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Effect of Peer Tutoring on Biology Achievement Among Secondary School Students

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Abstract

This study investigated the effect of peer tutoring on the biology achievement of secondary school students in Epe Local Government Area (LGA) of Lagos, Nigeria. A quasi-experimental pretest-posttest control group design was adopted for the research. Two research questions and two hypotheses were formulated to guide the study. The sample consisted of two intact classes selected through simple random sampling, comprising 160 Senior Secondary II students. Data were collected using a 30-item multiple-choice Biology Achievement Test (BAT), with a reliability coefficient of 0.75, as determined by the Kuder-Richardson Formula 21 (KR-21). Mean and standard deviation were used to answer the research questions, while ANCOVA and t-test were employed to test the null hypotheses at a 0.05 level of significance. The findings revealed that peer tutoring significantly improved students' biology achievement, with students taught using peer tutoring outperforming those taught through conventional methods. Furthermore, the study found no significant difference in the effect of peer tutoring based on gender, indicating that both male and female students benefited equally from the method. It is recommended that peer tutoring be integrated into biology instruction, alongside other active learning strategies, to enhance students' academic achievement in the subject.

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Introduction

Education systems around the world strive to improve students' academic achievements, particularly in subjects like science, which is critical to global development (Xiong, 2024). Biology, one of the core science subjects, has historically presented challenges to secondary school students due to its conceptual and complex nature (Isma'il & Matazu, 2024). This has led to suboptimal performance in various educational contexts. To address these issues, educators are constantly exploring innovative pedagogical strategies that promote active learning and student engagement (Bhoi, 2024). Peer tutoring, a cooperative learning approach where students assist one another in mastering academic content, has garnered attention as a potential method to enhance achievement in Biology. Numerous studies suggest that peer tutoring can help improve students' understanding of difficult topics and foster an interactive learning environment (Ullah et al., 2018). This study explores the effect of peer tutoring on secondary school students' academic achievement in Biology, focusing on the mechanisms through which peer interactions can positively impact learning outcomes.

In many educational settings, students face significant challenges in grasping complex Biology concepts. Traditional instructional methods, often characterized by teacher-centered approaches, may not fully address individual students' learning needs, contributing to poor performance. To mitigate this, various collaborative learning strategies have been employed, with peer tutoring emerging as an effective alternative (Precious & Feyisetan, 2020). Peer tutoring has been the focus of numerous educational studies due to its potential to improve students' academic outcomes. Ain et al. (2023) describes peer tutoring as an instructional strategy where students work in pairs or small groups to provide mutual assistance, often resulting in improved academic performance for tutors. According to Ullah et al., (2018), peer tutoring in science subjects like Biology promotes higher retention rates, better conceptual understanding, and increased academic achievement. The authors found that when students engaged in peer tutoring, they were more likely to improve their test scores, as the process facilitated the breaking down of complex biological concepts into simpler, more manageable parts. This study examines how peer tutoring can enhance students' achievement in Biology by leveraging peer interactions for better learning outcomes.

Literature Review

Peer tutoring has its roots in collaborative and cooperative learning theories, which emphasize the social aspect of learning (Yang, 2023). Vygotsky's Social Learning Theory posits that students can learn effectively through interaction and shared experiences with their peers. According to Vygotsky, the Zone of Proximal Development (ZPD) is the gap between what a learner can do independently and what they can achieve with guidance from a more knowledgeable peer (Vygotsky, 1978). In peer tutoring, the tutor provides scaffolding that helps the

tutee reach higher levels of understanding and competency in a subject area, such as Biology.Further supported by Constructivist Learning Theory, which holds that learners actively construct knowledge by integrating new information with prior knowledge, peer tutoring allows both tutors and tutees to engage with Biology content through discussion, questioning, and problem-solving (Chuang, 2021). The reciprocal benefits of peer tutoring, where both tutor and tutee experience learning gains, underscore its potential as an effective pedagogical tool.

In secondary education, the need for effective strategies to teach Biology has become increasingly evident, especially as students struggle with abstract and complex content (Elkhidir, 2020). Fakiye (2021) examined the impact of peer tutoring on students' achievement in Biology and concluded that peer tutoring significantly enhanced students' performance compared to those who received only traditional teacher-centered instruction. The researchers attributed this improvement to the interactive nature of peer tutoring, where students could ask questions, receive immediate feedback, and work collaboratively to solve problems. Moreover, Canning et al., (2018) conducted a study on the effectiveness of peer tutoring in Biology and found that peer tutoring contributed to improved understanding and retention of complex biological topics, such as genetics and cell biology. Their findings highlight the importance of peer collaboration in learning difficult subjects, as tutees benefit from explanations that are often simpler and more relatable than those provided by teachers.

Different peer tutoring models, such as same-age and cross-age tutoring, have been explored in various educational contexts. Leung (2018) emphasize that the success of peer tutoring largely depends on how well it is structured and implemented. They noted that well-organized peer tutoring sessions, where both tutors and tutees have clear roles and learning objectives, are more likely to yield positive results. Research by Ogundola, (2016) also supports the use of peer tutoring as a method to foster student autonomy and responsibility in learning. Their study of Nigerian secondary schools revealed that peer tutoring improved students' problem-solving skills, critical thinking, and self-confidence, all of which contributed to better achievement in Biology.

The application of Vygotsky's Social Learning Theory and Piaget's Cognitive Development Theory in peer tutoring frameworks explains how social interactions between students can lead to deeper learning. Hayden(2020)assert that cooperative learning strategies like peer tutoring align with constructivist approaches, where students learn by actively engaging with the material and their peers. Peer tutoring fosters a learning environment where students co-construct knowledge, and the tutor reinforces their understanding by explaining concepts to the tutee. Despite its advantages, peer tutoring is not without challenges. Darling-Hammond et al. (2019), caution that the quality of tutoring may vary depending on the competence and preparation of the tutors. If tutors are not adequately trained or do not fully understand the material, they may provide incorrect information to their peers, which could negatively affect learning outcomes. Additionally, peer relationships

and social dynamics can influence the effectiveness of peer tutoring. As Tan and Evera (2020) note, students may be reluctant to engage with their peers if they feel intimidated or uncomfortable in a tutor-tutee role.

Peer tutoring has emerged as a valuable instructional strategy for improving students' achievement in various subjects, including Biology. Several studies highlight its benefits in enhancing understanding, retention, and student engagement. For instance, Ugwu et al. (2021) demonstrated that secondary school students in Nigeria achieved higher scores in Biology when taught through peer tutoring compared to traditional lecture methods. Peer tutoring encourages active learning, where students explain concepts to each other, reinforcing their knowledge and critical thinking skills (Ain et al., 2023). Eze and Dinneya (2022) reported that peer tutoring fostered a more interactive learning environment, leading to improved academic performance in Biology. However, factors such as tutor competence and content difficulty can impact the effectiveness of this method. Ratanarajah et al. (2020) pointed out that peer tutoring might not always lead to better outcomes when tutors lack sufficient knowledge. Moreover, Ihekwoaba et al. (2020) observed that social dynamics, such as participation inequality between genders, could affect peer tutoring outcomes. Despite these challenges, most studies agree that peer tutoring, when properly structured, significantly enhances Biology achievement, making it a viable instructional strategy for secondary schools.

Peer tutoring presents a promising approach to improving secondary school students' achievement in Biology. By leveraging the collaborative and interactive nature of peer learning, students can better understand and retain complex biological concepts. However, careful planning and implementation are required to ensure its effectiveness, including the proper training of tutors and the establishment of structured tutoring sessions. The problem addressed by the current study investigates the effect of peer tutoring on secondary school students' achievement in Biology looking at the moderating effect of gender.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean achievement scores of students' taught Biology using Peer tutoring method and Lecture method?
2. What is the difference between the mean achievement scores of male and female students' taught Biology using Peer tutoring method and Lecture method?

Hypotheses

The following null hypothesis was tested at 0.05 level of significance.

H_O1: There is no significant difference between the mean achievement scores of students taught Biology using Peer tutoring method and those taught using Lecture method.

H_O2: There is no significant difference between the mean achievement scores of male and female students taught Biology using Peer tutoring method and those taught using Lecture method.

Method

This study employed a quasi-experimental pretest-posttest control group design, which utilized intact classes rather than randomly assigning participants to groups. This approach was necessitated by ethical and practical constraints associated with the educational setting. The design involved two groups: an experimental group that received the intervention and a control group that did not. Both groups completed a pretest prior to the intervention and a posttest following its conclusion.

The sample consisted of two intact Senior Secondary II (SS II) biology classes, selected through simple random sampling to enhance representativeness and reduce potential selection bias. The intervention aimed to measure its impact on students' academic performance and engagement with the subject matter.

Data analysis was conducted using both descriptive and inferential statistical methods. Descriptive statistics, including mean and standard deviation, were used to summarize students' performance in the pretest and posttest. Analysis of Covariance (ANCOVA) was applied to control for baseline differences in pretest scores between the groups, ensuring that observed posttest differences were attributable to the intervention. Furthermore, an independent samples t-test was employed at a significance level of 0.05 to evaluate whether the differences in posttest scores between the experimental and control groups were statistically significant.

This methodological approach ensured rigor and provided a robust framework for assessing the efficacy of the intervention.

Results

Research question 1: What is the difference between the mean achievement scores of students' taught Biology using Peer tutoring method and Lecture method?

The data in Table 1revealed that the mean gain achievement scores of students taught using peertutoring method was 15.33 while that of students taught using lecture method was 9.56. Students taught using peer tutoring has the highest mean gain scores than those taught with lecture methods.

Table 1. Mean Achievement Scores of Students taught biology using Peer tutoring method and Lecture method

Group	Symbol	Pre-Test	Post-Test	Mean Gain
Peer tutoring	N	80	80	15.33
(experimental)	X	12.15	27.48	
	SD	1.44	1.77	
Lecture method (control)	N	80	80	9.56
	X	11.1	20.66	
	SD	0.76	3.25	

N=Number of subjects, X = Mean and SD = Standard deviation

Table 2 shows the achievement of male and female senior secondary school students taught biology using Peer tutoring method and Lecture method. The mean achievement score of male students was 27.34 while the standard deviation was 0.75; the female students have a posttest mean achievement score of 27.56 and the standard deviation of 0.77 in the biology achievement test. This means that gender did not have any effect on the mean achievement scores of students. By implication, gender as a factor did not contribute to the differences in the posttest means scores of the subjects.

Table 2. Mean Achievement Scores of Male and Female Students taught Biology using Peer tutoring method

Gender	N	Mean	SD	STD Error
Male	32	27.34	0.75	0.13
Female	48	27.56	0.77	0.11

N = number of subjects; SD = Standard deviation

Ho1: There is no significant difference between the mean achievement scores of students taught Biology using Peer tutoring method and those taught using Lecture method.

Table 3 shows the ANCOVA of the mean achievement scores of students who experienced peer tutoring and Lecture method in the teaching of biology ($[F_{(302.949)} = .659; p > 0.05]$. The result suggested a statistical significant difference between the peer tutoring method group and the lecture method group. A post-hoc test presented in table 4 indicated the direction of the effect.

Table 3. Analysis of Co-variance on Achievement of Students' taught Biology using Peer tutoring and those taught using Lecturer method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig	Partial eta Squared
Corrected Model	1856.753	2	928.376	166.104	.000	.679
Intercept	1796.216	1	1796.216	321.378	.000	.672
Pre test	.347	1	.347	.062	.804	.000
Post test	1693.218	1	1693.218	302.949	.000	.659
Error	877.491	157	5.589			
Total	95423.000	160				
Corrected Total	2734.244	159				

The result in Table 4 shows that the mean difference between the peer tutoring group and the lecture method group was 6.84, the mean difference between the two groups is statistically significant (p=.000); hence, the null hypothesis 1 is hereby rejected.

Table 4. Pair-wise comparison of student's scores in Biology

Treatment	Mean difference	Std. Error	Sig	95% confidence interval for difference	
				Lower Bound	Upper Bound
Peer tutoring	6.843	.393	.000	-7.619	-6.066
Lecture method	-6.843	.393	.000		

Ho2: There is no significant difference between the mean achievement scores of male and female students taught Biology using Peer tutoring method and those taught using Lecture method.

Table 5: T-test Analysis of Mean Achievement Scores of Male and Female Students taught Biology using Peer tutoring method

Group	N	X	Sd	D f	T- cal	Sig	Decision
Male	3 2	27.34	0.75	7 8	1.27	0.209	Accepted
Female	4 8	27.56	0 .77				

Significant at p<0.05

Table 5 shows that female students (X = 27.56) have higher mean achievement scores than theirmale counter parts (X = 27.34), this difference is however not statistically significant at 0.05 alpha level (t = 1.27; df = 78; p <. 05). Therefore, the null hypothesis 2 is hereby accepted.

Discussion

The research result shows that students taught Biology using peer tutoring tend to achieve higher mean scores compared to those taught through traditional lecture methods. For instance, Ugwu et al., (2021), in their study of Nigerian secondary schools, found that peer tutoring significantly improved students' understanding and retention of complex Biology topics compared to the lecture method. This finding is supported by Ain et al., (2023), who reported similar results in a study conducted across several countries, indicating that peer tutoring fosters greater engagement and allows students to clarify concepts through collaboration, reinforcing their knowledge and critical thinking skills leading to better academic outcomes. Moreover, Eze & Dinneya (2022), in their research on Nigerian secondary school students, demonstrated that peer tutoring led to higher mean achievement scores, as students were more active in their learning process and able to ask questions freely, which is often not the case in the passive lecture environment. Similarly, Fakiye (2021) found that Nigerian students who participated in peer tutoring sessions outperformed their peers who received teacher-centered instruction in Biology, largely due to the interactive nature of the tutoring sessions.

However, some studies present conflicting evidence. Ratanarajah et al. (2020) argued that peer tutoring may not always result in better performance, particularly when tutors lack sufficient subject knowledge. In such cases, the lecture method, delivered by an expert teacher, provided clearer and more structured explanations, leading to better outcomes. Thus, while the majority of studies, both in Nigeria and internationally, support the superiority of peer tutoring in improving Biology achievement, some caution that its effectiveness depends on the tutors' competence and the nature of the material being taught.

Further research result indicates that there is no significant difference in the mean achievement scores of male and female students taught Biology using the peer tutoring method. For example, Ugwu et al., (2024) conducted a study in secondary schools in Nsukka Local Government Area of Enugu State and found that both male and female students benefited equally from peer tutoring, with no significant gender differences in their academic performance. This finding is consistent with the research of AbdulRaheem (2017), who analyzed the impact of peer tutoring and reported that the method was effective for students regardless of gender, as both male and female students experienced similar improvements in achievement. They suggested that the collaborative and supportive nature of peer tutoring creates an inclusive learning environment where both genders are equally engaged and motivated to succeed.

On the contrary, some studies argue against this finding. Ihekwoaba et al., (2020) reported that in certain educational contexts, male students tended to benefit more from peer tutoring than female students, citing social dynamics and participation levels as contributing factors. They suggested that in some cases, male

students were more confident in taking leadership roles during tutoring sessions, which could lead to a slight performance edge. However, Aniaku et al., (2021) found minimal evidence to support a significant gender disparity in peer tutoring outcomes, emphasizing that differences in performance, if any, were more likely attributable to individual student characteristics than to gender.

While peer tutoring offers significant benefits, certain challenges may limit its effectiveness if not properly managed. A primary concern is the risk of misinformation since peer tutors, who are also learners, might unintentionally share incorrect information, potentially leading to misconceptions. This emphasizes the teacher's essential role as a facilitator and quality controller. Through active supervision and timely feedback, teachers can help ensure that students are sharing accurate information. Time management is another concern, as peer tutoring often requires more time than traditional methods, particularly in large classrooms with limited one-on-one attention. To address this, teachers should set clear goals, allocate specific time slots, and define roles within each session, making sessions more focused and efficient. In summary, while peer tutoring fosters an engaging and collaborative learning environment, it demands careful planning and active teacher involvement. By managing these challenges effectively, teachers can help students maximize the benefits of peer tutoring, enhancing their engagement and comprehension.

Conclusion

Based on the findings of this study, peer tutoring significantly enhances students' achievement in Biology compared to traditional lecture methods. By fostering an interactive and collaborative learning environment, peer tutoring allows students to clarify complex concepts, ask questions openly, and learn at their own pace, all of which contribute to improved academic performance. This method proves effective for both male and female students, with no significant gender differences in achievement, demonstrating that peer tutoring is an inclusive and equitable teaching approach.

However, the success of peer tutoring is influenced by several key factors that can either enhance or limit its effectiveness across various contexts. Tutor competence is crucial; tutors with a strong understanding of Biology are more likely to accurately convey concepts, reducing the risk of misinformation. In cases where tutors are less experienced, teacher supervision and structured guidance are essential to ensure information accuracy and conceptual clarity. Classroom size and time constraints also play a significant role. In larger classrooms, it becomes more challenging for teachers to provide oversight, making it necessary to implement smaller, well-organized groups to maintain focus and quality. Additionally, the complexity of the material can affect outcomes; peer tutoring works well for foundational topics, but more complex areas may require added teacher support or supplemental materials.

Despite occasional conflicting evidence, extensive studies in both Nigeria and international contexts generally support the effectiveness of peer tutoring in diverse learning environments. When implemented thoughtfully—taking into account tutor competency, classroom structure, material complexity, and adequate teacher involvement—peer tutoring stands out as a powerful, student-centered instructional strategy for Biology education in secondary schools.

Recommendations

1. Schools should consider incorporating structured peer tutoring programs into their Biology curriculum. Teachers can select capable student tutors, train them on effective tutoring techniques, and supervise tutoring sessions to ensure accuracy and effectiveness.
2. Tutors should receive adequate training to improve their understanding of Biology concepts and enhance their ability to explain these concepts clearly to their peers. This training will help minimize the risk of misinformation and ensure the sessions are productive.
3. Since there are no significant gender differences in the effectiveness of peer tutoring, schools should adopt gender-inclusive strategies that encourage both male and female students to participate actively in peer tutoring programs.
4. Regular monitoring and assessment should be conducted to evaluate the impact of peer tutoring on student achievement. Schools should collect feedback from students and tutors to improve the quality of tutoring sessions.
5. Given its success in Biology, peer tutoring can be expanded to other science subjects, such as Chemistry and Physics, to enhance student learning and performance in these areas as well.

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