Demonstration And Guided - Inquiry Strategies On Biology Achievement Of Secondary School Students With Different Learning Styles In Rivers State, Nigeria.

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Abstract: *The study investigated the effects of teaching strategies (demonstration and guided inquiry) on Biology achievement of secondary school students with different learning styles (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) in Rivers State. A quasi-experimental design was adopted, specifically the pre-test, post-test non - equivalent control group design. The sample consisted of 247 SS2 students drawn from three randomly sampled governments owned secondary schools in Obior/Akpor Local Government Area in Rivers State. Three research questions and three null hypotheses were formulated to guide the study. Frequent count; mean and standard deviation were used to answer the research questions while ANCOVA was used to test the hypotheses. Treatment consisted of teaching Biology concepts to the two experimental groups using demonstration and guided – inquiry strategies while the other third group which is the control group was taught using lecture strategy. Two instruments Biology Achievement Test (BAT) and Index of Learning Styles (ILSQ)adopted from Felder and Solomon (2004) were used for data collection. The two instruments were subjected to both face and content validity. Test-retest reliability coefficient was computed using Pearson Product Moment Co-relationcoefficient which gave a reliability coefficient of 0.84 for a BAT. The ILSQ was used for the identification of students' learning styles. The internal consistency for each of the learning styles was determined using Cronbach Alpha which gave a reliability index of 0.88 for active/reflective, 0.82 for sensing/intuitive, 0.85 for visual/verbal, and 0.79 for sequential/global learning styles. The findings revealed that there was no significant difference in the mean scores of students taught Biology concepts using demonstration and guided – inquiry strategies. There was a significant difference was found to exist in the academic achievement of Biology students with different learning style taught using demonstration and lecture, guided-inquiry and lecture. Based on the findings of this study, it was recommended among others that Biology teachers should identify the learning styles of their students and use teaching strategies that complement them.*
Key Words*: Learning Styles, Teaching Strategies, Academic achievement and Biology*

I.   Introduction

The 21st century is characterized by advancement in science and technology. For Nigeria to realize accelerated development in the 21st century, she needs qualitative science education in schools. Over the last two decades, there have been repeated calls for reforms and innovations aimed at improving Science Education in Nigeria, in line with global standards. This suggests that there are issues in science Education in Nigeria that needs to be improved upon. In recent times, several innovations in the field of Education are embedded in Science Education in order to achieve reform and innovations for improvement.

Science has a unique nature. It is an organized body of knowledge in form of concepts, laws, theories and generalizations. Ugbong (2016) defined science as a study of nature and natural phenomena in order to discover their principles and laws. Science involves observing, classifying, experimenting, measuring, inferring, organizing data etc. which should be impacted on learners through the process of education. Dabah (2016) defined Science Education as the study of the connection between science as a discipline and the application of educational principles to comprehend science teaching and learning in the classroom. Therefore, science education acquaints students with certain basic knowledge, skills and attitudes needed for future work in science and science-related fields.

Biology is the study of plants and animals (Michael, 2015). It is one of the science subjects studied at the senior secondary schools' level in Nigeria. It is among the science subjects taken in Senior School Certificate Examination (SSCE), General Certificate in Education (GCE) etc. Many students that registered for these science subjects in secondary schools in Nigeria performed poorly in external examinations ((Ikitde, & Edet, 2013: Okoli &Azubuike, 2012).

Teaching is an act of imparting knowledge to a learner (Okenze, 2016).The teaching of Biology requires making necessary provisions for students' active participation in the learning process so that they will be able to connect scientific concepts and theories to real purposes and practices in the world in which they live. Teaching strategies are the several ways in which knowledge; skills etc. are inculcated in a teaching/learning process, through the guidance of a teacher. An appropriate instructional strategy gives rise to an enriched learning environment and hence better learning outcome (Uche and Awujo, 2014). It is believed that most effective learning takes place when the interactive process is one that is best suited to the individual students in terms of learning styles. All students have different learning styles and the function of the teacher is to identify these learning styles and find appropriate instructional strategies that will match the preferred styles in order to enhance effective teaching and learning process

Learning styles (Visual / Verbal, Active / Reflective, Sensing / Intuitive, and Sequential / Global learning styles) are different approaches or ways of learning by students (Ibe, 2015; Fayombo, 2015; Ikitde, & Edet, 2013). Active learners tend to retain and understand information best by doing something and working with others. While Reflective learners learn by thinking things through, working alone. Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships. Sensors often like solving problems by well-established methods and dislike complications and surprises; intuits like innovation and dislike repetition. Visual learners remember best what they see--pictures, diagrams, flowcharts, timelines, films etc. Verbal learners get more out of words. They prefer written and spoken explanations. Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it." Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it. In this study, the effect of individual students learning styles on achievement in Biology was also investigated.

Demonstration teaching strategy involves the use of instructional materials to show learners how something is done.in order to enable them to acquire skills necessary for performing the given task. While guided – inquiry strategy is a student – centred activity, oriented teaching strategy in which the teacher directs students through the problem - solving approach to discover answers to the instructional topic at hand. However, the theory of multiple intelligence suggests that there are a number of distinct forms of intelligence that each individual possesses in varying degrees. According to Howard Gardner (1995), the implication of the theory is that learning/teaching should focus on the particular intelligence of each learner. For example, if an individual has strong spatial or musical intelligence, they should be encouraged to develop these abilities. Gardner (1995) points out that the different intelligence represents not only different content domains but also learning modalities/learning styles. Piaget (1970) cognitive development was a progressive reorganization of mental processes as a result of biological maturation and environmental experience. Akin to Piaget theory, interaction during the teaching and learning process help to instruct, teach and lead learners towards internal cognitive development. However, when a teacher recognizes students' learning styles during the teaching-learning process using appropriate teaching strategy, it will go a long way to increase interactions among students and also help them in cognitive development.

Hornby (2015) defines achievement as a thing that somebody has done successfully especially using their own effort and skills. Academic achievement is referring to as the knowledge attained or skills developed in the school subjects, usually determined by test scores or marks assigned by the teacher (Akuda & Izu, 2016). There are conflicting reports in the literature concerning the effect of teaching strategies on students' achievements. In this study,therefore, the effect of teaching strategies (demonstration, guided – inquiry, lecture) on students' achievement in Biology was investigated.

II. Statement of the Problem

Most teachers do not realize that the way students process and understand information differ from one another in the classroom. The inability of teachers to identify individual differences among students during teaching – learning process attributes to the persistent poor performance of students academically. Although, many researchers have identified some factors contributing to students' persistent failure in schools as inadequate laboratory equipment, inadequate science teachers, lack of science textbooks, poor teaching strategies amongst others (Ikitde, & Edet, 2013.; Okoli& Azubuike, 2012) but the neglected variables are learning the style

To overcome these problems, there is a need to strike a balance of effective instructional strategies for science subjects such as demonstration, guided – enquiry and lecture to students' individual learning styles (Visual/Verbal, Active/Reflective, Sensing/ Intuitive, and Sequential/Global). If the balancing is achieved, it is believed that all students will be taught in a manner they prefer which will lead to effective teaching and

learning. It is against this background that the researcher seeks to investigate the effect of instructional strategies on students' achievement in secondary school Biology.

III. Aim and Objectives of the Study

The aim of this study is to investigate the effect of learning styles (active/reflective, sensing/intuitive, visual/verbal, and sequential/ global) and teaching strategies (guided inquiry, demonstration and lecture) on students' achievement in Biology. The specific objectives are to:

1) Determine the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using lecture strategy
2) examine the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using guided inquiry strategy and those taught using lecture strategy
3) ascertain the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using guided - inquiry strategy?

Research Questions

1) What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using lecture strategy?
2) What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using guided inquiry strategy and those taught using lecture strategy?
3) What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using guided - inquiry strategy?

Hypotheses

Ho$_2$: There is no significant difference in the mean scores of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using lecture strategy

H$_{O3}$: There is no significant difference in the mean scores of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology using guided inquiry strategy and those taught using lecture strategy

Ho$_4$: There is no significant difference in the mean scores of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using guided inquiry strategy

IV. Method

The design of the study was quasi-experimental research design. It utilizes the non – randomized pre-test and post-test control group design. The classes used were intact classes and for the fact that the school authorities may not permit the disruption of classes for the sake of the research. The sample for the study consisted of 247 SS2 senior secondary school Biology students in the selected government-owned secondary schools in Obio/Akpor Local Government Area in Rivers State, Nigeria. Purposive random sampling was used to select three secondary schools that have similar characteristics in Obio/Akpor Local Government Area. Simple random sampling technique (balloting without replacement) was used to select two classes from each of the selected secondary schools in Obio/Akpor local government areas in Rivers State. The three secondary schools selected were grouped into two as Experimental and control groups. Two schools represent the experimental group, while the other remaining school was used as a control group.

Two instruments Biology Achievement Test (BAT) and Index of Learning Styles Questionnaire (ILSQ) were used for data collection. BAT was extracted from WAEC, NECO and JAMB passed questions The Biology concepts in the test were flowering plants. The items of the instrument BAT were 50 multiple choice questions as adopted from Solomon and Felder (2004), consisted of 44 items with option A & B, changes were made in some of the items to reflect the cultural background of the students. The ILSQ was used to determine individual students' learning styles on the first week and numbers were assigned to their scripts for easy identification. The instruments were validated by two lecturers in the department of measurement and evaluation and two lecturers in Curriculum Studies and Educational Technology. The Test-retest reliability coefficient was computed using Pearson Product Moment Co-relationcoefficient which gave a reliability coefficient of 0.84 for the BAT. The internal consistency for each of the learning styles was determined using Cronbach Alpha which

gave a reliability index of 0.88 for active/reflective, 0.82 for sensing/intuitive, 0.85 for visual/verbal, and 0.79 for sequential/global learning styles.

The treatment lasted for the period of 6weeks. The pre-test was administered to both experimental and control groups on the first week before treatment. BAT was administered again as Post-test to all the groups after reshuffling the questions and changing the colour of the question papers. Lesson notes on demonstration and guided – inquiry strategies were given to the regular Biology teachers in the two schools used as experimental groups, while Lesson notes on lecture were also given to the regular Biology teachers in the control group. The Biology teachers were used as research assistants. They were trained by the researchers for two weeks on how to teach the students based on their learning styles using different teaching strategies.

V. Results

The scores obtained were analysed using frequent count mean and standard deviations for the research questions. The hypotheses were tested at 0.05 level of significance using ANCOVA.

Research Question One

What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using lecture strategy

Table 4.1: Mean Scores and Standard Deviation (SD) of Students with Different Learning Styles Taught Biology Concepts Using Demonstration and those taught using Lecture

SUBJECTS	N	Pre-test $\bar{X}$	SD	Post-test $\bar{X}$	SD
Experimental Group					
Demonstration (Learning Styles)					
Active/ Reflective (A/R)	26	15.8	5.68	42.92	7.147
Visual/Verbal(V/V)	20	16.2	5.88	37.70	8.537
Sensing/Intuitive (S/I)	17	15.5	5.5	40.82	7.371
Sequential/ Global(S/G)	22	16.2	5.88	40.11	7.136
	85			**40.24**	
Control Group					
Lecture (Learning Styles)					
Active/ Reflective (A/R)	17	15.0	5.51	29.00	7.025
Visual/Verbal(V/V)	23	14.3	5.60	32.45	4.291
Sensing/Intuitive (S/I)	22	15.5	5.40	29.64	4.672
Sequential/ Global(S/G)	21	15.5	5.5	30.53	5.829
	83			**30.12**	

Research Question Two

What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using guided inquiry strategy and those taught using lecture strategy?

Table 4.2: Mean Scores and Standard Deviation (SD) of students With Different Learning Styles Taught Biology Concepts Using Guided Inquiry Strategy and those taught using **Lecture Strategy**

SUBJECTS	N	Pre-test $\bar{X}$	SD	Post-test $\bar{X}$	SD
Experimental Group					
Guided – inquiry (Learning Styles)					
Active/ Reflective (A/R)	26	14.7	5. 55	43.67	5.827
Visual/Verbal(V/V)	19	15.8	5.68	39.90	6.925
Sensing/Intuitive (S/I)	10	13.5	4.88	42.05	5.216
Sequential/ Global(S/G)	24	15.3	5.4	40.87	6.639
	79			**41.80**	
Control Group					
Lecture (Learning Styles)					
Active/ Reflective (A/R)	17	15.0	5.51	29.00	7.025
Visual/Verbal(V/V)	23	14.3	5.60	32.45	4.291
Sensing/Intuitive (S/I)	22	15.5	5.40	29.64	4.672
Sequential/ Global(S/G)	21	15.5	5.5	30.53	5.829
	83			**30.12**	

Research Question Three

What is the mean difference in the performance of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using guided - inquiry strategy

Table 4.3: Mean scores and Standard Deviation (SD) of students with different learning styles taught Biology concepts using demonstration and those taught using guided – inquiry

SUBJECTS	N	Pre-test		Post-test	
		$\bar{X}$	SD	$\bar{X}$	SD
Experimental Groups					
Demonstration (Learning Styles)					
Active/ Reflective (A/R)	26	15.8	5.68	42.92	7.147
Visual/Verbal(V/V)	20	16.2	5.88	37.70	8.537
Sensing/Intuitive (S/I)	17	15.5	5.5	40.82	7.371
Sequential/ Global(S/G)	22	16.2	5.88	40.11	7.136
	85			**40.24**	
Guided – inquiry (Learning Styles)					
Active/ Reflective (A/R)	26	14.7	5. 55	43.67	5.827
Visual/Verbal(V/V)	19	15.8	5.68	39.90	6.925
Sensing/Intuitive (S/I)	10	13.5	4.88	42.05	5.216
Sequential/ Global(S/G)	24	15.3	5.4	40.87	6.639
	79			**41.80**	

Ho₁ There is no significant difference in the mean scores of students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using lecture strategy

Table 4.4: One-way Analysis of Covariance (ANCOVA) of mean scores of Students with Different Learning Styles Taught Biology concepts Using demonstration strategy and those taught using lecture

Source	Sum of Squares	Df	Mean Square	F	Sig.	Decision at p< .005
Corrected Model	8527.899[a]	4	2131.975	13.730	.000	S
Intercept	7689.235	1	7689.235	49.518	.000	S
Pre-Test	8391.507	1	8391.507	54.041	.000	S
Learning Style	514.859	3	171.620	1.105	.022	S
Error	25310.934	163	155.282			
Total	516196.000	168				
Corrected Total	33838.833	167				

Table 4.5: Multiple Classification Analysis (MCA) of the mean Scores of Students with Different Learning Styles Taught Biology Concepts Using demonstration and those taught using lecture

Grand Mean = 35.18	N	Unadjusted		Adjusted for independent	
Variable + Category		Dev'n	Eta	Dev'n	Beta
Teaching Strategies			40		41
Demonstration	85	7.80		1.44	
Lecture	83	5.91		1.05	
Learning Styles					
Sensing/Intuitive	39	1.12		1.06	
Active/Reflective	43	1.02		1.01	
Visual/Verbal	43	1.02		1.01	
Sequential/Global	43	1.02		1.01	
Multiple R =.44					
Multiple R. Square =.0,09					

Table 4.6: Result of Least Significant Difference (LSD) Post Hoc Test for Multiple Comparison of Learning Styles on the mean scores of Students with different learning styles Taught Using demonstration strategy and those taught using lecture strategy

(I) Learning Style for Lecture	(J) Learning Style for Lecture	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval forDifference	
					Lower Bound	Upper Bound
Active/Reflective	Visual/Verbal	1.939	2.723	.477	-3.438	7.316
	Sensing/Intuitive	4.988	2.805	.077	-.552	10.527
	Sequential/Global	1.493	2.706	.582	-3.850	6.837
Visual/Verbal	Active/Reflective	-1.939	2.723	.477	-7.316	3.438
	Sensing/Intuitive	3.049	2.757	.270	-2.395	8.493
	Sequential/Global	-.446	2.690	.869	-5.758	4.866
Sensing/Intuitive	Active/Reflective	-4.988	2.805	.077	-10.527	.552
	Visual/Verbal	-3.049	2.757	.270	-8.493	2.395
	Sequential/Global	-3.495	2.763	.208	-8.951	1.962
Sequential/Global	Active/Reflective	-1.493	2.706	.582	-6.837	3.850
	Visual/Verbal	.446	2.690	.869	-4.866	5.758
	Sensing/Intuitive	3.495	2.763	.208	-1.962	8.951

H_{o2}: There is no significant difference in the mean scores of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology using guided inquiry and those taught using lecture

Table 4.7: One-way Analysis of Covariance (ANCOVA) mean scores of Students with Different Learning Styles Taught Biology Concepts Using guided-inquiry and those taught using lecture

Source	Sum of Squares	Df	Mean Square	F	Sig.	Decision at p< .005
Corrected Model	6780.327[a]	4	1695.082	9.512	.000	S
Intercept	6880.504	1	6880.504	38.612	.000	S
Pre-test	5554.119	1	5554.119	31.168	.000	S
Learning Style	1272.635	3	424.212	2.381	.042	S
Error	27976.982	157	178.197			
Total	512782.000	162				
Corrected Total	34757.309	161				

Table 4.8: Multiple Classification Analysis (MCA) of the mean Scores of Students with Different Learning Styles Taught Biology Concepts Using guided-inquiry, and those taught using lecture

Grand Mean = 35.96	N	Unadjusted		Adjusted for independent	
Variable + category		Dev'n	Eta	Dev'n	Beta
Teaching Strategies			49		47
Guided-Inquiry	79	9.68		1.38	
Lecture	83	5.91		1.05	
Learning Styles					
Sensing/Intuitive	32	1.52		1.25	
Active/Reflective	43	1.16		1.07	
Visual/Verbal	42	1.19		1.09	
Sequential/Global	45	1.11		1.05	
Multiple R =.50					
Multiple R. Square =.09					

Table 4.9: Result of Least Significant Difference (LSD) Post Hoc Test for Multiple Comparison of Learning Styles on Students' Achievement in Biology Taught Using guided-inquiry strategy and those taught using lecture strategy

(I) Learning Style	(J) Learning Style	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval For Difference	
					Lower Bound	Upper Bound
Active/Reflective	Visual/Verbal	4.590	2.900	.115	-1.138	10.318
	Sensing/Intuitive	8.214[*]	3.118	.009	2.054	14.373
	Sequential/Global	4.228	2.850	.140	-1.402	9.857
Visual/Verbal	Active/Reflective	-4.590	2.900	.115	-10.318	1.138
	Sensing/Intuitive	3.624	3.143	.251	-2.584	9.831
	Sequential/Global	-.362	2.864	.899	-6.020	5.295

Sensing/Intuitive	Active/Reflective	-8.214[*]	3.118	.009	-14.373	-2.054
	Visual.Verbal	-3.624	3.143	.251	-9.831	2.584
	Sequencial/Globa	-3.986	3.096	.200	-10.102	2.130
Sequencial/Globa	Active/Reflective	-4.228	2.850	.140	-9.857	1.402
	Visual.Verbal	.362	2.864	.899	-5.295	6.020
	Sensing/Intuitive	3.986	3.096	.200	-2.130	10.102

Ho₃: There is no significant difference in the mean scores of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught Biology concepts using demonstration strategy and those taught using guided inquiry strategy

Table 4.10: One-way Analysis of Covariance (ANCOVA) of the mean scores of Students with Different Learning Styles Taught Biology concepts using demonstration strategy and those taught using guided inquiry strategy

Source	Sum of Squares	df	Mean Square	F	Sig.	Decision at p< .005
Corrected Model	9188.823[a]	4	2297.206	44.744	.000	S
Intercept	15301.129	1	15301.129	298.027	.000	S
Pre-Test	9011.852	1	9011.852	175.528	.000	S
Demonstration *Guided-Inquiry	84.369	3	28.123	.548	.650	ns
Error	8163.275	159	51.341			
Total	705580.000	164				
Corrected Total	17352.098	163				

VI. Discussion

Table 4.1, shows that students with different learning styles taught biology concepts using demonstration and lecture strategies the mean scores and standard deviation of students with differentlearning styles taught Biology concepts using demonstration and lecture strategies shows that the mean score of Active/Reflective learners taught using demonstration strategy is 42.92with standard deviation of 7.147, while Active/Reflective learners taught using lecture strategy had a mean score of 29.00 with standard deviation of 7.025. Visual/Verbal learners taught using demonstration strategy had 37.70 mean scores with a standard deviation of 8.537 while those Visual/Verbal learners taught using lecture strategy had a mean score of 32.45 with a standard deviation of 4.291. Sensing/Intuitive learners taught using demonstration strategy had 40.82 mean scores with a standard deviation of 7.371. while those Sensing/Intuitive learners taught using lecture strategy had 29.64 with a standard deviation of 4.672. Sequential/Global learners taught using demonstration strategy had a mean score of 40.11 with a standard deviation of 7.136. while those Sequential/Global learners taught using lecture strategy had30.53 meanscores with a standard deviation of 5.829. This shows that students taught using demonstration strategy based on their learning styles had a higher mean score than those taught using lecture strategy based on their learning styles. This also implies that demonstration strategy has more Active/Reflective learners than other types of learning styles while lecture strategy has more visual/verbal learners than other types of learning styles.

When the mean difference in the present study was put to statistical test using the ANCOVA, the result Table 4.4, showed that there was there is a significant difference in the achievement of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology using demonstration strategy and lecture strategy ($F(1, 163) =155.282$, with p = 0.022; p<.05). Therefore, the null hypothesis was rejected at .05 level of significance. Table 4.5, shows multiple regression indexes (R) of .44 and multiple regression square index (R^2) of .09. This implies that 9% of the total variance in the achievement of biology students is attributable to the influence of different learning styles of students when taught with demonstration and lecture strategies. To find the direction of significance, the achievement scores were subjected to least significance difference (LSD) for a post hoc analysis. Post-hoc analysis in Table 4.6, revealed that the mean difference between active/reflective and visual/verbal was 1.939, between sensitive/intuitive and active/reflective was 4.988, between sensitive/intuitive and verbal/visual was 3.049, sequential/global active/reflective and was 1.493, between sequential/global and visual/ verbal was 0.446, and between sequential/global and sensitive/intuitive was 3.945. This implies that sequential/global learning style was the most effective in facilitating students' achievement in biology when taught with demonstration strategy and lecture strategy. This was seconded by active/reflective style followed by Visual/Verbal and sensitive/intuitive learning style which are of the same pace. Hence, demonstration strategy and lecture strategy is the most effective instructional strategy for Biology students with Sequential/Global learning styles.

Table 4.2 shows the mean scores of students with different learning styles taught Biology concepts using guided inquiry strategy and lecture strategy. Active/Reflective learners taught using guided – inquiry had a mean score of 43.67 with a standard deviation of 5.827, while Active/Reflective learners taught using lecture

strategy had a mean score of 29.00 with a standard deviation of 7.025. Visual/Verbal learners taught using guided - inquiry strategy had a mean score of 39.90 with a standard deviation of 6.925. while Visual/Verbal taught using lecture strategy had a mean score of 32.45 with a standard deviation of 4.291. Sensing/Intuitive learners taught using guided - inquiry strategy had a mean score of 42.05 with standard deviation of 5.216, while those Sensing/Intuitive taught lecture strategies had a mean score of 29.64 with standard deviation of 4.672, Sequential/Global taught using guided - inquiry strategy had a mean score of 40.87 with standard deviation of 6.639. while those taught using Guided – inquiry strategy had a total mean score of 41.80 whilethose Sequential/Global taught using lectures had a mean score of 30.53 with a standard deviation of 5.829. This implies that guided inquiry strategy has more active/reflective learners than other types of learning styles while lecturehas more visual/verbal learners than other types of learning styles.

Table 4.7, showed that there was a significant difference in the achievement of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught Biology concepts using guided-inquiry strategy and lecture strategy (F (1, 157) =178.197, with p = 0.042; p<.05). Therefore, the null hypothesis was rejected at .05 level of significance.

Table 4.8, shows a multiple regression index (R) of .50 and multiple regression square index (R2) of .09. This implies that 9% of the total variance in the achievement of Biology students is attributable to the influence of different learning styles of students when taught with guided-inquiry and lecture strategy. To find the direction of significance, the achievement scores were subjected to least significance difference (LSD) for a post hoc analysis in table 4.9

Post-hoc analysis in Table 4.9, revealed that the mean difference between active/reflective and visual/verbal was 4.590, between sensitive/intuitive and active/reflective was 8.214, between sensitive/intuitive and verbal/visual was 3.624, sequential/global active/reflective and was 4.228, between sequential/global and visual/ verbal was 0.362, and between sequential/global and sensitive/intuitive was 3.986. This implies that active/reflective learning style was the most effective in facilitating students' achievement in biology when taught with guided-inquiry strategy and lecture strategy. This was seconded by sensitive/intuitive style followed by Visual/Verbal and Sequential/Global learning style which are of the same pace. Hence, guided-inquiry strategy and lecture strategy is the most effective instructional strategy for biology students with learning styles.

Result in Table 4.3, revealed students with different learning styles taught Biology concepts using demonstration and guided inquiry shows that the mean score of Active/Reflective learners taught using demonstration strategy is 42.92 with standard deviation of 7.147, while Active/Reflective learners taught using guided – inquiry had a mean score of 43.67 with standard deviation of 5.827. Visual/Verbal learners taught using demonstration strategy had 37.70 mean score with a standard deviation of 8.537 while those Visual/Verbal learners taught using guided – inquiry had a mean score of 39.90 with a standard deviation of 6.925. Sensing/Intuitive learners taught using demonstration strategy had 40.82 mean scores with a standard deviation of 7.371. while those Sensing/Intuitive learners taught using guided – inquiry had 42.05 with a standard deviation of 5.216. Sequential/Global learners taught using demonstration strategy had a mean score of 40.11 with a standard deviation of 7.136. while those Sequential/Global learners taught using guided – inquiry had 40.87 meanscores with a standard deviation of 6.639. This shows that Active/Reflective learners taught using guided – inquiry strategy had the highest mean score than those taught using demonstration strategy while Sequential/Global learners taught using demonstration strategy had a higher mean score than those taught using guided – inquiry strategy.

When the mean difference in the present study was put to statistical test using the ANCOVA, the result In Table 4.10, showed that there was no significant difference in the achievement of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology using demonstration strategy and guided inquiry (F(1, 159) =51.341, with p = 0.650; p<.05). Therefore, the null hypothesis was accepted at .05 level of significance.

VII.   Conclusion
1. The study showed that the students with different learning styles taught Biology concepts in the experimental groups using demonstration and guided – inquiry strategies had the highest mean scores in this study while those students with different learning styles in the control group taught Biology concepts using Lecture strategy had the least mean score in comparison to the three groups.
2. Active/reflective learners taught Biology concepts using Demonstration strategy had a higher mean score than other types of learning styles
3. Active/reflective learners taught Biology concepts using Guided- inquiry strategy had a higher mean score than other types of learning styles
4. Visual/verbal learners taught Biology concepts using Guided- inquiry strategy had a higher mean score than other types of learning styles

5. There was a significant difference in the mean scores of students taught Biology concepts using demonstration and lecture strategies
6. There was a significant difference in the mean scores of students taught Biology concepts using guided - inquiry and lecture strategies
7. There was no significant difference in the mean scores of students taught Biology concepts using demonstration and guided – inquiry strategies
8. The significant difference in the mean scores of learning styles for Biology students shows that the eight (8) learning styles must be adopted by teachers for academic excellence and to ensure that all learners are carried along in the learning place.

VIII. Recommendations

The following recommendations are made a sequel to the findings, from the study:
1) Teachers should find out the learning styles of their students and use appropriate instructional strategies that will concise with the learning styles for effective teaching and learning to take place in Biology classrooms.
2) Workshops and seminars should be organized for biology teachers to update their knowledge and familiarize themselves with the index of learning style questionnaire for possible use in order to identify their students' learning styles with a view to incorporate them into appropriate instructional strategy during the lesson.
3) Adequate relevant instructional materials and facilities should be provided for schools. This is to help the teachers perform better and be more productive in their work.
4) Curriculum planners for senior secondary school Biology should design the curriculum in such a way that will benefit students with multiple learning styles.
5) Educators and instructional designers need to build courses and programmes that will be of benefit to students of multiple learning styles.

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