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Teaching strategies on biology achievement of secondary school students with different learning styles in rivers state, Nigeria

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Abstract
This study investigated the effect of teaching strategies (guided inquiry, demonstration and lecture) on Biology achievement of secondary school students with different learning styles (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) in Rivers State. The study adopted the quasi-experimental research design with non-randomised pretest and posttest groups. The sample consisted of 247-year two (SS2) Biology 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. Two instruments Biology Achievement Test (BAT) and Index of Learning Styles (ILSQ) were used in the study. The two instruments were subjected to both content and face validity. The ILSQ as adopted from Felder and Solomon (2004) was used for the identification of the students' learning styles. Test-retest reliability coefficient was computed using Pearson Product Moment Co-relation coefficient which gave a reliability coefficient of 0.84 for BAT. The ILSQ was used for the identification of students' learning styles. The internal consistency for each of the learning styles were determine 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. From the findings, a significant difference was found to exist in the academic achievement of Biology students with different learning style taught using demonstration, guided-inquiry and lecture. There was no significant difference in the mean scores of male and female students with different learning styles taught Biology using demonstration, 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.

Keywords: learning styles, teaching strategies, academic achievement, biology and gender

Introduction

Biology is the study of plants and animals (Michael, 2015) [10]. It is a science subject offered at senior secondary school level in Nigeria and it is among the subjects taken at Senior School Certificate Examination (SSCE). Many students who registered for Biology in external examinations such as SSCE, NECO, GCE, JAMB etc performed poorly (Ibe, 2015) [8]. Teaching is the act of imparting knowledge. The teaching of science in general and Biology, in particular, required the active participation of students in the teaching-learning process, to enable students to connect scientific concepts and theories to real purposes and practices in the world in which they live (Dumela,.& Bree, 2016) [3]. Unfortunately, the majority of the teachers teach Biology without engaging the learner actively during the teaching-learning process. (Okoli &Azubuike, 2012: Ibe, 2015).) [11, 8].

Students' poor performance in external examinations could be as a result of poor teaching strategies and neglecting of students' learning styles. However, different teaching strategies have been introduced but could not improve the achievement of students in Biology. Teaching strategies are different ways employed by a teacher to impart knowledge to the learners. It is also disheartening to note that, in spite of the much focus on teaching strategies in science, students' performance in science subjects particularly Biology have continued to record a persistent and depressing downward trend ((Ikitde, & Edet, 2013: Okoli &Azubuike, 2012) [9, 11].

Several factors have been identified as affecting students' achievement, these factors include inadequate laboratory equipment, inadequate science teachers, lack of science textbooks, poor teaching strategies amongst others but the neglected variables is learning the style. It is believed that effective learning takes place when the interactive process is one that is best suited to the individual students in terms of learning styles (Ikitde, & Edet, (2013) [9].

Learning styles (Visual / Verbal, Active / Reflective, Sensing / Intuitive, and Sequential / Global learning styles) are different approaches or ways of learning by students (Akinbobola, 2015: Fayombo, 2015; Dumela. 2016) [1, 4, 3]. Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. While Reflective learners prefer to think about it quietly first. 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 investigated.

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) [6], the implication of the theory is that teaching and learning 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) [6] points out that the different intelligence represents not only different content domains but also learning modalities/learning styles.

Piaget (1970) [12] 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.

Academic achievement is referred to as the knowledge attained or skills developed in the school subjects, usually determined by test scores or marks assigned by the teacher (Akude & Izu, 2015) [2]. There are conflicting reports in the literature concerning the effect of teaching strategies on students' achievements. In this study, therefore, the effect of instructional strategies (demonstration, guided – inquiry, lecture) on Biology achievement of students with different learning styles (Active/Reflective, Sensing/ Intuitive, Visual/Verbal, and Sequential/Global learning styles) was investigated.

Gender is the physical and/or social condition of being male or female (Hornby, 2015) [7]. Bridging the gap between men and women at all levels of scientific endeavour has become a priority in the science agenda of many nations. Although the number of female scientists has increased, yet gender equality has not been achieved. In this study, therefore, gender differences in achievement in Biology among senior secondary school students were also investigated.

Statement of the Problem

To overcome these problems of students' poor performance, there is need to strive for 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 hoped that all students will be taught in a manner they prefer which will lead to an increased comfort level to learn, and high achievement. It is against this background that the researchers sought to investigate the effect of learning styles and teaching strategies on the achievement of students in senior secondary school Biology.

Aim and Objectives of the study

The aim of the study was to determine the effect of Instructional teaching strategies (demonstration, guided inquiry and lecture) on Biology achievement of students with different learning styles. Specifically, the study will

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, guided inquiry and lecture strategies
2. Compare 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
3. Determine the mean difference in the performance of male and female students with different learning styles (Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global) taught Biology concepts using demonstration, guided inquiry and lecture strategies

Research Questions

The following research questions guided the study: following research questions guided the study:

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

Hypotheses

The following hypotheses were formulated to guide the study. This was tested at 0.05 alpha level:

H_{O1}: 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, guided

inquiry and lecture strategies

Ho_2: 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

Ho_3: There is no significant difference in the mean scores of male and female students (gender) with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught Biology concepts using demonstration, guided inquiry and lecture strategies

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. ILSQ as adopted from Solomon and Felder (2004) [5], 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-relation coefficient which gave a reliability coefficient of 0.84 for 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.

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, guided inquiry and lecture strategies?

Table 1: Mean scores and standard deviation (SD) of students with different learning styles taught biology concepts using demonstration, guided - inquiry and lecture.

		Pretest		Posttest	
Subjects	**N**	$\bar{X}$	**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	
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	
Total	247				

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 demonstration strategy and those taught using guided - inquiry strategy

Table 2: Mean scores and standard deviation (SD) of students with different learning styles taught Biology concepts using demonstration and those taught using guided – inquiry

		Pretest		Posttest	
Subjects	**N**	$\bar{X}$	**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	

Research question three

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

Table 3: Mean scores and Standard Deviation (SD) of Male and Female Students with Different Learning Styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) Taught Biology Concepts Using Demonstration, Guided Inquiry and Lecture

Gender	**Learning Style**	**Demon- stration N**	$\bar{X}$	**SD**	**Guided-inquiry N**	$\bar{X}$	**SD**	**Lecture N**	$\bar{X}$	**SD**
Male	A/ R	12	4.86	0.90	8	3.40	0.53	6	1.88	0.28
	V/V	9	3.64	0.67	9	3.82	0.60	13	4.08	0.61
	S/I	7	2.83	0.52	6	2.55	0.40	9	2.83	0.42
	S/ G	10	4.05	0.75	10	4.25	0.66	7	2.20	0.33
		38	3.85		33	3.51		35	2.75	
Female	A/ R	14	5.60	1.10	18	7.42	1.06	11	3.20	0.68
	V/V	11	4.40	0.86	10	4.12	0.59	10	2.91	0.62
	S/I	10	4.00	0.78	4	1.65	0.23	13	3.78	0.80
	S/ G	12	4.80	0.94	14	5.77	0.82	14	4.07	0.87
		47	4.7		46	4.74		48	3.49	
Total		85			79			83		247

Ho_1: There is no significant difference in the achievement of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology concepts using demonstration, guided-inquiry, and lecture strategies

Table 4: One-way analysis of covariance (ANCOVA) of students' achievement in biology with different learning styles taught using demonstration, guided-inquiry, and lecture strategies

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Decision at p<.005**
Corrected Model	12449.294[a]	4	3112.323	20.368	.000	S
Intercept	13963.158	1	13963.158	91.381	.000	S
Pretest	11976.256	1	11976.256	78.378	.000	S
Learning Style	943.958	3	314.653	2.059	.106	NS
Error	36978.010	242	152.802			
Total	867279.000	247				

Corrected Total	49427.304	246				

Ho_2: 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 5: 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				

Ho_3 There is no significant difference in the mean scores of male and female students (gender) with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught Biology concepts using demonstration, guided inquiry and lecture

Table 6: One-way analysis of covariance (ANCOVA) of the mean scores of male and female students (Gender) with different learning styles taught biology concepts using demonstration, guided-inquiry, lecture

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision at p<.005
Corrected Model	13343.627[a]	8	1667.953	11.001	.000	S
Intercept	14370.644	1	14370.644	94.786	.000	S
Pretest	11390.852	1	11390.852	75.132	.000	S
Gender	590.186	1	590.186	3.893	.050	S
Learning Style	1053.351	3	351.117	2.316	.076	NS
Gender * Learning Style	272.247	3	90.749	.599	.617	NS
Error	36083.677	238	151.612			
Total	867279.000	247				
Corrected Total	49427.304	246				

Discussion

Table 1 shows that guided – inquiry strategy had a total mean score of 41.80 followed by demonstration strategy with a total mean score of 40. 24. Lecture strategy had the lowest mean score of 30. 12. The table also revealed out of the 247 students with different learning styles taught Biology concepts shows that the mean score of Active/Reflective learners taught using demonstration strategy is 42.92 with a standard deviation of 7.147, while Active/Reflective learners taught using guided – inquiry had a mean score of 43.67 with a standard deviation of 5.827. 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 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. 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 score 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. 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 guided – inquiry had 40.87 mean scores with a standard deviation of 6.639. Sequential/Global learners taught using lecture strategy had 30.53 mean scores with a standard deviation of 5.829. 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. Lecture strategy had 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, showed that there is no significant difference in the achievement of students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology concepts using demonstration, guided-inquiry, and lecture teaching strategies ($F(1, 242) = 152.802$, with $p = 0.106$; $p > .05$). Therefore, the null hypothesis was accepted at. 05 level of significance. This implies that the three teaching strategies differ significantly in their enhancement of the achievement of Biology students with different learning styles.

Result in Table 2, 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 mean scores 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 5, 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.

In Table 3, shows that out of the 247 male and female students with different learning styles taught biology using demonstration, guided inquiry and lecture 38 male were sampled in demonstration strategy with the following learning style; 12 (4.86) are Active/Reflective, 9 (3.64) are Visual/Verbal, 7 (2.83) are Sensing/Intuitive while10 (4.05) are Sequential/Global. 47 female were sampled in demonstration strategy with the following learning style; 14 (5.60) are Active/Reflective, 11 (4.40) are Visual/Verbal, 10 (4.00) are Sensing/Intuitive while12 (4.80) are Sequential/Global. 33 male were sampled in guided inquiry strategy with the following learning style; 8 (3.40) are Active/Reflective, 9 (3.82) are Visual/Verbal, 6 (2.55) are Sensing/Intuitive while10 (4.25) are Sequential/Global. 46 female were sampled in guided inquiry strategy with the following learning style; 18(7.42) are Active/Reflective, 10 (4.12) are Visual/Verbal, 4(1.65) are Sensing/Intuitive while14 (5.77) are Sequential/Global. 35 male were sampled in lecture strategy with the following learning style; 6 (1.88) are Active/Reflective, 13 (4.08) are Visual/Verbal, 9 (2.83) are Sensing/Intuitive while7 (2.20) are Sequential/Global. 48 female were sampled in lecture strategy with the following learning style; 11 (3.20) are Active/Reflective, 10 (2.91) are Visual/Verbal, 13 (3.78) are Sensing/Intuitive while14 (4.07) are Sequential/Global this implies that male in demonstration strategy, guided inquiry, and lecture strategy outperformed their female counterpart.

When the mean difference in the present study was put to statistical test using the ANCOVA, the result in Table 6, showed that no significant difference in the achievement scores of male and female students with different learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) taught biology using demonstration, guided-inquiry, lecture teaching strategies (F (1, 238) =151.612, with p = 0.612; p>.05). Therefore, the null hypothesis was accepted at. 05 level of significance. There was no significant difference in the students' performance based on gender. This is in line with Ikitde and Edet (2013) [9] presents the obtained F-value effects of three variables (teaching strategies, learning style and gender as 0.43. Hence the result was not significant at P< 0.05. The result, therefore, means that there is no significant influence of gender on biology students' achievement with different learning styles when taught using guided-inquiry, demonstration and lecture teaching strategies. This is because it follows naturally that one can retain what one has learnt and vice versa. As both the male and female were given equal opportunities, there is a tendency that there will not be any significant differences in their retention.

The finding of Ibe (2015) [8] shows that the computed-F (10.41) is greater than the critical-F (2.40). This result rejects the null hypothesis that there is no significant difference in the biology mean scores of students in the learning styles groups (Visual / Verbal, Active / Reflective, Sensing / Intuitive, and Sequential) and Control group at posttest. Equally the table shows no significant gender by group interaction since the F-computed (0.35) is less than the critical-F (2.40). The null hypothesis of no significant difference is upheld. The reason for this result could be that the learning styles are gender friendly in the sense that it does not favour a particular gender. It could also be that there is a positive interaction among the students posited by the teacher's good understanding of the different learning styles that exist among the students and the application of appropriate teaching methods in lesson delivery. In the same vein, the above finding could be attributed to the characteristics of four learning styles as propounded by Kolb. They have teaching strategies that are learner friendly and easy to implement. The learning styles are cognitively based in that they promote thinking at every stage in the classroom, and equally encourage learners' active participation in the classroom. This finding agrees with Demirbas and Demirkan (2007) who ascertained "Learning styles of design students and the relationship between academic performance and gender in design education".

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. 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.
6. There was no significant influence of gender on students' achievement when taught Biology concepts using guided-inquiry, demonstration, and lecture strategies based on their different learning styles.

Recommendations

The following recommendations are made 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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