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EFFECTS OF SQ4R INSTRUCTIONAL STRATEGY AND LECTURE METHOD AND BIOLOGY STUDENTS' ACHIEVEMENT IN DELTA NORTH SENATORIAL DISTRICT OF DELTA STATE

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ABSTRACT

The study aimed at determining the effects of SQ4R instructional strategy and lecture method and biology students' achievement in Delta North Senatorial District of Delta State. The independent variables are the SQ4R instructional strategy and lecture method, the dependent variables are achievement and retention and the intervening variables is sex. Three research questions and three hypotheses were raised and formulated to guide the study. The study adopted a non-equivalent planned variation quasi-experimental design. The sample for the study comprised of Four hundred and thirty (430) senior secondary two (SSII) Biology students in Six (6) public co-educational secondary schools in Delta North Senatorial District of Delta State. The instrument for data collection is the Biology Achievement Test (BAT). The instrument was properly validated and reliability ($r = 0.89$) determined before it was used. Before the treatment, both group of students were pre-tested and after exposure to the two teaching methods, they were post-tested. Data collected were analyzed with descriptive statistics of mean and standard deviations, paired sample t-test, independent sample t-test, Analysis of variance and Analysis of CO-variance statistics. The findings of the includes: (i) There was significant difference in the achievement and retention of Biology students taught with SQ4R instructional strategy and lecture method in favour of the students taught with SQ4R instructional strategy (ii) There was a significant difference in the achievement of male and female students taught with SQ4R instructional strategy in favour of the females and a non-significant difference in the male and female students achievement taught with lecture method (iii) There was a significant interaction effects between methods and sex on achievement and (vii) There was a significant interaction effects between methods and sex on achievement. Based on these findings, it was concluded that SQ4R instructional strategy is more suitable for the teaching of Biology when compared with lecture method and it was concluded that faculty of Educations should include the strategy in their curriculum so that pre-service teachers can acquire the skills upon graduation.

KEYWORDS: SQ4R Instructional Strategy, Biology Students' Achievement, Lecture Method, Students' Retention, Gender Differences

INTRODUCTION

Background to the Study

The term Biology is derived from the Greek words bios meaning “life” and logos meaning “study.” It is broadly defined as the scientific study of life and living organisms, encompassing their structure, function, growth, origin, evolution, and distribution. The knowledge of Biology enables one to understand the fundamental processes that sustain life, from the molecular and cellular levels to the complexity of entire ecosystems. An organism, in biological term, refers to any living entity capable of carrying out life processes such as metabolism, growth, reproduction, and response to stimuli. Organisms may exist as unicellular forms, such as bacteria and some or as multicellular entities like plants, animals, and fungi. In its broadest sense, biology is the study of living things. It can also be called the science of life from its objective standpoint. All living things or living organisms are studied under this division of science. It pays attention and study on the things related to living organisms such as organization of life, their functions, patterns and order of organisms, growth and development of living organisms and so on. Living things have variety of shapes, forms and functions, and biologists study life in many different ways from the cell at the smallest and ecosystems at large. Due to that, biology has variety of branches and divisions such as evolutionary biology, cellular biology, genetics, growth and developmental biology and so on. Central to biology are five fundamental themes: the cell as the basic unit of life, genes and heredity as the basis of inheritance, evolution as the driver of biological diversity, energy transformation for sustaining life processes, and the maintenance of internal stability (homeostasis). For a student to study biology effectively, such student must be involved in the act of reading (Modell et al, 2015; Davies et al, 2013).

A survey conducted by the Nigerian Educational Research and Development Council (NERDC) in 2021 indicated that only 56% of Nigerian adults read at least one book per year. According to a report by the National Bureau of Statistics (NBS) in 2020, Nigeria had an adult literacy rate of approximately 62%, with reading frequency being much lower. The same report highlighted that an average Nigerian reads less than one book a year, which starkly contrasts with other African nations like South Africa and Kenya, where the reading rate is significantly higher. This sudden decline in reading rate prompted this research. Reading is the process of looking at a series of written symbols and getting the meaning from them. There are several types of reading, but four key techniques are skimming, scanning, intensive, and extensive reading. Skimming is the act of reading that enables one get the main idea, scanning is for finding specific facts, intensive reading is for detailed analysis of a short text, and extensive reading is for general comprehension of longer texts for pleasure. When students are made to effectively read, there is every high tendency for them to understand the concepts. Getting students to study in school through reading is a major concern in this era, since there are a lot of distraction coming most especially from the technological innovation and couple with the fact that most students have poor reading habits. Increasing people's literacy is inseparable from reading culture. For students to be made to internationally study by reading, teachers should incorporate instructional strategies that will encourage reading in the teaching and learning process. When this is done, students will become

continuous readers not periodic readers, who only reads when there is test or examinations. One of the instructional strategy that has the characteristics of promoting reading is the SQ4R.

SQ4R is an acronym that stands for survey, question, read, reflect, recite, and review. S = Survey, Q = Question (Question as You Survey), R = Read, R = Reflect, R = Recite (Recite Immediately After Reading an Assignment). Survey helps to gain an overview of the material's organization and main ideas by reading headings, subheadings, the introduction, and conclusion. It helps you understand the structure and what you need to learn before you even begin reading in detail., question helps students to look for specific fact in a topic and turn headings and subheadings into questions. This act gives reading purpose, keeps one focused, and makes the brain process the information more actively. To find the answers, students read the text section by section, actively looking for the solutions to the questions formulated. The third phase of this strategy is reflect. Reflect involves thinking critically about the information to connect it with one's prior knowledge, other topics, or personal experiences. This act enables the reader to relate the old concept to the new concept to be learnt. When this is achieved, understanding has taken place. This process helps transfer information from one short-term to long-term memory. The fourth phase of the strategy is the recite. In the recite phase, the learner recounts the main ideas of what is read in his or her own words. When this is achieved, it shows that the reader has conceptually understood the topic he or she has read.

The SQ4R is a useful reading strategy because it aids reading comprehension and is especially helpful for difficult textbook material. It also helps to transform passive reading into an active and efficient learning process. This systematic approach significantly improves reading comprehension, information retention, and critical thinking skills, especially with dense or complex material (Churat et al, 2022). The SQ4R reading technique (Survey, Question, Read, Reflect, Recite, Review) offers several advantages for effective learning. It helps reader get a quick overview of the text by surveying, which saves time. By asking questions, it enables learners engage actively with the material, boosting curiosity and focus. Reading with purpose improves comprehension. Reciting what has been read reinforces memory and helps identify gaps in understanding. This act of applying SQ4R promote reviewing of concept studied. Reviewing consolidates knowledge and makes it easier to recall later. Reflecting deepens understanding by connecting new knowledge to previous knowledge, making learning meaningful. This method encourages active reading rather than passive skimming, which improves concentration. The application of SQ4R helps organize information systematically, making study sessions more efficient. It builds critical thinking skills by prompting learners to question and reflect (Churat et al, 2022).

This method supports long-term memory retention through repetition and active engagement. SQ4R promotes better note-taking, as learners recite and review, making notes more effective. It encourages self-monitoring, as learners raise and answer questions during the reading process. By asking questions, learners engage actively with the material, boosting curiosity and focus and this enables them to read with purpose. Reading with purpose improves comprehension and retention. Reflecting

deepens understanding by connecting new knowledge to previous knowledge, making learning meaningful. Reciting what has been read reinforces memory and helps identify gaps in understanding. Reviewing consolidates knowledge and makes it easier to recall later. This method encourages active reading rather than passive skimming, which improves concentration. It also reduces rereading because learners process information more thoroughly the first time. This helps organize information systematically, making study sessions more efficient.

Looking at the importance of reading in the teaching and learning process and the fact that students have poor reading habits, using an instructional strategy that promotes structured reading habits becomes a necessity but observation and experience has shown that lecture method is the predominant method used in the teaching of Biology. Lecture method is regarded as the oldest method of teaching. It is the method in which the teachers impart knowledge to the students. Teachers make use of this method at all levels of learning. In applying this method, teachers make use of gestures, changes in voice, positions and facial expressions (Okoye, 2009). The teachers are more active and students are passive. In the lecture method, the teachers are the ones who play an important role in educating students. They speak and students are meant to listen to them and understand. The use of lecture method enables teachers and students to cover a large portion of the scheme of work over a period of time (Kalimaposo & Kaumba 2013). Though Lecture method promotes a more passive style of reading where students are not actively engaging with the material and contents. According to Di Biase (2019), research findings have shown that the instructional strategies employed by teachers have a great role to play on students' achievement.

Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school (Steinmayr et al, 2014). Achievement in Biology refer to scores obtained by Biology students after an examination. The outcome of achievement is used in the grading of students and determining the efficacy of a teaching method. Any students who obtained high achievement score must have retained a high percentage of what was taught. Studies have shown that students who employ SQ4R instructional strategy tend to have improved reading comprehension and academic performance (Kiewra 2012). Empirical evidence suggests that SQ4R enhances students ability to identify main ideas and retain information. Studies on the influence of the effectiveness of SQ4R strategy shows that it enhances comprehension through surveying, questioning, reading, reflecting, reciting and reviewing. SQ4R improves students' ability to identify main ideas and organize information. It fosters critical thinking and autonomous learning skills. SQ4R aids recall of information boosting exam performance by developing systematic learning approaches. It also enhances note taking and time management skills. SQ4R supports diverse learning styles and subjects and as a result, students become more engaged with complex concepts which ultimately leads to improvement in academic performance. An effective strategy should be able to improve students' achievement irrespective of their sex.

Sex refers to a set of biological attributes in humans and animals (Coen S et al, 2012). It is primarily associated with physical and physiological features including chromosomes, gene expression, hormone levels and function, and reproductive/sexual anatomy. Sex is usually categorized as female or male. The biology classroom is made up of male and female students with different biological, psychological and physical differences. These set of students are exposed to the same learning and examination conditions irrespective of the differences in their biological make up . These differences in their biological make up can account for the differences in their academic achievement. Studies indicate that SQ4R benefits both genders equally in academic achievement. The strategies structured approach helps males and females organize information effectively. Its active engagement aspect may particularly aid males in focusing on text while females might leverage its organizational aspects for better note-taking. SQ4R adaptability supports diverse learning styles across sexes. The characteristics of the strategy enhances critical thinking both in male and female students.

Literature has shown that the use of SQ4R has been found to improve student's achievement in other subjects most especially in Comprehension. SQ4R may be useful in teaching Biology by enhancing students' engagement with complex scientific texts. This could be achieved by engaging students in intensive studying through Surveying, Questioning, Reading, Reciting and Reviewing of concepts. These acts may promote understanding since it will make Biology students intentional in their reading. Since there is a difference in the mode of application of SQ4R and lecture method in the classroom, it becomes necessary to determine their impact on students' achievement. It is against this background that this study seeks to investigate the effect of SQ4R instructional strategy and Lecture method on biology students' achievement in senior secondary schools and also determined if there was a significant variation in the male and female students' achievement taught with SQ4R in Delta North Senatorial District.

RESEARCH QUESTIONS

The following questions were raised to guide the study:

1. What is the difference between the mean achievement scores of students taught biology using SQ4R instructional strategy and those taught with lecture method?
2. What is the difference between the mean achievement scores of male and female students taught biology with SQ4R instructional strategy and Lecture method?
3. What is the interaction effect between methods and sex on students' achievement in biology?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

H₀₁: There is no significant difference between the mean achievement scores of students taught biology using SQ4R instructional strategy and those taught with lecture method

H0₂: There is no significant difference between the mean achievement scores of male and female students taught biology with SQ4R instructional strategy and Lecture method

H0₃: There is no significant interaction effect between methods and sex on students' achievement in biology

Purpose of the Study

The purpose of this research was to investigate the effects of SQ4R instructional strategy on students' achievement in Biology.

Research Design

The study adopted pre-test-post-test non-equivalent planned variation quasi-experimental design. This design involves the use of two teaching strategies, two levels of sex (male and female), repeated testing (pre-test and post-test). The independent variables are the SQ4R instructional strategy and lecture method, the dependent variables are achievement and the intervening variables is sex (male and female).

This design is appropriate for the study because intact classes were used and there is no randomization of subjects as experimental and control groups (Campbell & Stanley, 1963; Dutra & Reis, 2016; Creswell, 2009).

Population of the Study

The population of the study is made up of 20174 senior secondary school two (SSII) Biology students in the 179 public secondary schools in Delta North Senatorial District of Delta State. The choice of senior secondary two (SSII) is due to the fact that, senior secondary school two (SSII) Biology students are not involved in external examinations such as NECO and WAEC.

Sample and Sampling Techniques

The sample size for the study comprised of Four hundred and thirty (430) senior secondary two (SSII) Biology students in Six (6) public co-educational secondary schools in Delta North Senatorial District of Delta State. A multistage sampling technique was employed in selecting the sample. This was done as follows: First, three local government areas were sampled using simple random sampling technique. In the second stage, the schools in the sampled local government areas were listed in different blind bag and from each stratum, three schools were selected.

Research Instrument

The instrument that was used for data collection is the Biology Achievement Test (BAT). The Biology Achievement Test (BAT) consisted of fifty (50) multiple choice questions adapted from the West African Senior School Certificate Examinations, WASSCE 2022 to 2025 Biology question papers on the topics to be taught. The topics taught were Classification of plants, Digestive system, Modification in the feeding habits of organisms, Transport systems and Respiratory systems).

Validity of Research Instrument

The research instrument was face validated by three experts: One experienced Biology teacher from Obiaruku Grammar School, an expert in measurement and evaluation and one science educator from the Department of Science Education, Faculty of Education, Delta State University, Abraka. The experts were requested to validate the instrument alongside the research questions and hypotheses. The experts agreed the test items will measure what they are supposed to measure.

Content validity for the BAT was established using a table of specification based on Blooms taxonomy, this is to ensure that all concepts were properly represented and this is shown in Table 1.

Table 1 Table of Specification of a 50-item Biology Achievement Test based on Blooms Taxonomy

Sub units (%)	Mental Skills						Total (100%)
	Lower Order	Higher Order					
	Knowledge (26%)	Comprehension (20%)	Application (18%)	Analysis (14%)	Synthesis (12%)	Evaluation (10%)	
Classification of plants (28%)	3	3	2	2	1	3	14
Digestive system (20%)	3	2	2	2	1	-	10
Modification in the feeding habits of organisms (20%)	3	1	2	2	2		10
Transport system I (12%)	2	2	1	1			6
Transport system II (10%)	1	1	1		1	1	5
Respiratory system (10%)	1	1	1		1	1	5
Total	13	10	9	7	6	5	50

Reliability of the Instrument

The reliability of the BAT was establishing the reliability of the instrument, the BAT was administered to forty-three (43) SSII Biology students in Irri Grammar School, Irri in Isoko South Local Government of Delta State, which is outside the sampled schools for the study. The data were analyzed using Kuder-Richardson formula 21. The choice of Kuder-Richardson formula 21 to establish the reliability coefficient of the instrument is based on the fact that it is most appropriate for objective test items that are homogenous and dichotomously scored (Borg & Gall, 1979). Analysis of the data obtained using Kuder-Richardson formula 21 yielded a reliability of 0.98. This shows the instrument is reliable. Any research instrument used for a study is considered reliable if it attains a reliability coefficient of 0.70 or above (Johnson & Christenson, 2000).

Treatment Procedure

The treatment is for two groups: SQ4R approach group and Lecture teaching group. The duration for the study was for six weeks and the duration for the treatment also was for six weeks. Six Biology teachers were selected from the six schools (3 per each group) and they served as research assistants. The treatment procedure followed these phases.

Phase 1: Training of the Research Assistants

The three Biology teachers that served as research assistants used for the study were trained on the skills of using SQ4R for three days and the training lasted for two hours per day. The first part of the training focused on the theories, origin and characteristics of the SQ4R. When that has been understood, the researcher together with the research assistants practiced the implementation of the SQ4R using the training manual developed by the researcher (Appendix II). The training came to a close when the researcher is convinced that the trained research assistant can correctly apply the teaching strategy in their respective classes. The training manual specifically defined the steps to be followed in teaching and the specific roles teachers and students are to play.

One week before the start of treatment, all the Biology science teachers used for the study were given extracts which contained the contents to be taught for six-weeks. The extracts were gotten from the recommended Biology textbooks. Lesson plan written on each of the concepts in the six-week instructional unit using SQ4R and lecture method were handed over to the specific teachers to apply in their various classes. This was done to ensure the various classes are taught using the recommended methods. The lesson plans contain both the teachers and students' activities during the specific lessons for specified classes.

Phase 11: Pre-testing of both group of Students

Three days before the treatment proper, the two groups (SQ4R and lecture method groups) were pre-tested with the BAT. This was done to determine if the groups were equivalent or not and to ensure that the difference between the pre-test and posttest and delayed post test scores was due to treatment.

Actual treatment: During treatment in each of the instructional groups of study, the following activities were carried out by both the research assistant (teachers) and students.

Teaching by Biology teachers using SQ4R Instructional strategy: The steps are:

Survey: Teacher introduced the topic by directing students to scan headings, subheadings, graphs, formulas, and diagrams in the textbook extract. Students' skim through the material to get a general idea by identifying bold terms, symbols, charts, and definitions, this is the survey stage.

Question stage: The teacher asked students to transform headings into questions. Students write down questions that they will answer during the lesson and engage in small group discussions to solve problems. Students in this stage read actively to answer the questions they formulated by highlighting definitions, formulas, or key steps in solving problems. In this stage, the teacher guides.

Read Stage: The teacher asked the students to read the text or extract having the questions raised at the back of our mind. Students actively read the text to make meaning out of it.

Reflection Phase: The students reflected on what has been read and provide answers to questions raised in step 2. This encouraged critical thinking through real-life connections and open-ended questions and this enabled them connect the topic with daily life and reflect on what they have learned and how they can apply it (Gunning, 1996; Gunning, 2010).

Recite stage: In this stage, the teacher asked students to explain concepts read in their own terms from memory after putting them in various groups. Students in this stage recite key information aloud without referring to the textbook extract given to them as they answer their own questions verbally or in writing.

Summary stage: The teacher gave a summary of what is been learnt putting into consideration students' explanations at step 3 and 4 to make learning more concrete and eradicate or minimize misconception if there is any.

Evaluation: Teacher ask students questions; students answer and also ask teacher questions.

Teaching of Biology by the Teachers using Lecture Method

In teaching the concepts using lecture method, the following steps were taken for each of the concept taught.

Step 1: Teacher asked questions to elicit students' knowledge about the concept to be taught

Step II: Teacher explained the concepts to be taught

Step III: Teacher asked students questions to find out their levels of understanding

Step IV: Teacher answered students' questions

Step V: Teacher summarized the lesson.

Step IV: Post - testing

At the end of six weeks of instruction, the groups (SQ4R and lecture method) were given a post-achievement test to respond to.

Method of Data Analysis

All research questions were answered using descriptive statistics of the mean and standard deviation. While the hypotheses were tested using paired sample t-test statistics, independent sample test statistics and ANCOVA. Specifically, All research questions were answered using descriptive statistics of mean and standard deviations statistics. Hypothesis one and two were tested with independent sample t-test statistics, hypotheses three was tested with analysis of Covariance.

RESULTS

Research Question One: What is the difference between the mean achievement scores of students taught biology with SQ4R instructional strategy and those taught with lecture method?

In ascertaining the difference between the mean achievement scores of students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District, the post test scores of students in both groups were subjected to analysis using descriptive statistics as shown in Table 2.

Table 2 Descriptive statistics of Mean and Standard deviation showing the difference in the mean scores of Biology students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District at Post-test

Methods	N	Mean	Mean Diff	SD
SQ4R	215	66.12		9.08
			31.23	
Lecture	222	34.89		9.52

The analysis of the difference in the mean scores of students taught with SQ4R instructional strategy and lecture method, students taught with SQ4R at post-test obtained a mean score of 66.12 with a standard deviation of 9.08 and their counterpart taught with Lecture method, obtained a mean score of 34.89 with a standard deviation of 9.25. The mean difference between the two set of scores is 31.23. In order to determine if the difference is significant, hypothesis two was tested.

H0₁: There is no significant difference between the mean achievement scores of students taught biology using SQ4R instructional strategy and those taught with lecture method

To determine the appropriate statistics to use in testing hypothesis two, the students' pre-test scores were analysed with independent sample t-test statistics and this shown in Table 3

Table 3 Independent sample t-test statistics comparing the mean scores of Biology students taught with SQ4R instructional strategy and lecture method on students' achievement in Delta North Senatorial District at pre-test

Methods	N	Mean	Mean Diff	SD	df	tcal	Sig(2-tailed)
SQ4R	215	19.11		7.49			
			0.27		428	.371	0.710
Lecture	222	18.84		7.46			

The Table shows that the difference at pre-test was not significant since a calculated sig value of 0.710 which is greater than 0.05 alpha level of significance was obtained. With this, hypothesis one was tested with independent sample t-test statistics as shown in Table 4

Table 4 Inferential statistics of independent sample t-test comparing the difference in the mean scores of Biology students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District at Post-test

Methods	N	Mean	Mean Diff	SD	df	tcal	Sig(2-tailed)
SQ4R	215	66.12		9.08			
			31.23		428	34.76	0.00
Lecture	222	34.89		9.52			

Table 4 shows that the difference between the mean achievement scores of both group of students is significant, this is because the calculated sig value of 0.00 which is less than 0.05 alpha level of significance was obtained when the data were analyse. With this, H_{01} which states that there is no significant difference between the mean scores of students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District is rejected.

Research Question Two: What is the difference between the mean achievement scores of male and female students taught biology with SQ4R instructional strategy and Lecture method in Delta North Senatorial District?

In establishing the difference between the mean scores of male and female students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District, the post test scores of students in both groups were subjected to analysis using descriptive statistics as shown in Table 5.

Table 5 Descriptive statistics of Mean and Standard deviation showing the mean scores of male and female Biology students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District

Methods	Sex	N	Mean	Mean Diff	SD
SQ4R	Male	106	64.87		9.17
				2.54	
	Female	102	67.41		8.85
Lecture	Male	121	35.41		10.12
				1.13	
	Female	101	34.28		8.75

The analysis on the difference in the mean scores of male and female students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District using descriptive statistics of mean and standard deviation shows that the male students taught with SQ4R instructional strategy had a mean score of 64.87 with standard deviation of 9.17, while the female students mean score was found to be 67.41 with a standard deviation of 8.85. The mean difference between the two set of scores

is 2.54, on the other hand, for the lecture group students, the male students obtained a mean score of 35.41 with standard deviation of 10.12 while their female counterparts obtained a mean score of 34.28 with a standard deviation of 8.75. The mean difference between the two set of scores is 1.13. In order to determine if the difference is significant, hypothesis three was tested.

H0₂: There is no significant difference between the mean achievement scores of male and female students taught biology with SQ4R instructional strategy and Lecture method in Delta North Senatorial District

Since no significant difference was found in Table 2, independent sample t-test statistics was used to test hypothesis three and the results are shown in Table 6

Table 6 Independent sample t-test statistics comparing the mean scores of male and female Biology students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District

Methods	Sex	N	Mean	Mean Diff	SD	df	tcal	Sig (2-tail)
SQ4R	Male	106	64.87		9.17			
				2.54		206	2.03	0.04
	Female	102	67.41		8.85			
Lecture	Male	121	35.41		10.12			
				1.13		220	0.79	0.380
	Female	101	34.28		8.75			

Table 6 shows that the difference between mean achievement scores of male and female students taught with SQ4R instructional strategy is significant, this is because the calculated sig value of 0.04 which is less than 0.05 alpha level of significance was obtained when the data were analyse. While for the lecture method, this was found not to be significant since the calculated sign value of 0.380 which is greater than 0.05 alpha level of significance was obtained, with this, H0₃ which states that there is no significant difference between the mean scores of male and female students taught with SQ4R instructional strategy and lecture method in Delta North Senatorial District is rejected for SQ4R and not rejected for lecture method.

Research question Three: What is the interaction effects between methods and sex on students' achievement in biology in Delta North Senatorial District?

In establishing the interaction effects between methods and sex on students' achievement in Delta North Senatorial District, the post test scores of students in both groups were subjected to analysis using descriptive statistics as shown in Table 7

Table 7 Descriptive statistics of Mean and Standard deviation showing the interaction mean effects of methods and sex on achievement in Delta North Senatorial District at Post-test

Methods	Sex	N	Mean	Mean Diff	SD
SQ4R		215	66.12		9.08
				31.23	
Lecture		222	34.89		9.52
SQ4R	Male	106	64.87		9.17
				2.54	
	Female	102	67.41		8.85
Lecture	Male	121	35.41		10.12
				1.13	
	Female	101	34.28		8.75

The analysis of the difference in the mean scores of students taught with SQ4R instructional strategy and lecture method, students taught with SQ4R at post-test obtained a mean score of 66.12 with a standard deviation of 9.08 and their counterpart taught with Lecture method, obtained a mean score of 34.89 with a standard deviation of 9.25. The mean difference between the two set of scores is 31.23. Also, the analysis on the difference in the mean scores of male and female students taught with SQ4R instructional strategy and lecture shows that the male students taught with SQ4R had a mean score of 64.87 with standard deviation of 9.17 while the female mean score was found to be 67.41 with a standard deviation of 8.85. The mean difference between the two set of scores is 2.54, on the other hand, for the lecture group students, the male students obtained a mean score of 35.41 with standard deviation of 10.12 while their female counterparts obtained a mean score of 34.28 with a standard deviation of 8.75. The mean difference between the two set of scores is 1.13. In order to determine if the difference is significant, hypothesis six was tested.

H0₃: There is no significant interaction effect between methods and sex on students' achievement in biology in Delta North Senatorial District

In establish if there is a significant the interaction effects between methods an sex on students' achievement in Delta North Senatorial District, the pre-test and post test scores of students in both groups were subjected to analysis using Analysis of Covariance statistics as shown in Table 8.

Table 8 Analysis of Covariance statistics comparing the effects of Methods and sex on Achievement

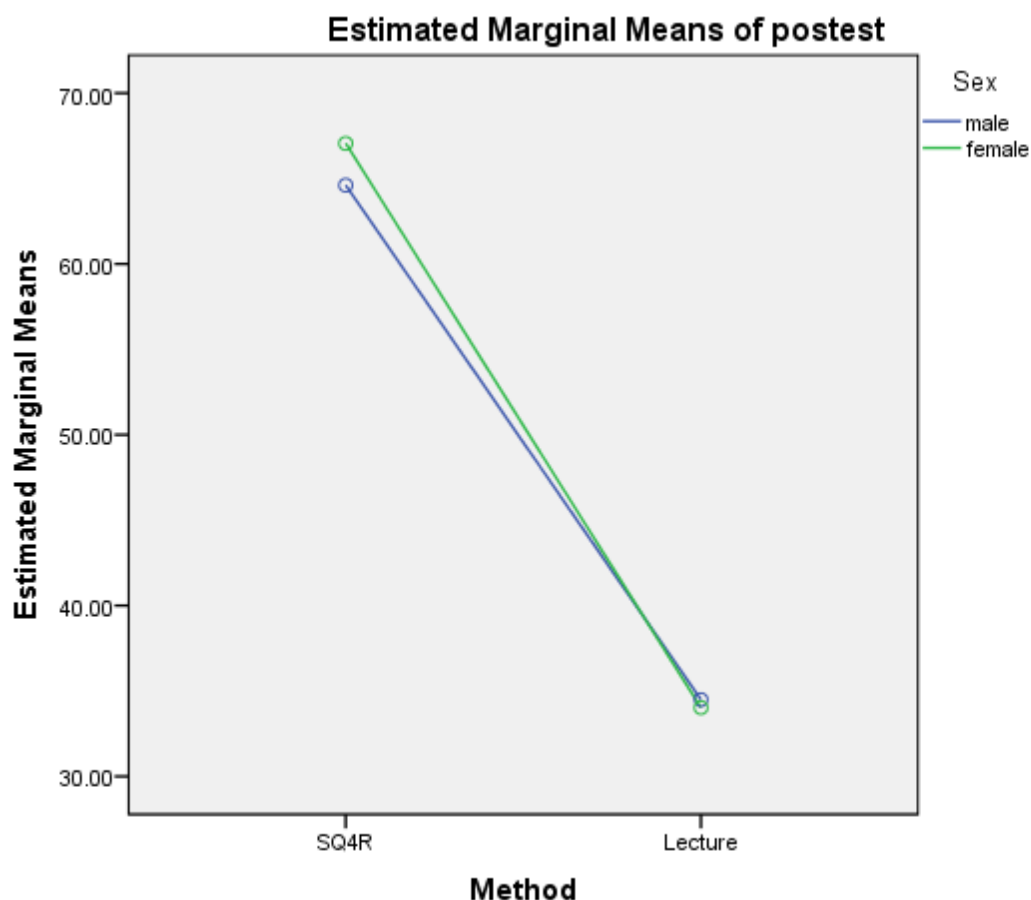
Source	Type III Sum of Square	df	Mean square	F	Sig.
Corrected Model	122915.747	4	30728.937	692.304	0.000
Intercept	66524.030	1	66524.030	1498.746	0.000
Pre-test	17818.008	1	17818.0081	401.429	0.000
Method	103392.741	1	103392.745	2329376	0.000
Sex	2.728	1	2.728	0.061	0.804
Method*Sex	441.178	1	441.178	9	.939
	0.002				

Error	18864.244	425	44.385
Total	1216580.00	430	
Corrected Total	14`779.991	429	

The Table shows that the interaction effects between methods and sex is significant since the calculated sig values of 0.002 which is less than 0.05 alpha level of significance was obtained. With this, H_0 which states that there is no significant interaction effect between methods and sex on students' achievement in biology in Delta North Senatorial District is rejected.

In order to determine the type of interaction effects existing between methods and sex on achievement, a graph was plotted and this is shown in Fig 1

Fig 1: A graph between methods and sex showing the interaction between method and sex on achievement



Covariates appearing in the model are evaluated at the following values: pretest = 19.0213

Fig shows that the existing interaction effect between method and sex on achievement is disordinal

DISCUSSION OF FINDINGS

Getting students to study in school through reading is a major concern in this era, since there are a lot of distraction coming most especially from the technological innovation and couple with the fact that most students have poor reading habits. Increasing students' literacy is inseparable from reading culture. For students to be made to internationally study by reading, teachers are encouraged to incorporate instructional strategies that will encourage reading in the teaching and learning process. To answer this call, this study investigated the impact of SQ4R instructional strategy on students' achievement using some biological concepts in Delta North senatorial district and the following findings emerged.

In determining if there is variation between the achievement of students taught with SQ4R instructional strategy and lecture method, the second finding of the study showed a significant difference in the achievement of Biology students taught with SQ4R instructional strategy and lecture method. As shown in Table 2 students taught with SQ4R instructional strategy and lecture method, students taught with SQ4R at post-test score obtained a mean score of 66.12 with a standard deviation of 9.08 and their counterpart taught with Lecture method, obtained a mean score of 34.89 with a standard deviation of 9.25. The mean difference between the two set of scores is 31.23. This was found to be significant in Table 4 were the calculated sig value of 0.00 which is less than 0.05 alpha level of significance was obtained. This significant difference was as a result of the differences in the characteristics of the SQ4R instructional strategy and the Lecture method. The SQ4R instructional strategy has a framework that enabled the students to be active readers, and provided four core comprehension strategies which are Preparational, Organizational, Elaborative, and Monitoring strategies. These strategies enabled the students to question their understanding and reflect on them. This process enabled them to integrate new information with their existing knowledge and this support the formation of correct mental models unlike where the lecture method was used. This could have accounted for the significant difference which was in favour of the SQ4R instructional strategy group. This finding agreed with that of Basar and Gurbuz (2017), Sari et al., (2018) and Iswan et al., (2019) who whose finding showed that SQ4R instructional strategy improved comprehension and students' achievement in mathematics when compared with other methods.

On ascertaining if there will be difference between the achievement of male and female students taught with SQ4R instructional strategy and lecture method, the third finding of the study shows that there was a difference in the achievement of male and female students taught with SQ4R instructional strategy and lecture method. In Table 5, shows that the male students taught with SQ4R had a mean score of 64.87 with standard deviation of 9.17 while the female mean score was found to be 67.41 with a standard deviation of 8.85. The mean difference between the two set of scores is 2.54, on the other hand, for the lecture group students, the male students obtained a mean score of 35.41 with standard

deviation of 10.12 while their female counterparts obtained a mean score of 34.28 with a standard deviation of 8.75. The mean difference between the two set of scores is 1.13. This difference was however found to be significant for SQ4R instructional strategy group students in Table 6 in favour of the female students. These significant differences observed which is in favour of the female students showed that the female students enjoyed the reading activities more than the male. This could be due to the fact females are natural readers. This finding disagrees with that of Ahmed (2025) who found no variation in the academic achievement of male and female students taught with SQ4R. Also, Table 6, shows that for the lecture method, the difference is not significant and this is due to the fact that both the male and female students enjoyed the activities almost at the same levels. This finding agrees with the finding of Agboro-Eravwoke (2022) who found no difference in the achievement of male and female students' exposed to same instructional strategy.

In order to determine if there is a significant interaction effects between methods and sex on students' achievement, the sixth finding in Table 8 shows that the interaction effect is significant. The Table shows that the calculated sig values of 0.002 which is less than 0.05 alpha level of significance was obtained. This shows that the sex interacted with the methods in influencing students' achievement. This finding disagrees with the finding of Agboro-Eravwoke et al (2025) whose study found no significant interaction effect between method and sex on achievement.

CONCLUSION

Based on the findings of the study, the following conclusions emerged

Since one of the findings of the study showed that the use of SQ4R instructional strategy had positive effects on students' achievement and retention, it can be concluded that SQ4R is a more suitable strategy for the teaching of Biology when compared with lecture method.

Another finding of the study showed a significant difference in the mean achievement scores of male and female students taught with SQ4R instructional strategy, it is therefore concluded that SQ4R instructional strategy is sex-biased in promoting achievement.

Since one finding of the study showed that there is a significant interaction between methods and sex on students' achievement, it can be concluded that sex interacted with method to promote achievement when SQ4R instructional strategy and lecture method was used.

Recommendation

Biology teachers should be encouraged at all levels to adopt the usage of SQ4R instructional strategy in Teaching since it was found to improve students' achievement

School administrators should organize seminars and workshop for to train teachers to acquire the skills needed for the usage of SQ4R instructional strategy and should be encouraged to do use it

Curriculum planners should include SQ4R instructional strategy in the curriculum for faculty of Education and Colleges of Education so that pre-service teachers will acquire the skills needed for its usage before the graduate.

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