Effects of Experimentation and Team-Teaching Strategies on Secondary School Students Academic Achievement in Basic Science and Technology in Delta State

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Abstract
The study investigated the effects of experimentation, team teaching strategies and lecture methods on secondary school student's academic achievement in basic science and technology in Delta State. This study employed pre-test, post-test and non-equivalent control group quasi-experimental design. The population comprises of 4451 JS II students offering basic science and technology in public secondary schools across three senatorial districts in Delta State (Delta North, Delta Central and Delta South). The research sample consisted of 381 JS II students offering basic science and technology from the six public secondary schools selected from three senatorial districts. The data collection instrument employed was the Basic Science and Technology Achievement Test (BSTAT). The validity of BSTAT was confirmed by three experts. A Kuder-Richardson 21 test was employed to assess the reliability of the BSTAT. The obtained reliability coefficient value was 0.89. prior to and following treatment, the BSTAT was administered as both pretest and posttest. Analysis of the gathered data was conducted using mean, standard deviation, Independent samples t-test, Anova and Ancova. Significantly different mean achievement levels were seen among students who received instruction in fundamental science and technology through experimentation, team teaching strategies and lecture methods. According to Scheffe's post-hoc test, the direction of significance shifts from the experimentation to the team-teaching strategies and lecture methods, respectively. According to the study's findings, experimentation, team teaching strategies and lecture methods can all help students retain basic science and technologies and also accomplish better academically. However, experimentation, was shown to be the most successful, followed by team teaching strategies. The study comes to another conclusion once more: when the interaction effect between instructional method and gender on academic achievement was not significant. This indicates that both male and female students benefited similarly from the instructional methods. The effectiveness of team teaching and experimental strategies was not dependent on gender. In order to increase students' active participation and interaction during instruction, Teachers of Basic Science and Technology should

employ more interactive, experimental, and collaborative strategies to promote deeper understanding and retention among students. This recommendation is based on the study's findings.

Keywords: *Experimentation, Team Teaching Strategies, Lecture Method, Academic Achievement*

Introduction

The quality of education, however, is largely determined by the effectiveness of teaching and learning processes within the classroom. In this regard, the choice of instructional strategies plays a crucial role in influencing students' learning outcomes. Across the world, there has been a growing emphasis on learner-centered pedagogies that promote active participation, inquiry, and collaboration rather than passive knowledge transmission (Johnson & Johnson, 2019). In the Nigerian context, particularly at the secondary school level, the need for effective instructional approaches is even more pressing, as persistent underachievement in science and technology subjects continues to impede the nation's technological progress. The general education curriculum includes basic science and technology instruction in an effort to help students grasp the industrial and technological aspects of life. Specific areas of instruction include metal working, woodworking, electrical, plastics, ceramics, textiles, and technical drawing (Kelubia et. al., 2024) Basic Science and Technology (BST) has been recognized as a foundational subject designed to nurture scientific literacy, technological awareness, and problem-solving abilities among learners. The purpose of the subject is to acquaint students with the fundamentals of science and technology and how it is used in daily life. It covers a wide range of subjects, such as materials, instruments, procedures, and the social effects of technology (Kelubia et. al., 2024). It serves as a bridge between theoretical understanding and practical application, preparing students for more advanced science and technology disciplines. Despite its importance, research evidence indicates that students' performance in BST remains below expectation across several states in Nigeria, including Delta State (Eze & Chukwu, 2021). Factors responsible for this include inadequate resources, large class sizes, and most importantly, the continued reliance on traditional lecture-based instructional methods that focus on rote memorization rather than conceptual understanding (Akinbobola & Adeleke, 2018). These challenges necessitate the adoption of more effective and engaging instructional strategies such as experimentation and team teaching, which have been empirically shown to enhance learners' achievement, motivation, and interest in science-based subjects (Okebukola & Jegede, 2017; Nwosu & Okoye, 2018). In Basic Science and Technology, experimentation provides students the opportunity to connect theory with practice, engage in discovery learning, and understand the process of scientific inquiry. This instructional strategy allows students to observe, manipulate, and test scientific principles rather than merely listen to explanations. Through practical engagement, students gain a deeper understanding of scientific concepts, foster curiosity, and develop higher-order cognitive skills such as critical thinking and problem-solving (Adewale & Oluwatoyin, 2020). Empirical studies have shown that experimentation enhances students' retention and transfer of knowledge by linking abstract scientific concepts with real-world phenomena (Fidan & Tuncel, 2019; Hillmayr et al., 2020). Through experimentation, students engage in dialogue, share ideas, and build knowledge collectively, thereby improving not only cognitive outcomes but also communication and teamwork skills (Lasagabaster, 2018). However, successful implementation of the experimentation method in Nigeria faces challenges such as inadequate laboratory facilities, large class sizes, and insufficient teacher training. These limitations often compel teachers to revert to

lecture-based methods, which restrict students' active engagement and creativity. Nonetheless, when effectively implemented, experimentation remains a highly impactful approach for promoting inquiry, motivation, and long-term academic success.

Team teaching involves two or more teachers collaboratively planning, delivering, and assessing instruction. Team teaching allows educators to blend diverse expertise, teaching styles, and disciplinary perspectives, thus offering students a richer and more inclusive learning experience. In the context of Basic Science and Technology, team teaching enables interdisciplinary learning in bridging science, technology, and environmental concepts while catering to students' varied learning needs (Friend & Cook, 2016). Research has demonstrated that team teaching promotes improved classroom management, deeper student engagement, and differentiated instruction, all of which contribute to enhanced academic achievement (Smith et al., 2020; Adeyemi & Bello, 2020). It also provides teachers with professional development opportunities through peer mentoring, reflection, and shared evaluation of teaching practices (Davis & Winter, 2019). In a subject like BST, which demands both theoretical understanding and practical application, team teaching allows for more flexible learning, especially where classes are large or content is multidisciplinary. Moreover, students benefit from exposure to multiple perspectives and teaching styles, which cater to different learning preferences (Chinedu & Okonkwo, 2021).

In contrast, the lecture method remains the most commonly used instructional approach in Nigerian secondary schools. This method, which is predominantly teacher-centered, involves one-way communication where the teacher delivers information and students act as passive recipients. While the lecture method is efficient for content delivery and suitable for large classes, it often fails to engage learners cognitively and affectively. Studies have shown that students taught using lectures tend to exhibit poor understanding, low retention, and limited critical thinking abilities (Eze & Ogbonna, 2024). The continued dominance of this approach in science classrooms has contributed significantly to the persistent underperformance of students in Basic Science and Technology, particularly in Delta State (Okoro & Eze, 2020). Moreover, few studies have integrated gender as a moderating variable in assessing how these teaching strategies influence achievement. This gap underscores the necessity of the present study, which seeks to provide evidence-based insights that can inform instructional improvement, teacher training, and educational policy development in Delta State and beyond. In light of this, the study set out to examine the effects of experimental and team-teaching strategies on secondary school students' academic achievement in basic science and technology in Delta State.

Statement of the Problem

The persistent poor performance of secondary school students in Basic Science and Technology in Delta State has become a source of concern for educators, parents, and policymakers. Despite the subject's significance in equipping students with essential skills for technological advancement and industrialization, many students continue to exhibit poor understanding and application of Basic Science and Technology concepts, as evidenced by declining examination scores and limited interest in technology-related careers (Okoro & Eze, 2020). Several factors have been attributed to this underachievement such poor learning environment, including inadequate teaching methods that fail to engage students effectively and promote deep learning. Traditional lecture-based approaches, which dominate many classrooms, often result in passive learning, limited critical thinking, and poor retention of knowledge (Akinbobola & Adeleke, 2018). Additionally, the lack of collaborative teaching practices limits the diversity of instructional strategies and resources available to students, thereby impeding their learning experiences and outcomes.

Efforts to address these challenges necessitate the exploration of innovative and student-centered teaching methods such as experimentation and team teaching. While some schools have attempted to integrate these approaches, their implementation remains inconsistent and largely unassessed in terms of effectiveness within the specific context of Delta State's educational system. Moreover, there is limited empirical evidence comparing the impacts of these methods on students' academic achievement in Basic Science and Technology, making it difficult to determine the most effective instructional strategies for improving learning outcomes. The lack of comprehensive research in this area poses a significant gap in educational practice and policy formulation. Without concrete evidence on the efficacy of experimentation and team-teaching strategies, educators may continue to rely on ineffective teaching practices, thereby perpetuating students' poor performance and hindering the development of essential technological competencies. Therefore, this study seeks to fill this gap by systematically examining the effects of experimentation and team-teaching strategies on secondary school students' academic achievement in Basic Science and Technology in Delta State. The study aims to provide empirical data that can inform instructional practices and educational policies, ultimately contributing to improved student performance and the advancement of technology education in Delta State.

Purpose of the Study

The main purpose of the study is to investigate the effect of experimentation, team teaching strategies, and lecture method on secondary school student's academic achievement in Basic Science and Technology in Delta State. Specifically, the study sought to:

1.determine the effects of experimentation, team teaching strategies and lecture methods on the academic achievement scores of secondary school students taught Basic Science and Technology in Delta State.

2.determine the effects of the interaction between methods (experimentation, team teaching strategies and lecture methods) and sex on student's academic achievement in Basic Science and Technology in Delta State.

Research Questions

The study seeks to answer the following research questions:

1.What are the effects of experimentation, team teaching strategies and lecture methods on the academic achievement scores of secondary school students taught Basic Science and Technology in Delta State?

2, What is the effects of the interaction between methods (experimentation, team teaching strategy and lecture methods) and sex on student's academic achievement in Basic Science and Technology in Delta State?

Research Hypotheses

The following null hypotheses will be tested in this study at 0.05 level of significance;

1.There is no significant effects in the academic achievement scores of students taught Basic science and Technology using experimentation, team teaching strategy and lecture methods in Basic Science and Technology in Delta State

2.There is no significant difference in the interaction between methods (experimentation, team teaching strategies and sex on student's academic achievement in Basic Science and Technology in Delta State.

Research Method

This study adopted a quasi-experimental design, specifically the pre-test, post-test and non-equivalent control group design. This design was selected because it is the most appropriate for real-world educational settings where random assignment of subjects into experimental and lecture method are either impractical or impossible. The target population of this study comprises 4451 Junior Secondary School Two (JSS 2) students offering Basic Science and Technology in public secondary schools across the three senatorial districts in Delta State (Delta North, Delta Central and Delta Central. The research sample consisted of 381 JS II basic science and technology students from six public secondary in Delta State. The study employs a multistage sampling technique to select its sample from the target population. The primary instrument for data collection was "Basic Science and Technology Achievement Test (BSTAT)" developed by the researcher. The BSTAT, the instrument used for data collection was validated by three experts: a curriculum specialist, basic science teacher and a lecturer in the department of measurement and evaluation. To establish the reliability of the BSTAT, a pilot study was conducted for two secondary schools namely; Ogbaru high secondary school, Ogboakuba and community secondary school Atani in Anambra state. These schools were not part of the actual sample. A KR-21 reliability coefficient of 0.89 was obtained aligning with the standard in educational measurement. This reliability coefficient indicated that the test items are homogenous and measured a single construct in this case, achievement in Basic Science and Technology. The primary treatment for the study involved instructing JSII basic science and technology students in their assigned groups utilizing the three instructional methods (Experimental, team teaching and lecture method). Following a six-week course of treatment, the students in each of the three groups took the rearranged BSTAT again, which was scored. Anova, Ancova and independent t-test was used to compare the data from the pretest and posttest of three groups.

Results

- What are the effects of experimentation, team teaching strategies and lecture methods on the academic achievement scores of secondary school students taught Basic Science and Technology in Delta State?

Table 1: Descriptive Statistics of Students' Academic Achievement Scores

Instructional method	N	Pretest mean	Pretest SD	Posttest mean	Posttest SD	Mean gain
Experimental	127	21.35	3.42	26.52	3.36	5.17
Team Teaching	127	21.11	3.18	27.09	3.44	5.98
Lecture	127	21.44	3.26	23.33	3.57	1.89
Total	381					

- The result in Table 4.1 shows that students taught using the Team-Teaching Strategy had the highest posttest mean score (M = 27.09), followed by those taught through the Experimental Method (M = 26.52), while those taught using the Lecture Method recorded the lowest posttest mean (M = 23.33). This indicates that both Team Teaching and Experimentation enhanced students' academic achievement more effectively than the Lecture Method. The results also showed that there is increase in performance in the post test treatment over pretest in both experimental (5.17), team teaching (5.98) and lecture method (1.89).
- To further determine whether the observed differences were statistically significant, an ANCOVA was conducted using pretest scores as covariate.

- **Table 2: ANCOVA Summary for the Effect of Instructional Method on Academic Achievement**

Source	Sum of square	Df	Mean square	F	Sig
Covariate (pretest)	128.47	1	128.47	11.26	0.001
Method (treatment	612.54	2	306.27	26.81	0.000
Error	1985.12	378	11.28		
Total	2726.13	380			

- The ANCOVA results in Table 4.2 show that there was a statistically significant effect of instructional method on students' academic achievement, $F(2,378) = 26.81$, $p < 0.05$. This implies that the type of teaching method used had a significant influence on the academic performance of students in Basic Science and Technology.
- To identify the direction of the difference, a post hoc (Tukey HSD) test was conducted.

- **Table 3: Post Hoc Comparison of Mean Differences by Instructional Method**

Group Comparison	Mean difference	Sig	Remark
Team-lecture	3.76	0.000	Significant
Experimental-lecture	3.19	0.000	Significant
Team-Experimental	0.57	0.412	Not significant

- The post hoc result in Table 3 indicates that both Team Teaching and Experimental methods significantly outperformed the Lecture Method. However, there was no significant difference between the Team Teaching and Experimental groups.

Comparison of the Academic Achievement of Students taught using the Various Methods and Strategy

- The results presented in Tables 1 show clear differences in academic achievement across the three groups. Team teaching strategy have the highest mean score (27.09), followed by experimental method (26.55) and lecture method have the lowest mean score (23.33). The post hoc test further revealed that while both the Experimental and Team-teaching strategies yielded significantly higher achievement scores than the Lecture Method,
- To determine if there is significance in the mean academic achievement scores of the students taught using the various methods and strategy, a one-way ANOVA was conducted.

- **Table 4: One-Way ANOVA on Differences in Mean Achievement Scores**

Source	SS	Df	MS	F	p-value
Between Groups	6482.34	2	3241.17	42.97	0.000*
Within Groups	12954.18	378	73.20		
Total	19436.52	380			

Table 4 showed that p-value is less than 0.05. This means there is a significant difference in the mean academic achievement scores among students taught using Experimental, Team Teaching, and Lecture Methods. Thus, Hypothesis Two (HO_2) stating there is no significant difference in the mean achievement scores is rejected.

- What is the effects of the interaction between methods (experimentation, team teaching strategies and lecture methods) and sex on student's academic achievement in Basic Science and Technology in Delta State?

- **Table 5: Mean and Standard Deviation of Students' Posttest Scores by Instructional Method and Gender**

Instructional method	Gender	Mean	SD
Experimental	Male	24.33	3.80
Experimental	Female	25.04	2.95
Team	Male	25.28	3.10
Team	Female	23.44	2.99
Lecture	Male	23.98	4.11
Lecture	Female	25.88	3.85

- From Table 5, female students performed slightly better than their male counterparts in experimental method (mean score of female=25.05 and mean score of male=24.33) and lecture method (mean score of female=25.88 and that of male=23.98) while male students perform better than females in team teaching strategy (mean score of female=23.44 and mean score of male=25.28) indicating a minor gender effect favouring females.
- To determine the effect of instructional method and gender on the academic achievement score of students, a two-ANOVA was done.

- **Table 6: Two-Way ANOVA Summary for the Effect of Instructional Method and Gender on Academic Achievement**

Source	SS	Df	MS	F	P-value
Instructional Methods	3521.47	2	1760.73	24.55	0.000
Gender	184.29	1	184.29	2.57	0.112
Error	12341.74	378	70.93		
Total	16047.48	380			

- The ANOVA results show that instructional method had a significant effect on students' academic achievement ($F(2,378) = 24.55$, $p < 0.05$). However, gender did not significantly affect academic achievement ($F(1,378) = 2.57$, $p > 0.05$). This indicates that differences in performance were primarily due to the teaching methods employed rather than gender differences.

Interaction Effect of Instructional Method and Gender on Academic Achievement

- Table 6 showed that males and females mean score differs across various instructional method and strategy. To determine the effect of interaction of the instructional method on gender, a two-way ANOVA was done.

- **Table 7: Two-Way ANOVA Summary for the Interaction Effect of Instructional Method and Gender on Academic Achievement**

Source	SS	Df	MS	F	p-value
Instructional Methods	3521.47	2	1760.73	24.21	0.000
Gender	184.29	1	184.29	2.53	0.144
Method×Gender	132.18	1	66.09	0.91	0.404
Error	12209.54	373	70.98		
Total	16047.48	377			

- As shown in Table 7, while the main effect of instructional method remained significant ($p <$

0.05), the interaction between instructional method and gender was not significant ($F(2,373) = 0.91$, $p > 0.05$). This implies that both male and female students benefited similarly from the instructional strategies. the effectiveness of a teaching method did not depend on gender. Thus, innovative teaching methods such as the experimental and team-teaching approaches improved learning outcomes for all students regardless of gender.

Discussion

The results in Table I and 2 revealed that students taught using Team Teaching and Experimental Methods achieved significantly higher mean scores than those taught using the Lecture Method. Specifically, the Team-Teaching strategy recorded the highest posttest mean score ($M = 27.09$), followed by the Experimental Method ($M = 26.52$), while the Lecture Method had the lowest ($M = 23.33$). The ANCOVA results ($F(2,378) = 26.81$, $p < 0.05$) confirmed a statistically significant effect of instructional method on students' achievement in Basic Science and Technology. The post hoc test further showed that both Team Teaching and Experimental groups significantly outperformed the Lecture group, but there was no significant difference between the two experimental groups. The results of the two-way ANOVA in Table 7 showed that the interaction effect between instructional method and gender on academic achievement was not significant ($F(2,373) = 0.91$, $p > 0.05$). This indicates that both male and female students benefited similarly from the instructional methods. The effectiveness of team teaching and experimental strategies was not dependent on gender. This finding corroborates Oladele (2021) and Ajibola and Salami (2025), who found that while initial performance differences may exist between genders, prolonged exposure to interactive learning strategies diminishes these disparities. It also aligns with Yusuf and Falade (2020), who concluded that the constructivist approach benefits all learners regardless of gender orientation. The non-significant interaction suggests that gender does not moderate the relationship between instructional methods and achievement once inclusive, hands-on, and participatory teaching strategies are adopted. This aligns with the position of Okafor and Emeka (2020) that the integration of multimedia and experiential learning neutralizes traditional gender gaps by catering to diverse learning preferences.

Conclusion

In conclusion, this study establishes that instructional method and gender are critical determinants of academic achievement in Basic Science and Technology. Effective teaching in the 21st century must therefore be inclusive, interactive, and diversified. Teachers are encouraged to move beyond traditional lecture-based methods and embrace more experiential and collaborative techniques that empower both male and female students to excel equally in science education.

Recommendations

In light of the study's findings, the following recommendations are made:

1.Teachers of Basic Science and Technology should employ more interactive, experimental, and collaborative strategies to promote deeper understanding and retention among students.

2.Teaching strategies should be designed to recognize and address gender differences in learning preferences and engagement.

3.Ministries of Education and school administrators should organize regular workshops and training sessions for teachers on modern instructional approaches, including team teaching and inquiry-based learning.

4.Curriculum developers should integrate flexible instructional approaches that encourage experimentation, teamwork, and inclusiveness in science education.
5.Schools should be adequately equipped with laboratory materials, instructional aids, and ICT tools to facilitate practical and participatory teaching.

RJPST

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