as it enhances students' acquisition of science process skills in abstract concepts in biology.*

**Keywords:** project, inquiry, strategies, science, process skills.

## Introduction

The Biology is the science that deals with the study of varieties of living organisms including plants, animals and micro-organisms. The importance of biology in our daily lives lies in the fact that biology attempts to find out the unifying principles that exists among diverse organisms having morphological and functional inequalities. Biology covers the study of all the living things and their interactions into the biosphere. This is a very important task because we are able to know the behavior or functioning of each population when it faces other

individuals from other populations or the specific sectors of the biosphere that are affected and/or benefited by that behavior or functioning of the populations into a community.

The importance of Biology is shown virtually in all field of education such as agriculture, medicine, pharmacy. Ezekiel, Yilshik & Joseph, (2021) and Lawal, (2011) reported that biology is a very important science subject that offer a basic requirement for further learning of a number of science related professional courses like medicine, agriculture, pharmacy, nursing and so on. Biology helps in the production of high yielding varieties of crop plants and their diseases resistant varieties. Biology helps in minimizing human suffering and curing of hereditary abnormalities like hemophilia, and down's syndrome. Ezechi, (2021) reported that "the principles of genetics are applied in the field of medicine, agriculture and science. Ezekiel, Yilshik & Joseph, (2021) and Chukwuemeka (2011) stressed the importance of biology that "a sound theoretical and practical knowledge of biology is very necessary for the management of our natural resources, provision of good health facilities for the masses, adequate food supply and favorable life environment. Also, the contributions of the biologist are critical and dynamic in industries, technologies, crime detection, controlling of environmental pollution, diseases control, population control, and factual sciences. Biology curriculum is design to provide students with the knowledge of the key concepts in biology, to promote their knowledge of the world around them, as well as develop broadly applicable skills such as problem solving, communication, critical thinking and objectives reasoning ability to prepare the students for work place and self-sustainability in the world economy (FME 2014).

In spite of the fact that biology curriculum has very good and reliable objectives, it appears that the objectives of teaching biology in secondary schools are not achieved because students do not acquire the required skills (science process skills) that will enable them to comprehend abstract concepts. The science process skills includes; observing, measuring, classifying, communicating, predicting, inferring, deferring, questioning, and controlling variables, hypothesizing, defining operationally, formulating models, designing experiments and interpreting data. This is necessary because, integrating the science process and skills into teaching requires the processes of science to be more explicit in lessons, investigations and activities already in use in science curriculum (Awolere, 2015). Fifteen of these skills had been identified by American Association for the Advancement of Science (AAAS) Henta, Murni & Muzzazinah (2019). These are observing, measuring, inferring, and classifying, communicating, predicting, using number, using space/time relationship, questioning, controlling variables, Hypothesizing, defining operationally, formulating models, designing experiment and interpreting data. Due to the level of the students in senior secondary school classes, only eleven of the science process skills are concern with in this study, they are observation, recording, drawing, measuring, identifying, classifying, inferring, graphing, calculating, predicting, and experimenting.

Previous researches found out that science subject are taught in abstract way without using science process skills. WAEC Chief Examiner's (2011, 2016 and 2017), in Biology has reported that students do have problems in science process skills. They have therefore suggested that because of the poor science process skills demonstrated by the students, there is the need for the Biology teachers to help students develop these science process skills

acquisition by teaching them better (Chief examiner's report, 2017). Available statistics from WAEC and Chief Examiners Reports (2010 – 2019) on senior secondary school student's performance in Biology showed a very poor performance at Senior Certificates Examinations especially in the essay and practical assessment where learners display negative and very poor acquisition of science process skills. Student's possessing poor acquisition of science process skills in science subjects contradicting the targets of federal government in the national Policy on Education (NPE, 2019), which laid emphasis on assisting students to secure fitting abilities, capacities and skills, both mentally and physically which will enable them to live and add to the advancement of his environment (FME, 2014). Despite, the important of science process skills in acquisition of knowledge and skills. Jack, (2013) in his research study discovered that over 68% of students still experience difficulty in acquiring science process skills, that is only 30% of students acquired the required science process skills.

The significance of the science process skills has led to the expansion of the goals of science education to include an understanding by and development in the students of these process skills Flavia, Bernard & Eugenia (2022). Science Process Skills (SPS) are cognitive and psychomotor skills which scientists employ in problem identification, objective inquiry, data gathering, transformation, interpretation and communication Awolere, (2015). Science process skills are special skills that learners and teachers use in carrying out mental operation of and physical activities in the field of science. It is an attempt to make students fully aware as well as understand the ways scientists work and the need to be equipped and prepared with possible careers in science and technology that will lead to development of science process skills as it was stated in the objective statement Jamal (2022).

The Science Process Skills need to be improved upon on the students through teaching using appropriate instructional strategies. Among the strategies that have been previously used are; Experiential Strategy by Awolere, (2015), Critical Exploration Strategy by Oloyede, (2014), Puzzled Based Critical Thinking Motivation Strategies by Ogundiwin, (2013) to mention few.

Despite, the use of all these strategies by teachers, students' still experienced low rate and poor display of science process skills in the senior secondary school certificate examination as it was reported in the WAEC Chief Examiner reports (2013 and 2018). The students' poor performance in science process skills acquisition in Biology have been attributed to the inappropriate strategies of teaching mainly employed by most Biology teachers. Researchers have revealed that the teacher-centered strategy normally used by the teachers would not assist the learners to be active recipient of knowledge by which there performance can be improved (Adewumi & Ogundiwin (2021), Ogundiwin, 2013; Babayemi, 2014 and Awolere, 2015.) Scholars have therefore suggested the use of active teaching and learning strategies to take care of the deficiencies.

One of the suggested active instructional strategies is Project Strategy. The ordinary meaning of project is plan or scheme. Project instructional strategy is a systematic teaching strategy that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and task Anette & Maija (2022) and Olatoye & Adekoya, (2010). The project strategy of teaching involves assigning a particular work to students to do and complete out of his/her/ their spare time and report back to the teachers as at when demanded. There are two type of project

methods they are group and individual project method. This research work is embarking on group project strategy and individual project strategy. Group project strategy is based on simplicity, yet sound principle. We learn physical or mental skills by actually performing those skills under supervision. An individual learn to write by writing, to weld by welding, and to fly an aircraft by actually performing flight maneuvers. Students also learn mental skills, such as speed reading by project strategy. Skill requiring the use of tools, machines and equipment are particularly well suited to this particular instructional strategy.

The group project strategy provides an excellent opportunity for the complete act of thinking by the students. Project instructional strategy is a teaching strategy in which students acquire knowledge through the planning and execution of practical projects which may exist at individual and group levels respectively. It is an intentional process of diagnosing problems, critiquing experiments, distinguishing alternatives, planning investigation, researching conjectures', searching for information, coherent arguments Anette & Maija (2022), Aksela & Haatainen (2019), and Adewumi (2014), expressed their view on both inquiry and project strategies stated that "inquiry is often conflated or used interchangeably with other terms that describe similar learning and teaching approaches such as hands-on, problem based, project based, students centered, inductive and dialogic approaches. In group project strategy students have occasion to define the problem, plan his work, find appropriate resources, carryout his plan and draw conclusion. Project strategy seems to have the components to motivate teachers and students to develop a cooperative work mainly aiming at the students to perceive and understand all the necessary stages required to arrive at logical conclusion Anette & Maija (2022).

Inquiry strategy is another active strategy. Is a student centered and teacher guided instructional strategy that engages students in investigating real world questions that they choose within a broad thematic framework. Inquiry is a style or strategy of teaching where the learner with minimum guidance from the teacher seeks to discover and create answers to a recognized problem through procedure of making a diligent search. According to Toma (2022) and Bonus & Antal (2021) inquiry strategy is a way people learn when they are left alone. Cabalang and Cabalang (2021), Laksana (2017) and Katja (2011) reported that nowadays the acronym inquiry based learning (IBL) is treated as a key to solving problems which exist in science and maths education as well as in other subjects on a global level. Inquiry is often widely used in other term such as inquiry based teaching and inquiry based strategy without clarifying connections and distinctions Katja, (2011). Eric (2012) reported that teaching science through inquiry is the cornerstone of good teaching because it stimulates excitement among students when learning science. Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomenon. It involves investigation, searching, defining a problem, formulating hypothesis, gathering and interpreting data and arriving to a conclusion. Inquiry strategy opposed traditional methods where the teacher takes a dominant didactic role delivery science interaction to students through lectures, demonstration, expository and text reading. To overcome traditional method of teaching teacher needs to shift to learner centered strategy of teaching by given assignment which challenge the learner imagination in as many as possible.

In the course of focusing on the students' performance, gender was factored in. It has been noted that gender refers to the amount of masculinity and feminists found in human

beings. Most studies show that on average girls do better in school than boys, girls get higher grounds and complete high school at a high rate compare to boys Adewumi (2014). standardized achievement tests also show that female are better at spelling and perform better on tests of literacy writing and general knowledge in education Yuniskurin,,Noviyanti, Mukti Mahana and Zubidah (2019) showed that achievement in secondary school science subjects could be influenced by gender. It has been reported that there are sex differences in specific ability performance of students. It was reported above that girls are better in spelling, writing and other knowledge in contrast to this Okafor (2021) and Ekon and Eni (2015) showed that women were not only under-represented but their levels of achievement in the fields of sciences and technology where low compared to the males. In recent years many research have been carried out on gender related issues.

Many studies had been carried out on similar topic both at the national and international levels, focusing on the use of instructional strategies to improve students' acquisition of science process skills. Works have been carried out on each of the two strategies separately and on different subjects. However, not much has been done using these two strategies together in the area of abstract concepts in Biology. It is this gap that this research work stands to fill. This research work determined the impact that Project and Inquiry Strategies have on learners Science Process Skills Acquisition in abstract concepts in Biology. It also examined whether the gender of the students have any effects/influence on the students learning outcomes in abstract concepts in Biology.

### **Statement of the Problem**

The prevailing poor outcomes of students' performance in biology every year in Senior School Certificate Examination is attributed to that the instructional strategies employed by teachers are inappropriate. These strategies did not help students learn and develop the ability to think critically and show a high degree of independence that is required for students to identify resources and communicate effectively. These deficiencies had been found to result in low enrolment of students that gained admission to higher institution to read Biological science and other Biological based related courses. A number of studies have been carried out using instructional strategies to address this poor students' performance in Biology such as Experiential Strategy by Awolere, (2015), Pre-theoretic intuition quize Ogundirin (2013), Critical Exploration Strategy by Oloyede, (2014) and so on. However, it is necessary to carry out a study where students will be equipped with the instructional materials needed to engage in scientific oriented activities that will remove misconception in Biology, leading to improved students' performance.

Thus, this study seeks to determine to what extent the two instructional (project and inquiry) strategies of teaching would help students in the understanding of selected abstract concepts in biology and consequently improve the acquisition of science process skills in genetics concepts in Biology. It also examined Students' learning outcomes on the moderating effects of gender on students' science process skills.

## **Purpose of the Study**

The main purpose of this study was to investigate the effect of two teaching instructional (project and inquiry) strategies on students' science process skills acquisition in some selected abstract concepts in biology in Kwara State. Specifically, the study sought to

1. Determine the difference between the science process skills acquisition mean score of the students exposed to project and inquiry strategies in some selected abstract concepts in biology and compare with their counterpart taught using conventional strategy.
2. Examine the difference between science process skills acquisition mean score of male and female students exposed to project and inquiry strategies in some selected abstract concepts in biology.

## **Research Questions**

Two research questions were formulated to guide the study.

1. What is the difference between the science process skills acquisition mean score of the students exposed to Project and Inquiry instructional strategies in some selected abstract concepts in biology and compare with their counterpart taught using conventional strategy?
2. What is the difference between science process skills acquisition mean score of male and female students exposed to project and inquiry strategies in some selected abstract concepts in biology?

## **Research Hypotheses**

To guide the study two null hypotheses were formulated and were tested at 0.05 level of significance:

**H<sub>01</sub>:** There is no significant difference between the science process skills acquisition mean score of the students exposed to Project and Inquiry instructional strategies in some selected abstract concepts in biology and compare with their counterpart taught using conventional strategy

**H<sub>02</sub>:** There is no significant difference between science process skills acquisition mean score of male and female students exposed to project and inquiry strategies in some selected abstract concepts in biology

## **Methodology**

This study adopted a pre-test, post-test control group, quasi-experimental design. The target population for the study included all the Senior Secondary School Two (SS2) Biology Students in Kwara State were considered most appropriate because they would have been exposed to some biology basic concepts which would enable them solve problems in biology. A multi-stage stratified sampling procedure was adopted. There were three senatorial districts in Kwara State. A simple random sampling procedure using the table of random numbers was adopted for the selection of senatorial districts, local government, town, and schools. A judgmental procedure was used for selecting six (6) schools from two local government areas. The six schools were randomly assigned to treatments and control groups, one school for Project Strategy, one school for Inquiry Strategy and one school for conventional strategy in each Local Government Area of the study. Intact classes of the representative schools were used for the research. Six instruments were used in the study.

The instrument used for this study was Students Acquisition of Science Process Skills Scale (SASPSS) which was developed by the researcher. It was divided into two 2 sections A and B. Section A seeks personal information on the students with respect to name of school, gender and age, while section B consists of the scale items on the acquisition of science process skills, it was made up of eleven questions that cut across the following science process skills. Observing, classifying, measuring, inferring, drawing, recording, predicting identifying, calculating, graphing and experimenting. Initially, 15 scale questionnaire items were prepared on the selected science process skills. The questionnaire was given to three experienced biology secondary school teachers and one expert in the area of measurement and evaluation. This was done to ascertain face, content and construct validity of the instrument. Amendments were made according to their suggestions. From their assessment, only eleven (11) scale questionnaire items survived scrutiny. It was later trial-tested in a secondary school that was not selected for the main study. The scoring criteria of the pretest and post test was according to the rating scale that was designed by the researcher i.e. Students Acquisition of Science Process Skills Rating Scale (SASPSRS). The rating scales used in the study (SASPSRS) are, Very Good =5, Good =4, Very Fair =3 Fair =2 and Poor =1. A Kuder-Richardson formular 21(Kr21) was used. An average reliability co-efficient of 0.83 and an average item difficulty index of 0.48 were observed. Teachers Guides on Project Instructional Strategy, Teachers Guides on Inquiry Instructional Strategy and Teachers Guilds on Conventional Strategy and Evaluation Sheet for Assessing Teachers' Performance during Training Project strategy, Inquiry strategy and Conventional strategy.

The experiment lasted for seven weeks: the first week was used for visitation to the schools, taking permission from necessary authorities and familiarization with the schools as well as the Biology teachers teaching the classes that were used for the experiment and the students. The pretest was administered that same week. The teaching section was for period of five weeks, the last week which was seventh week was used for administration of of posttest. The data collected were analyzed using descriptive statistics, Analysis of Covariance (ANCOVA) and Scheffe post hoc test at 0.05 level of significance.

## **Results**

**Research Question one:** What is the difference between the science process skills acquisition mean score of the students exposed to project and inquiry instructional strategies in some selected abstract concepts in biology and compare with their counterpart taught using conventional strategy?

**Table 1***Descriptive Statistics of Science Process Skills Acquisition Associates with Treatment*

	<b>Science Process Skills Scores</b>		
	PS	IS	CS
No of cases	34	46	40
Pre-test mean	26.00	20.37	19.55
Pre-test S.D	6.53	7.61	6.84
Post-test mean	36.18	32.33	27.30
Post-test S.D	3,95	3.91	3.84
Mean Gain	+10.18	+11.96	+7.75

- PS – Project Strategy
- IS – Inquiry Strategy
- CS –Conventional Strategy

Table 1 Displays the Descriptive statistics of the students’ science process skills acquisition scores. The post test scores improved for project strategy in science process skills acquisition mean score with 10.18 while the Inquiry strategy post test scores shows improvement with 11.96 and the conventional strategy shows improvement in science process skills acquisition scores with 7.75. The mean gain is in ascending and descending order. Inquiry strategy (11.96) had higher mean gain than Project strategy (10.18) and Project strategy (10.18) had higher mean gain than conventional strategy (7.75).

Figure 1 displayed the bar charts showing the magnitude of descriptive statistics



**Figure 1**

*Bar Chart Showing Descriptive Statistics Associated with Treatment on Science Process Skills Acquisition mean Scores*

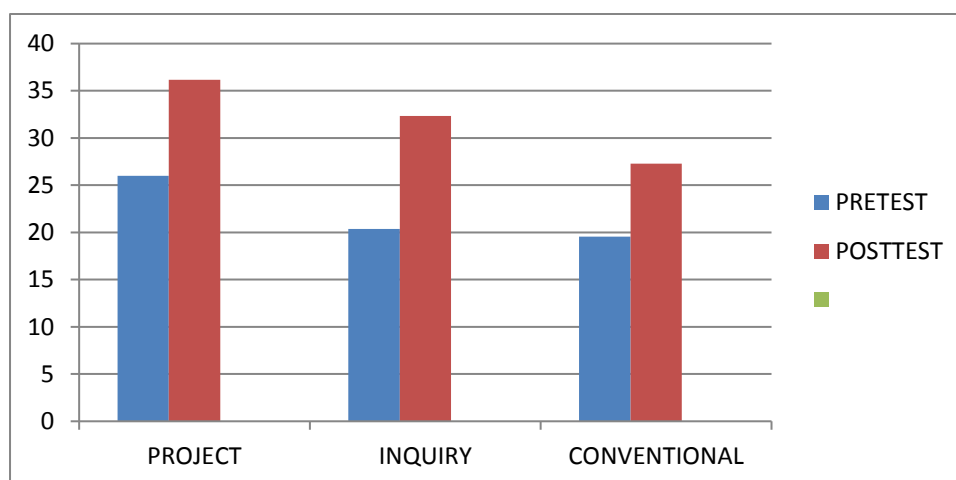


Figure 1 revealed the bar chart showing descriptive statistics associated with treatment on science process skills acquisition mean scores. The post test scores improved for Project strategy in science process skills scores by 10.18 (pretest mean = 26.00, posttest mean = 36.8). Inquiry strategy posttest scores shows greater improvement with 11.96 (pretest mean=20.37, posttest mean=32.33) Likewise, the conventional strategy also improved with 7.75 (pretest mean = 19.55 posttest means =27.30). The mean gain in ascending and descending order was. Project strategy which had lower mean gain than Inquiry strategy, Inquiry strategy had higher mean gain than project strategy and conventional strategy, conventional strategy had lower mean gain than project strategy. Also, the research question 1 can be further solve with the result of estimated marginal means of the treatment groups and control group in the table 3 below.

**Table 2**

*Estimated Marginal Means of Post Test Science Process Skills Scores by Treatment and Control Group.*

Treatment	N	Mean	Std deviation
Project	34	36.1765	3.01
Inquiry	46	32.3261	5.01
Conventional	40	27.3000	5.80

Table 2 shows that students exposed to the Project Strategy (PS) treatment group 1 had the highest adjusted post-achievement mean score in abstract concepts in biology ( $\bar{x}$  =36.18) and lowest adjusted post-achievement standard deviation score in abstract concepts in biology (3.01) followed by the Inquiry Strategy (IS) treatment group 2 ( $\bar{x}$  =32.33) with standard deviation of (5.01) while the students' in the Conventional Strategy (CS) control group had the least adjusted mean achievement score ( $\bar{x}$  =27.30) with highest standard deviation score in abstract concepts in biology of (5.80). This order is represented PS >IS > CS for mean. These means scores are differing with the standard deviation scores which revealed the existence of difference in the performance of the three groups. The difference could be regarded as the improvement achieved or the degree of enhancement of students' academic performance that could attributed to the use of Project and Inquiry strategies adopted in the study. The result shows that students taught the abstract concepts using Project and Inquiry strategies have a better mean score than those taught the same concepts using conventional strategy of teaching in senior secondary schools in Kwara State.

**Research Question Two:** What is the difference between science process skills acquisition mean score of male and female students exposed to project and inquiry strategies in some selected abstract concepts in biology?

**Table 3**

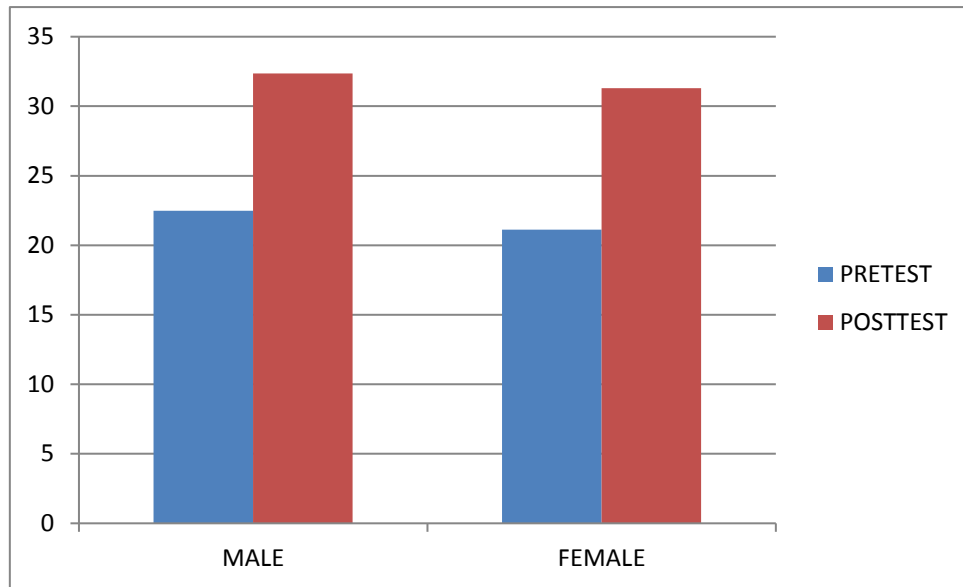
*Descriptive Statistics of Science Process Skills Associated with Gender.*

	Science Process Skills	
	Male	Female
No of cases	50	70
Pre test mean	22.48	21.13
Pre test S.D	8.17	7.03
Post test mean	32.36	31.30
Post test S.D	6.13	4.47
Mean Gain	9.88	10.17

Table 2 displays the descriptive statistics of the students' science process skills acquisition scores associated with gender. The mean gain for science process skills acquisition scores of female students' shows greater improvement (10.17) than that of male students' (9.88).

**Figure 1**

Bar charts showing the size of descriptive statistics of the students' science process skills scores associated with gender as presented in Table 2



**Figure 2.**

**Bar Chart Showing Descriptive Statistics Associated with Science Process Skills According to Gender**

Figure 2 revealed Bar Chart showing descriptive statistics associated with science process skills acquisition according to gender. The female students show greater improvements in mean gain of science process skills acquisition scores by 10.17 (pretest mean =21.13, post-test mean = 31.30) and male students by 9.88 (pretest mean = 22.48, post test mean =32.36).

**H0<sub>1</sub>:** There is no significant main effect of treatment on students' science process skills acquisition in abstract concepts in biology.

**Table 4**

*3 x 2 x 2 ANCOVA Post-test Science Process Skills Acquisition of Students by Treatment, Mental Ability and Gender.*

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta squared
Corrected Model	1731.147	12	144.262	10.156	.000	.532
PREACH	26.998	1	26.998	1.901	.171	.017
<b>Main Effect:</b>						
Treatment Group	795.471	2	397.735	28.001	.000*	.344
Mental Ability	.357	1	.357	.025	.874	.000
Gender	6.983	1	6.983	.492	.485	.005
<b>2-way Interactions:</b>						
Treatment x Mental Ability	18.369	2	9.185	.647	.526	.012

Treatment x Gender	52.504	2	26.252	1.848	.163	.033
Mental Ability x Gender	70.708	1	70.708	4.978	.028*	.044
<u>3-way Interactions:</u>						
Treatment x Mental Ability x Gender	33.787	2	16.894	1.189	.308	.022
Error	1519.844	107	14.204			
Total	124155.000	120				
Corrected Total	3250.992	119				

\* Significant at  $P < 0.05$

Table 4 revealed that there was a significant main effect of Treatment of the Science Process Skills of the Students'  $F(2,107) = 28.001, P < .05, \eta^2 = .344$ ); The effect of size of 34.4% was fair. On this basis, hypothesis 1b was rejected. This means that the difference between the science processes skills score of students exposed to treatment groups was significant. Also, table 2 revealed that students in the Project Strategy Treatment Group had the highest adjusted post test mean score ( $\bar{x} = 36.1765$ ) followed by the Inquiry Strategy Treatment Groups ( $\bar{x} = 32.3261$ ) while students' in Conventional Strategy Group has the least adjusted mean science process skills scores ( $\bar{x} = 27.3000$ ). Further, the source of the significant differences obtained was traced using Scheffe post-hoc test in Table 5

**Table 5**

*Scheffe Post-Hoc Tests Analysis of Post-Test Science Process Skills Score According to Treatment Groups.*

	Treatment	N	Mean	Project	Inquiry	conventional
1	Project	34	36.1765		*	*
2	Inquiry	46	32.3261	*		*
3	Conventional	40	27.3000	*	*	

Pairs of groups significantly different at  $P < 0.05$

The result from post-hoc analysis in Table 5 revealed that science process skills means scores of students in Project Strategy was significantly better than Inquiry Strategy while Inquiry Strategy was significantly better than Conventional Strategy in their mean science process skills scores. These revealed that the direction of increasing effect of instructional strategy (treatment) on abstract biology concepts was: Conventional Strategy did not perform better than Inquiry Strategy while Project Strategy performed better than Inquiry Strategy

**H0<sub>2</sub>.** There is no significant main effect of gender on student's science process skills acquisition in genetic concepts in biology. It was obtained from table 4 that there was no significant main effect of gender on the science process skills of the students ( $F(1,107) = 0.492, P > 0.05$ , partial eta square ( $\eta^2$ ) = 0.005. The effect size of 0.5% was negligible. Therefore hypothesis Ho 3b was not rejected.

**Table 6***Estimated Marginal Mean of Post Test Science Process Skills by Gender*

Gender	N	Mean	Std deviation
Male	50	32.3600	6.1271
Female	70	31.3000	4.4700

From Table 6 Male students had higher mean = 32.3600 while the female students' had a lower mean = 31.3000. But the difference was not significant.

## Discussion

There were significant differences in the effect of treatment on science process skills of students exposed to project strategy and Inquiry strategy as shown in Table 2. This findings shows that both strategies, project and Inquiry strategies enhanced students' science process skills over and above the conventional strategy. This result suggests that the project strategy effectively disseminated the science process skills of learners exposed to it than those exposed to Inquiry strategy and conventional strategies. These may be attribute to the systematic and organized nature of the project and Inquiry strategies developed and implemented in the course of the research study in which the learners where allowed to engage in various learning activity that enabled them to find out and develop their own knowledge of the abstract concepts individually or in groups and use their thinking skills for planning, execution, evaluation, reporting and recording. They also formulated hypothesis, gather materials, record and analysis data and draw conclusion on the lessons all by themselves with minimal teacher interference.

Furthermore, the involvement of the students in experimental groups in activities led to more understanding of abstract concepts in biology and removal of misconceptions of such concepts by working alongside peers and teacher guide the students to recognize and reduce the misconception in abstract concepts, if not completely remove. Since, abstract misconception is known as inaccurate or incomplete ideas about abstract concepts. Combating the students' abstract misconception with activity-based learning strategies (project and inquiry strategies) teachers are not only quell students' abstract misconception, they also teach students to take ownership of their learning process through the student centered strategies used. This result is in agreement with Anette and Maija (2022) who worked on three teaching strategies project, demonstration and lectures strategies. It was found that students exposed to project strategies brought about the most significant improvement in their achievement scores. This findings is also supported by Aksela and Haatainen (2019) who affirmed it that project strategy is more effective than other strategies because it affords the students' to study on their own. The findings is in agreement with the report of Anette and Maija (2022) and Aksela and Haatainen (2019) which suggested that project strategy encouraged collaboration among the students.

Inquiry strategy when compared with conventional strategy by Laksana (2017) analysis showed that Inquiry strategy was more effective. The findings further showed that Inquiry strategy contributed significantly to a better understanding of biological abstract concepts by

students than their counterparts treated with conventional strategy. This study is in support of Suleiman, (2011) who found that the guided Inquiry strategy of teaching biology enhanced student performance better than the conventional strategy.

This study also revealed higher science process skills scores for the learner exposed to the project and Inquiry strategies than those in the conventional strategy. This implies that those in the project and Inquiry strategies acquired better science process skills than their counterparts in the conventional group. This is likely to be as a result of systematic nature of individualistic activities that involved critical thinking and organized procedure developed and implemented in the study which emphasized active learner participation in group. This collaborate the findings of Jamal (2022) who reported that appropriate instructional teaching strategies (i.e investigative laboratory approach, hands-on-minds-on scientific activities) enable students to acquire science process skills.

The poor performance of students when expose to the conventional strategy in the post test science process skills mean score when compare with the other treatment groups meant scores may not be unconnected with the fact that the group was exposed to the strategy which is teacher-centered conventional strategy to only allow students to listen passively, with little or no interaction with the teacher's mean while low achievement in conventional strategy repeats itself in this study as it was in the findings of Anette and Maija (2022) and Aksela and Haatainen(2019), Ogundiwin (2013) and Suleiman (2011). This is because conventional strategies often compel learners to the passive recipient position of fact subjected down to (him/her) by the teachers.

The study further showed that gender has no significant main effect on students' science process skills. That is, gender had no influence on the acquisition of science process skills. Some researchers reported that there is significant effect of gender on the achievement of students, however, the finding of this work disagree with research findings of Okafor, (2021) and Yuliskurnianati, Noviyanti, Mukti, Mahanal and Zubaidah (2019) that established significant differences of treatment and gender on students' achievement. This finding is in mutual agreement with the findings of Ibitoye (2021) Ekon and Eni (2015) Adewumi (2014) and Ogundiwin (2013) who found that gender did not have a significant main effect on students' performance. The reason was that both male and female were given equal opportunity to participate actively in the classroom activities which were the function of the two strategies (project and Inquiry). The strategies disallow discrimination or gender marginalization.

## **Conclusion**

The findings of this study have shown that Project and Inquiry instructional strategies were effective in improving student's acquisition of science process skills in abstract concepts in Biology than the traditional or conventional teaching strategy. The reason for this was that the two instructional strategies enhanced the advancement of critical thinking ability of students' and allowed them to be actively involved in the learning activities and create positive environment for effective interaction of students with one another i.e both both instructional strategies were student-centered. It is noteworthy that students showed a higher level degree of commitment and involvement to solving of the abstract problems in Biology when taught using these strategies (Project and Inquiry). The two instructional strategies (project and inquiry) also

encouraged active participation of students to master the abstract concepts; therefore the students were able to solve problems on evolution and molecular aspect of biology easily.

### Recommendations

Based on the findings of the study, the following recommendations were advanced

- (1) Project and Inquiry instructional strategies should be adopted as strategies for studying abstract concepts in biology. This will enable students to be problem solvers, there by leading to improvement in the acquisition of science process skills of students in abstract concepts in biology.
- (2) Teacher should improve in the use of learner-centered strategies and make their lesson more practical, result-oriented adequate and inspiring for the students.
- (3) Government should utilize the services of various bodies such as Science Teachers Association of Nigeria. (STAN); All Nigeria Conferences of Principals of Secondary Schools (ANCOPSS); National Union of Teachers (NUT); and faculties/ institutes of education in the universities to organize in-service training programmes, workshops, conferences and seminars for serving biology teachers to update their knowledge on the use of innovate teaching strategies that can enhance acquisition of science process skills by biology students.

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