

Effects Peer Tutoring, Study Question-Based Instructional Strategies and Lecture Method on Students' Academic Achievement and Attitude Towards Chemistry in Delta and Bayelsa States

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Sponsor: TETFUND, Project reference number: TETF/CE/DRSD/COE/MOSOGAR/IBR/2022

Abstract

This study aimed to examine the effects of peer tutoring, study question-based strategies, and lecture method on the educational achievement and attitude of chemistry students in Delta and Bayelsa States. Four hypotheses guided the study. The study will adopt a 3x2 pretest, posttest, planned variation quasi-experimental factorial design. The study's sample size consisted of 622 students enrolled in SSII chemistry across twelve public mixed senior secondary schools in Delta and Bayelsa States. The schools in question were selected through the utilization of a stratified random sampling technique. The data gathering process involved the utilization of two instruments, namely the Chemistry Achievement Test (CAT) and the Chemistry Attitude Scale (CAS). The assessment of the instruments' face validity was conducted by a panel of three specialists. The reliability of the CAT and CAS was determined by the utilization of statistical methods, namely the Kuder Richardson 21 and Cronbach Alpha coefficients. These coefficients produced reliability values of 0.88 and 0.79 for CAT and CAS, respectively. The study consisted of three distinct groups, including peer tutoring, study question-based, and lecture groups. In this study, a peer tutoring instructional technique was used to provide chemistry teaching to the students in the peer tutoring group as the treatment. Similarly, study question-based instruction was used to teach the students in the study question-based group, while the students in the lecture group received instruction through the lecture method. Before the commencement of the treatment, pre-tests were administered, followed by a post test conducted following the finalization of the six-week treatment period involving CAT and CAS. The acquired scores were collected and subjected to analysis using ANCOVA and Scheffe's post-hoc test. The results of the study indicate a notable disparity in the average scores for achievement and attitude among students who were instructed in chemistry using three different strategies: peer tutoring, study question-based, and lecture. The study question-based strategy yielded the highest scores, followed by the peer tutoring strategy, and finally the lecture method. The findings of this research work indicate that the use of peer tutoring for studies and study question-based strategies promotes active student engagement in the process of learning, leading to enhanced academic achievement and a more positive attitude towards the subject of chemistry in Delta and Bayelsa States. These outcomes were observed to be superior to those achieved using the traditional lecture method. Study question-based strategy, more than peer tutoring, however, enables students to have a proper conceptualization of the chemistry contents taught leading to better achievement and attitude. Therefore, the study recommends that chemistry teachers at the secondary school level in Delta and Bayelsa States should consider implementing a study question-based strategy while teaching chemistry subjects.

Keywords: Peer tutoring strategy, study question-based strategy, lecture method, academic achievement and attitude

DOI: 10.7176/JEP/14-33-03

Publication date: November 30th 2023

1. Introduction

Chemistry is a scientific discipline concerned with the investigation of matter's composition, characteristics, structure, and transformations. It plays a crucial role in our comprehension of the environment and explains how various substances interact with one another. Chemistry provides students with a fundamental understanding of matter, energy, and the interactions between them. This knowledge is essential for further studies in fields such as medicine, pharmacy, engineering, and environmental sciences. Chemistry opens up various career paths, including chemical engineering, pharmaceuticals, biotechnology, environmental sciences, and research and development. By teaching chemistry, students are prepared for these industries, which contribute to economic growth and development. In addition, Nigeria's economy relies on various chemical industries, such as oil and gas, agrochemicals, and manufacturing. Teaching chemistry at the secondary level equips students with the knowledge and skills required to contribute to these sectors.

In order to effectively interest students in the study of chemistry and help their local community and the world at large, chemistry teachers use a variety of instructional techniques. The lecture method, although widely used in traditional classrooms, has been criticized for being teacher-centred and less interactive (Garrett, 2018). This instructional method primarily involves a teacher delivering information to students through verbal communication. Chemistry is an essential subject that necessitates a comprehensive comprehension of complex concepts, critical reasoning, and application. Students may not be fully engaged in the learning process in traditional lecture-based classrooms, resulting in reduced achievement levels and a lack of subject-related enthusiasm. Therefore, alternative instructional strategy, such as peer tutoring and study question-based instructional strategies, have emerged as potential strategies to promote active student involvement and deeper comprehension of chemistry concepts.

Peer tutoring is an educational approach wherein students collaborate in pairs or small groups to mutually facilitate their learning processes. It involves higher-achieving students (tutors) assisting lower-achieving students (tutees) by providing academic support, guidance, and explanations. This type of tutoring allows for personalized instruction, immediate feedback, and the integration of cooperative learning. This strategy emphasizes collaboration, problem-solving, critical thinking, and communication (Rajaram & Ranganathan, 2021). One of the significant benefits of using this strategy is the opportunity for students to learn from and with each other. By actively participating in group activities, students can exchange ideas, share different perspectives, and learn new strategies from their peers. This aids in the development of critical interpersonal and communication skills as well as a deeper comprehension and recall of the subject matter. To implement a peer tutoring instructional strategy effectively, it is crucial to carefully design and scaffold the tasks, promote equal participation and contributions from all group members, and provide clear learning objectives and assessment criteria (Singh & Gupta, 2021). Additionally, the duty of the instructor is to facilitate and guide the groups, rather than provide direct instruction. Peer tutoring instructional strategy is a powerful strategy that promotes student engagement, collaboration, and critical thinking that may culminate into improves academic achievement and attitude.

Another instructional strategy that has emerged as a promising strategy to enhance students' academic achievement and attitude is the study question-based strategy (Ovie A.F (2022)). The question-based strategy is an educational strategy that involves the active participation of students during the process of learning by use of thought-provoking questions (Khan & Choudhry, 2017). This pedagogical approach prioritizes inquiry-based learning, wherein students are motivated to engage in exploration, investigation, and assessment of knowledge with the purpose of cultivating a more profound comprehension of the information in the content. The educational approach known as study question-based strategy entails the utilization of open-ended questions to foster the emergence of critical thinking and problem-solving abilities. The purpose of these inquiries is to foster the inquisitiveness of students and promote their capacity for autonomous thinking, rather than only depending on the instructor for knowledge acquisition. The questions may be focused on specific concepts, theories, or problem-solving scenarios related to chemistry.

The benefits of using study question-based instructional strategy in chemistry education are numerous. One significant advantage is that it helps to foster a more active and engaged learning environment (Cardellini, Gholami & Tarsitani, 2020). Students are motivated to actively engage in their own learning by asking them thought-provoking questions. This method promotes the growth of higher-order cognitive skills, as students are compelled to engage in the critical examination of information, establish meaningful associations, and employ their acquired knowledge in practical contexts. The dynamic and interactive characteristic of this strategy fosters a sense of inquisitiveness and personal responsibility towards one's own educational journey. When students are exposed to meaningful and relevant learning experiences that are guided by their own curiosity, they are more inclined to achieve higher academic grades and cultivate a good attitude towards the subject of chemistry. Academic achievement pertains to the degree of success or attainment a student reaches in their educational trajectory. In this study, the academic achievement of students studying chemistry is examined. Academic assessment often involves the evaluation of a student's knowledge, skills, and comprehension of the curriculum through means such as grades, test scores, or other evaluations. The teaching method used by a teacher plays a significant role in shaping a student's academic achievement (Lee & Kim, 2020). Different teaching methods can impact students in various ways and influence their level of understanding, engagement and motivation. This study aims to conduct a comparative analysis of the effectiveness of three instructional strategies: peer tutoring, study question-based strategy, and lecture method. The primary objective is to determine which of these methods yields superior outcomes in terms of students' academic achievement and attitude towards the subject of chemistry.

The teacher's teaching method also plays a crucial role in shaping and influencing a student's attitude. Attitude refers to a student's individual curiosity and enthusiasm for learning in a specific subject or field of study (Smith, Williams & Johnston, 2020). In this study, it simply refers to a student's curiosity and enthusiasm for learning chemistry. It is a combination of a student's intrinsic motivation, personal values, and goals related

to their academic pursuits. When students have positive attitude towards a subject, they are more likely to be engaged, focused, and motivated to learn that subject. However, the situation is reversed when their attitude is negative. Different teaching methods can either enhance or diminish a student's attitude towards a subject. Thus, the study will further compare the effects of peer tutoring strategy, study question-based and lecture method on students' attitude towards chemistry to ascertain the most effective method for enhancing students' attitude towards chemistry. In light of this, this study aims to examine the effect of peer tutoring strategy, study question-based strategy, and lecture method on students' academic achievement and attitude towards chemistry in Delta and Bayelsa States. The objective is to determine the most effective instructional method for teaching chemistry in these regions.

2. Statement of the Problem

Chemistry is an important discipline that requires a comprehensive understanding of complex concepts, critical thinking skills, and practical application. Traditional lecture-oriented classroom settings may not effectively engage students in the learning of process, resulting in lower levels of achievement and limited enthusiasm towards the subject. Therefore, alternative instructional strategy, such as peer tutoring and/or coaching strategy and study question-based strategy, have emerged as potential strategy to promote active student involvement and deeper understanding of chemistry concepts. Therefore, the problem is: will peer tutoring and study question-based strategies enhance students' academic achievement and attitude towards chemistry more than the lecture method?

3. Purpose of the Study

The primary objective of this research work was to investigate the effect of three different instructional strategies - peer tutoring strategy, study question-based strategy, and lecture method - on students' academic achievement and attitude towards the subject of chemistry in Delta and Bayelsa States.

The specific purposes were to determine:

- i. the difference between the mean achievement scores of students taught chemistry through peer tutoring, study question-based instruction, and lecture method in Delta State;
- ii. the difference in the mean attitude scores among students taught chemistry with peer tutoring strategy, study question-based strategy and lecture method in Delta State.
- iii. the difference between the mean achievement scores of students taught chemistry through peer tutoring, study question-based instruction, and lecture method in Bayelsa State.
- iv. the difference in the mean attitude scores of students taught chemistry in Bayelsa State by peer tutoring, study question-based, and lecture method.

4. Hypotheses

The study was guided by the following null hypotheses.

1. There is no significant difference between the mean achievement scores of students in Delta State who were taught chemistry using the peer tutoring strategy, the study question-based strategy and the lecture method.
2. There is no significant difference between the mean attitude scores of students taught chemistry using peer tutoring strategy, study question-based strategy and lecture method in Delta State.
3. There is no significant difference between the mean achievement scores of students taught chemistry through peer tutoring, study question-based strategy and lecture method in Bayelsa State.
4. There is no significant difference in the mean attitude scores of students in Bayelsa State who were taught chemistry using the peer tutoring strategy, the study question-based strategy and the lecture method.

5. Methodology

The research will employ a 3x2 pre-test, post-test, planned variation quasi-experimental factorial design. The chosen design is deemed suitable for the study due to the absence of subject randomization. Instead, entire classes will be utilized to ensure minimal disruption to on-going school activities. The quasi-experimental strategy is considered the most appropriate approach for experimental studies that involve the utilization of intact classes. Furthermore, the impact of more than one independent variable on dependent variables will be simultaneously studied. The factorial design is considered the most appropriate experimental design for studies that aim to assess the simultaneous effects of multiple independent variables on multiple dependent variables. Quasi-experimental design is a suitable alternative to pure experimental design when randomization is not applied. The study's population consisted of 68,904 chemistry students in public senior secondary schools located in Delta and Bayelsa States. The study's sample size consisted of 622 chemistry students enrolled in SSII level across twelve public mixed senior secondary schools located in Delta and Bayelsa States. The schools in

question were selected through the utilization of a stratified random sampling technique. The initial phase of the sample methodology was the categorization of all public mixed senior secondary schools within the two states into their respective senatorial districts. Thereafter, the researcher randomly selected two schools each from the six senatorial districts in Delta and Bayelsa States using simple random sampling of balloting with replacement. The utilization of stratified random sampling was employed so as to ensure equitable opportunities for the selection of schools in both Delta and Bayelsa for the study.

The data gathering process involved the utilization of two instruments: the Chemistry Achievement Test (CAT) and the Chemistry Attitude Scale (CAS). The face validity of the instruments was assessed by three experts that consisted of an experienced chemistry teacher, a science educator specializing in chemistry, and an expert in the area of measurement and evaluation. These experts were selected from Anambra State. The reliability of the CAT was determined by the utilization of the Kuder Richardson 21 coefficient, given that the test items were of a dichotomous nature. The administration of the CAT was conducted on a group of 45 students in SSII at a school that was not a part of the sample of schools for this particular study. The data obtained were analyzed using the Kuder-Richardson 21 method. Upon doing an analysis, a reliability coefficient value of 0.88 was achieved. The Cronbach Alpha coefficient was employed to assess the reliability of the CAS because of the polytomous nature of the items. The CAS was administered to a sample of 30 students in SSII in a school located in Anambra State. The collected responses given by the students were then subjected to an analysis using Cronbach Alpha, resulting in a reliability coefficient value of 0.79. The reliability coefficients of 0.88 and 0.79 satisfy the criterion that any instrument with a reliability coefficient of 0.70 or above is considered reliable. Therefore, the study employed CAT and CAS as research instruments.

The study consisted of three distinct groups, including peer tutoring, study question-based, and lecture groups. The treatment implemented in this research consisted of instructing the students in the peer tutoring group in chemistry through the utilization of a peer tutoring strategy. Similarly, the students in the study question-based group were taught using a study question-based strategy, while the students in the lecture group received instruction through the lecture method. Before the commencement of the treatment, pre-tests were administered, while post-tests were conducted following a six-week time frame of treatment. The acquired scores were collected and subjected to analysis using Analysis of Covariance (ANCOVA) and Scheffe's post-hoc test.

Results

There is no significant difference between the mean achievement scores of students in Delta State who were taught chemistry using the peer tutoring strategy, the study question-based strategy and the lecture method.

Table 1

ANCOVA Comparison of Mean Achievement Scores of Delta State Students Taught Chemistry Using Peer Tutoring, Study Question-Based, and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7788.886 ^a	3	2596.295	20.753	.000
Intercept	101068.711	1	101068.711	807.888	.000
Pretest	51.205	1	51.205	.409	.523
Strategies	7750.646	2	3875.323	30.977	.000
Error	38406.439	307	125.102		
Total	1037686.000	311			
Corrected Total	46195.325	310			

Table 1 indicates a significant difference in posttest achievement scores between students taught chemistry utilising peer tutoring, study question-based, and lecture methods ($F(2,307) = 30.977, P(0.000) < 0.05$). This rejects the null hypothesis. Thus, Delta State students taught chemistry with peer tutoring, study question-based, and lecture methods have significantly different mean achievement scores. Scheffe's post-hoc test confirmed the difference's direction.

Table 2
Scheffe's Post-hoc Test of Peer Tutoring, Study Question-Based, and Lecture Methods on Delta State Students' Achievement

(I) Strategies	(J) Strategies	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Peer tutoring strategy	Study question-based strategy	-5.177*	1.588	.001	-8.301	-2.053
	lecture method	7.102*	1.513	.000	4.126	10.079
Study question-based strategy	Peer tutoring strategy	5.177*	1.588	.001	2.053	8.301
	lecture method	12.279*	1.577	.000	9.176	15.382
lecture method	Peer tutoring strategy	-7.102*	1.513	.000	-10.079	-4.126
	Study question-based strategy	-12.279*	1.577	.000	-15.382	-9.176

Table 2 presents the results indicating a statistically significant disparity in the average achievement scores of students who were instructed in chemistry using the peer tutoring strategy compared to those who were taught using the study question-based strategy. The findings favour the students who were taught using the study question-based strategy. Additionally, the mean achievement scores of students taught chemistry using the study question-based strategy were significantly different from those taught using the lecture method, with the former group exhibiting higher scores. Similarly, there was a significant difference in the mean achievement scores of students taught chemistry using the peer tutoring strategy compared to those taught using the lecture method, favouring the students instructed through the peer tutoring strategy. As stated by the findings presented in Table 2, the study question-based strategy demonstrated the highest level of effectiveness in boosting students' achievement in chemistry. This was followed by the peer tutoring strategy and the lecture method, respectively

There is no significant difference between the mean attitude scores of students taught chemistry using peer tutoring strategy, study question-based strategy and lecture method in Delta State.

Table 3
ANCOVA Comparison of Mean Attitude Scores of Delta State Students Taught Chemistry Using Peer Tutoring, Study Question-Based, and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5134.989 ^a	3	1711.663	39.535	.000
Intercept	105491.076	1	105491.076	2436.547	.000
Pretest	110.054	1	110.054	2.542	.112
Strategies	5090.511	2	2545.255	58.788	.000
Error	13291.660	307	43.295		
Total	1084912.000	311			
Corrected Total	18426.650	310			

As stated by the findings in Table 3, a difference that is statistically significant exists in the mean attitude scores after the intervention among students who were instructed in chemistry using the peer tutoring strategy, study question-based strategy, and lecture method. The analysis of covariance (ANCOVA) revealed a significant main effect, $F(2,307) = 58.788$, $p < 0.05$ demonstrating that the post-test attitude scores were significantly affected by the instructional technique that was chosen. Therefore, the null hypothesis is rejected. Hence, a notable disparity exists in the average attitude scores observed among students who were instructed in chemistry using the peer tutoring approach, study question-based strategy, and lecture method within Delta State. The determination of the direction of the difference was conducted using Scheffe's post-hoc test, as presented in Table 4.

Table 4
Scheffe's Post-hoc Test of Peer Tutoring, Study Question-Based, and Lecture Methods on Delta State Students' Attitude

(I) Strategies	(J) Strategies	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Peer tutoring strategy	Study question-based strategy	-3.173*	.934	.001	-5.011	-1.334
	lecture method	6.573*	.892	.000	4.817	8.328
Study question-based strategy	Peer tutoring strategy	3.173*	.934	.001	1.334	5.011
	lecture method	9.745*	.928	.000	7.919	11.572
lecture method	Peer tutoring strategy	-6.573*	.892	.000	-8.328	-4.817
	Study question-based strategy	-9.745*	.928	.000	-11.572	-7.919

Table 4 presents the results indicating a statistically significant disparity in mean attitude scores among students who were instructed in chemistry using the peer tutoring strategy compared to those who were taught using the study question-based strategy. Specifically, students taught using the study question-based method had higher average attitude scores. Additionally, students taught in chemistry using the study question-based strategy and those taught using the lecture method showed a substantial difference in mean attitude scores, with the former group displaying more positive attitudes. Furthermore, Students taught chemistry using the peer tutoring strategy and those taught using the lecture method showed a substantial difference in mean attitude scores, favouring the former group.

According to the findings presented in Table 4, the research question-based strategy demonstrated the highest level of effectiveness in increasing students' attitude towards chemistry in Delta State. This was followed by the peer tutoring strategy, and finally, the lecture method.

The mean achievement scores of students in Bayelsa State who learned chemistry through peer tutoring, study question-based technique, and lecture method did not differ significantly from one another.

Table 5
ANCOVA Comparison of Mean Achievement Scores of Bayelsa State Students Taught Chemistry Using Peer Tutoring, Study Question-Based, and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14106.624 ^a	3	4702.208	35.659	.000
Intercept	85404.968	1	85404.968	647.674	.000
Pretest	9767.174	1	9767.174	74.070	.000
Strategies	3653.125	2	1826.562	13.852	.000
Error	40482.290	307	131.864		
Total	1003632.000	311			
Corrected Total	54588.913	310			

A statistically significant variation in the mean achievement scores was discovered, as shown in Table 5. after the intervention was seen among students who were instructed in chemistry using the peer tutoring strategy, study question-based strategy, and lecture technique. The analysis of covariance (ANCOVA) revealed a significant main effect, $F(2,307) = 13.852$, $p < 0.05$, demonstrating that the post-test outcomes were significantly influenced by the teaching strategy chosen. Therefore, the null hypothesis is rejected. Hence, a notable disparity exists in the average achievement scores among students who were instructed in chemistry using the peer tutoring approach, study question-based strategy, and lecture method within Bayelsa State. The determination of the direction of the difference was conducted with Scheffe's post-hoc test, as illustrated in Table 6.

Table 6
Scheffe's Post-hoc Test of Peer Tutoring, Study Question-Based, and Lecture Methods on Bayelsa State Students' Achievement

(I) Strategies	(J) Strategies	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Study question-based strategy	peer tutoring strategy	4.181*	1.624	.011	.985	7.377
	lecture method	8.767*	1.673	.000	5.475	12.058
Peer tutoring strategy	Study question-based strategy	-4.181*	1.624	.011	-7.377	-.985
	lecture method	4.586*	1.535	.003	1.566	7.605
lecture method	Study question-based strategy	-8.767*	1.673	.000	-12.058	-5.475
	peer tutoring strategy	-4.586*	1.535	.003	-7.605	-1.566

Table 6 presents the findings indicating a statistically significant disparity in the average achievement scores of students who were instructed in chemistry using the peer tutoring strategy compared to those who were taught using the study question-based strategy. The result favours students that received instruction through the study question-based strategy. Additionally, a substantial difference in the mean achievement scores between students who received instruction in chemistry using the study question-based strategy compared to those who were taught using the lecture method is seen. Once again, the study question-based strategy yields higher achievement scores. Lastly, a significant disparity is observed achievement levels of students who were taught chemistry using a lecture method and a peer tutoring style. In this case, the peer tutoring strategy leads to higher achievement scores. According to the findings presented in Table 6, the study question-based strategy demonstrated the highest level of effectiveness in improving students' ability in the field of chemistry. This was followed by the peer tutoring strategy, and subsequently, the lecture method.

The mean attitude scores of students in Bayelsa State who took chemistry utilizing the peer tutoring technique, the study question-based strategy, and the lecture method did not differ significantly from one another.

Table 7
ANCOVA Comparison of Mean Attitude Scores of Bayelsa State Students Taught Chemistry Using Peer Tutoring, Study Question-Based, and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4897.952 ^a	3	1632.651	45.618	.000
Intercept	46747.369	1	46747.369	1306.179	.000
Pretest	15.256	1	15.256	.426	.514
Strategies	3988.109	2	1994.055	55.716	.000
Error	10987.347	307	35.789		
Total	1064759.000	311			
Corrected Total	15885.299	310			

The data shown in Table 7 indicates that, there exists a statistically significant difference in the mean attitude scores among students who received chemistry instruction through peer tutoring, after the intervention, study question-based strategy, and lecture approach. The analysis of covariance (ANCOVA) yielded a significant F-value of 55.716, that corresponds with p-value of less than 0.05 ($p < 0.05$), indicating that the observed differences are unlikely to have occurred by chance. The null hypothesis is therefore seen to be rejected. Hence, a notable disparity exists in the average attitude scores among students who received chemistry instruction through peer tutoring, study question-based strategy, and lecture method within Bayelsa State. The determination of the direction of the difference was conducted using Scheffe's post-hoc test, as presented in Table 8.

Table 8
Scheffe's Post-hoc Test of Peer Tutoring, Study Question-Based, and Lecture Methods on Bayelsa State Students' Attitude

(I) Strategies	(J) Strategies	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Study question-based strategy	peer tutoring strategy	4.088*	.925	.000	2.269	5.907
	lecture method	10.297*	1.014	.000	8.301	12.293
peer tutoring strategy	Study question-based strategy	-4.088*	.925	.000	-5.907	-2.269
	lecture method	6.209*	.813	.000	4.610	7.809
lecture method	Study question-based strategy	-10.297*	1.014	.000	-12.293	-8.301
	peer tutoring strategy	-6.209*	.813	.000	-7.809	-4.610

The average attitude scores of students who received chemistry instruction using the peer tutoring technique as opposed to those who received instruction using the study question-based strategy are significantly different, as shown in Table 8.

The findings show that students who were taught using the study question-based method had better mean attitude scores. Additionally, a substantial attitude score difference was seen between students who were taught chemistry using the lecture approach and those who were taught using a study question-based strategy, with the former group displaying more favourable attitudes. Similar to this, students taught chemistry using the peer tutoring strategy as opposed to those taught using the lecture method showed a substantial difference in mean attitude scores, favouring the former group. According to the findings presented in Table 8, the study question-based strategy demonstrated the highest level of effectiveness in increasing students' attitude towards chemistry. This was followed by the peer tutoring strategy, while the lecture method ranked third in terms of effectiveness.

6. Discussion

The study's findings show a significant difference in the average achievements levels of students who received chemistry instruction using three different teaching methods: peer tutoring, study question-based learning, and lecture technique. The results demonstrate that the study question-based strategy yielded the highest mean achievement scores, followed by the peer tutoring strategy, and finally the lecture method. One potential explanation for this discovery could be attributed to the requirement of active student engagement in both the study question-based teaching methods and peer mentoring instructional approach. These hands-on strategies encourage students to engage with the subject matter and actively think, analyse, and apply concepts, leading to a better understanding and retention of the material. The observed disparity in mean achievement scores among students instructed in chemistry using a study question-based strategy compared to those receiving peer tutoring may be attributed to the notion that the study question-based instructional approach potentially fosters greater student engagement in the learning process when compared to the peer tutoring strategy. Students are urged to think critically and develop their understanding by answering study questions, leading to a deeper level of engagement with the subject matter. This finding agrees with that of Khan and Choudhry (2017) and Jorca and Turman (2018). According to Khan and Choudhry (2017), the execution of a study question-based strategy has been found to yield greater academic outcomes in the field of chemistry when compared to the traditional lecture method. Similarly, Jorca and Turman (2018) discovered that using the peer tutoring technique resulted in greater academic accomplishment in the field of chemistry compared to the traditional lecture method.

The study found a statistically significant difference between the average attitude scores of students in the Delta and Bayelsa States who received chemistry instruction using the peer tutoring approach, study question-based strategy, and lecture method. One potential rationale for this observation could be according to the notion that the utilisation of study question-based instructional strategy and peer tutoring instructional strategy provides a heightened level of interactivity, collaboration, and individualised learning compared to the traditional lecture style. These aforementioned factors potentially played a role in the enhancement of attitude scores among pupils. The observed statistically significant disparity in the average attitude scores of students who were instructed in chemistry using a study question-based strategy as opposed to peer tutoring can potentially be attributed to the inherent nature of the study question-based strategy. This method promotes the growth of self-directed learners by encouraging students to take responsibility for their own learning. They learn how to study independently, prioritize information, and manage their time effectively, this could result in improved attitude scores. This finding aligns with that of Cardellini, Gholami and Tarsitani (2020) who reported that study question-based strategy promotes students' interest in chemistry than the lecture method. This finding further lends credence to

Tang and Abbott (2017) who reported that peer tutoring, more than the lecture method, positively influenced students' attitudes towards chemistry, leading to increased enjoyment and engagement in the subject.

7. Conclusion

The study concludes that the use of study peer tutoring and study question-based strategies enhance students' active engagement in the learning process, leading to increased chemistry achievement in Delta and Bayelsa States. Study question-based, more than peer tutoring, however, enables students to have a proper conceptualization of the chemistry contents taught leading to better achievement. The study further concluded that peer tutoring and study question-based strategies encourages students to learn than the lecture method in Delta and Bayelsa States. The individual's inclination towards acquiring knowledge contributes to a more favourable attitude towards the subject of chemistry. Comparatively, study question-based strategy is more effective than peer tutoring strategy in helping students cultivate a more positive attitude towards chemistry.

8. Recommendations

Based on the findings of this investigation, the researcher recommends the following:

1. Adoption of study question-based instructional strategy by secondary school chemistry instructors in Delta and Bayelsa States to teach chemistry concepts.
2. Adoption of peer tutoring instructional strategy by chemistry teachers as alternative strategy when the use of study question-based strategy is not feasible.

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