



The Impact of Dalton Instructional Model and Reciprocal Peer Tutoring on Students' Interest and Academic Performance in Basic Science Within the Akwanga Local Government Area of Nasarawa State, Nigeria.

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ABSTRACT

This research examined the effects of the Dalton Instructional Model and Reciprocal Peer-Tutoring on students' interest and academic performance in Basic Science in the Akwanga Local Government Area of Nasarawa State, Nigeria. The study was motivated by concerns over students' disinterest and low academic achievement in Basic Science, emphasizing the need for more engaging teaching strategies. A quasi-experimental pretest-posttest non-equivalent control group design was employed. The total population consisted of 13,200 students, from which a sample of 388 was selected. Schools were chosen using both cluster sampling and simple random sampling methods. Three groups were established: one utilizing the Dalton Instructional Model (130 students), another practicing Reciprocal Peer-Tutoring (129 students), and a conventional teaching group (129 students). Data collection was carried out using two instruments: The Basic Science Interest Inventory (BSII) and the Basic Science Performance Test (BSPT), both validated by experts and confirmed for reliability through appropriate internal consistency measures. Mean and standard deviation were used to analyze the research questions, while Analysis of Covariance (ANCOVA) was applied to test the null hypotheses at a significance level of 0.05. The results revealed that the Dalton group experienced an increase in interest from a pretest mean of 2.31 to a posttest mean of 3.72, the Reciprocal Peer-Tutoring group improved from 2.30 to 3.67, and the conventional group rose from 2.29 to 3.08. Regarding academic performance, the Dalton group increased from 28.46 to 68.41, the Reciprocal Peer-Tutoring group from 28.61 to 70.26, and the conventional group from 28.72 to 49.37. ANCOVA results indicated significant treatment effects on both interest, $F(2,384) = 85.91$, $p < .001$, and academic performance, $F(2,384) = 197.21$, $p < .001$. The study concluded that both the Dalton Instructional Model and Reciprocal Peer-Tutoring were effective in enhancing students' interest and performance in Basic Science. It was recommended that Basic Science teachers should incorporate learner-centered and collaborative teaching strategies into their classroom practices.

Keywords: Dalton Instructional Model, Reciprocal Peer-Tutoring, Basic Science, student engagement, academic success, learner-centered instruction

INTRODUCTION

Basic Science is crucial in the education of junior secondary school students in Nigeria. This subject provides learners with fundamental knowledge about scientific concepts, processes, and their applications in the real world, laying a strong foundation for further studies in various scientific disciplines. It also develops skills in observation, investigation, critical thinking, and the practical application of knowledge in daily life. Consequently, effective teaching and learning of Basic Science are essential for cultivating scientifically literate individuals and preparing students for future careers in science.

However, achieving these goals largely depends on the teaching methods employed by educators. Basic Science includes concepts that promote observation, investigation, discussion, experimentation, and the application of knowledge, rather than merely memorizing facts. Therefore, teaching strategies that actively engage students are likely to be more effective than those that treat them as passive recipients of information.



Recent research conducted in Nigeria indicates that learner-centered teaching methods can significantly enhance students' interest and academic performance in Basic Science. For example, Audu and Obadiah (2025) found that students who were taught using the jigsaw instructional strategy showed much greater engagement in Basic Science than those who experienced traditional teaching methods. Their study involved 209 Junior Secondary II students and employed a quasi-experimental design. In a similar vein, Chiekwe et al. (2025) discovered that guided discovery teaching notably increased students' interest in Basic Science compared to conventional teaching approaches.

Interest in a subject is essential as it can greatly influence students' attention, participation, motivation, and persistence in their learning endeavors. When students are truly interested, they are more likely to engage actively and invest the effort required to understand difficult concepts. Ongoing research in Nigerian Basic Science continues to emphasize the critical role that instructional strategies play in shaping students' emotional responses to learning science (Audu & Obadiah, 2025; Ahmed, 2025). For instance, a 2025 study on the Active Review Strategy examined how this interactive teaching method affected students' attitudes toward Basic Science.

Academic performance is a crucial measure of the effectiveness of teaching methods. It's important for students not only to develop a positive attitude towards Basic Science but also to demonstrate their understanding and application of scientific concepts. Recent research has shown that inquiry-based and collaborative teaching strategies can significantly improve academic outcomes. For instance, Idris and Yusuf (2025) observed marked differences in the interest and achievement of Basic Science students when comparing guided inquiry to traditional teaching methods.

One effective teaching strategy that can boost student engagement is the Dalton Instructional Model. This method emphasizes learner responsibility, independence, and self-paced learning through task-based activities, collaboration, and support from teachers. Rather than depending solely on lectures, students are encouraged to take control of their learning by working on well-defined tasks. Ongoing studies are examining the effects of Dalton-based instruction, particularly its influence on fostering learner autonomy. Qi et al. (2025) explored how the Dalton Plan affects learner independence and found it to be quite significant in promoting self-directed learning.

One effective strategy that places learners at the forefront is Reciprocal Peer-Tutoring (RPT). In this method, students' alternate roles as tutor and tutee, which allows them to explain concepts, pose questions, provide feedback, and resolve any misunderstandings. This dynamic transforms the classroom into an engaging learning environment and enables students to learn from one another.

Recent studies support the benefits of peer tutoring, particularly in STEM disciplines. A 2025 meta-analysis that reviewed 24 studies involving 3,311 participants found that peer tutoring significantly enhanced academic performance, achieving a remarkable effect size of 1.23, along with positive effects on various other learning outcomes.

Despite the increasing evidence favoring learner-centered approaches, there remains a lack of research directly comparing the Dalton Instructional Model and Reciprocal Peer-Tutoring in Basic Science, especially in the Akwanga Local Government Area of Nasarawa State. This study aims to investigate how these two teaching methods influence students' interest and academic success in Basic Science.

Statement of the Problem

The goal of Basic Science education is to improve students' understanding of scientific concepts, enhance their practical skills, develop problem-solving abilities, and cultivate a positive attitude towards science. However, the effectiveness of these objectives often depends on the teaching methods employed by educators.

Recent research conducted in Nigeria indicates that when teachers implement active and student-centered instructional strategies, there can be a noticeable increase in students' interest and academic performance. For instance, a study by Audu and Obadiah (2025) found that students who participated in jigsaw instruction

showed significantly greater interest compared to those who were taught using traditional methods. Similarly, Chiekwe et al. (2025) observed a significant rise in interest in Basic Science following the use of guided discovery instruction.

Moreover, peer tutoring has emerged as an effective strategy for improving learning outcomes. A 2025 meta-analysis on peer tutoring in STEM disciplines highlighted a considerable positive effect on academic achievement.

Despite these insights, there remains a gap in empirical evidence regarding the effectiveness of the Dalton Instructional Model and Reciprocal Peer-Tutoring in Basic Science classrooms in the Akwanga Local Government Area. Specifically, it is still uncertain whether these methods can enhance students' interest and academic performance more effectively than traditional teaching approaches, or which of the two methods is superior.

Therefore, this study seeks to investigate the impact of the Dalton Instructional Model and Reciprocal Peer-Tutoring on students' interest and academic performance in Basic Science within the Akwanga Local Government Area of Nasarawa State.

Aim of the Study

The main aim of this study was to investigate how the Dalton Instructional Model and Reciprocal Peer-Tutoring influence students' interest and academic performance in Basic Science in the Akwanga Local Government Area of Nasarawa State.

Objectives of the Study

This study set out to accomplish the following specific objectives:

- i. To explore the effect of the Dalton Instructional Model on students' interest in Basic Science;
- ii. To analyze how Reciprocal Peer-Tutoring impacts students' interest in Basic Science;
- iii. To evaluate the effect of the Dalton Instructional Model on students' academic performance in Basic Science;
- iv. To assess the influence of Reciprocal Peer-Tutoring on students' academic performance in Basic Science;
- v. To compare the levels of interest among students taught using the Dalton Instructional Model, Reciprocal Peer-Tutoring, and traditional teaching methods; and
- vi. To examine the academic performance of students taught through the Dalton Instructional Model, Reciprocal Peer-Tutoring, and conventional teaching strategies.

Research Questions

This study was guided by the following research questions:

- i. What differences exist in the average interest scores of students learning Basic Science through the Dalton Instructional Model compared to those taught using traditional methods?
- ii. How do the average interest scores of students taught Basic Science with Reciprocal Peer-Tutoring compare to those taught through conventional teaching?
- iii. What variations can be found in the average academic performance scores of students learning Basic Science via the Dalton Instructional Model versus those using traditional teaching methods?
- iv. How do the average academic performance scores of students taught Basic Science through Reciprocal Peer-Tutoring stack up against those taught with conventional methods?
- v. What differences are observed among the average interest scores of students taught using the Dalton Instructional Model, Reciprocal Peer-Tutoring, and conventional teaching?
- vi. What differences can be noted among the average academic performance scores of students taught using the Dalton Instructional Model, Reciprocal Peer-Tutoring, and conventional teaching?



Research Hypotheses

The following null hypotheses were tested at a significance level of 0.05:

H01: There is no significant difference in the average interest scores of students taught Basic Science using the Dalton Instructional Model, Reciprocal Peer-Tutoring, and conventional teaching.

H02: There is no significant difference in the average academic performance scores of students taught Basic Science using the Dalton Instructional Model, Reciprocal Peer-Tutoring, and conventional teaching.

H03: The Dalton Instructional Model does not significantly influence students' interest in Basic Science when compared to conventional teaching.

H04: Reciprocal Peer-Tutoring does not significantly impact students' interest in Basic Science when compared to conventional teaching.

H05: The Dalton Instructional Model does not significantly affect students' academic performance in Basic Science compared to conventional teaching.

H06: In comparing Reciprocal Peer-Tutoring with traditional teaching methods, there seems to be no notable effect on students' academic performance in Basic Science.

Significance of the Study

This research is important for various stakeholders, including Basic Science teachers, students, school administrators, teacher educators, curriculum developers, and researchers. Basic Science teachers can learn about alternative teaching strategies that encourage active participation, increase interest, and improve academic performance among students. Students can benefit from enhanced opportunities for independent learning, peer collaboration, and joint problem-solving. School administrators can use the findings to create professional development programs that assist teachers in adopting student-centered approaches. Teacher education institutions may find the results useful in training future educators with methods that foster active learning. Curriculum developers can also apply these insights to promote learner-centered strategies in the Basic Science curriculum. Finally, researchers can build on this study to explore other science subjects, different educational settings, gender groups, and various educational levels.

This study is crucial for various stakeholders, including Basic Science teachers, students, school administrators, teacher educators, curriculum planners, and researchers.

For Basic Science teachers, the findings can provide valuable insights into alternative teaching methods that promote active student engagement, ignite their interest, and improve academic performance.

Students will benefit from enhanced opportunities for independent learning, collaboration with peers, and problem-solving in a supportive setting.

School administrators can use the results to create professional development programs that encourage teachers to adopt learner-centered strategies.

Teacher education institutions may find the outcomes useful in equipping future educators with teaching methods that promote active learning.

Curriculum planners can also apply these findings to support the implementation of learner-centered approaches in the Basic Science curriculum.

Finally, researchers might use this study as a basis for further exploration across various science subjects, school environments, gender groups, and educational levels.



Scope of the Study

This research examined the effects of the Dalton Instructional Model and Reciprocal Peer-Tutoring on students' interest and academic performance in Basic Science. It specifically targeted students from the Akwanga Local Government Area in Nasarawa State. The independent variable in this study was the instructional strategy, which encompassed three different methods: the Dalton Instructional Model, Reciprocal Peer-Tutoring, and traditional teaching techniques. The dependent variables were the students' interest and their academic performance in Basic Science.

REVIEW OF LITERATURE

Concept of Basic Science

Basic Science is an extensive field designed to provide learners with crucial insights into the natural and physical world. It integrates elements of biology, chemistry, physics, earth science, and technology, forming a strong foundation for further scientific inquiry.

To effectively engage students, teaching Basic Science should motivate them to observe their environment, ask questions, engage in hands-on activities, share their findings, and apply their knowledge. This highlights the importance of teaching methods that encourage active learning in this subject.

Recent research in Nigeria indicates that the approach to teaching Basic Science can greatly influence students' interest and academic success. For example, Audu and Obadiah (2025) found that implementing jigsaw instruction significantly increased students' interest. Likewise, Idris and Yusuf (2025) noted that when guided inquiry was compared to traditional expository teaching, there were noticeable differences in both interest and achievement levels among students.

The Dalton Instructional Model is based on the Dalton Plan, created by Helen Parkhurst. This model emphasizes important principles like learner responsibility, independence, collaboration, purposeful assignments, and teacher support.

What makes this approach unique is its focus on empowering students to take control of their own learning. Instead of depending solely on traditional whole-class instruction, students are given specific tasks and encouraged to either work on their own or collaborate with peers, with teachers available to provide guidance as necessary.

In the current educational environment, the emphasis on learner autonomy is still prominent in Dalton-based instruction. Research by Qi et al. (2025) shows that the principles of the Dalton Plan remain relevant in contemporary teaching methods.

This model is especially effective for Basic Science education, as many scientific concepts can be taught through structured activities, investigations, assignments, and hands-on tasks. For example, students might engage in problems that involve observation, measurement, classification, experimentation, and interpreting results.

When considering students' interest, it includes their curiosity, enjoyment, attention, and willingness to participate in learning activities. The Dalton approach can boost this interest by giving learners more responsibility and promoting active involvement in their education.

Additionally, the ability to work at their own pace and collaborate with classmates can make the learning experience feel less restrictive. Students can take ownership of their assignments while also having the option to seek assistance from their teachers whenever they need it.

This argument is supported by recent research that shows how active, learner-centered approaches can ignite students' interest in Basic Science. For example, Audu and Obadiah (2025) discovered that students who



participated in jigsaw instruction exhibited a heightened interest, while Chiekwene et al. (2025) reported an increase in interest following the use of guided discovery instruction.

When discussing academic performance, we refer to how effectively students can showcase their knowledge and understanding after receiving instruction. The Dalton model may improve performance by providing students with various opportunities to engage with learning tasks.

Assignment-based learning allows students to practice concepts independently, while teacher consultations help identify and address any misunderstandings. Additionally, collaborative activities enable students to share and compare their explanations and solutions.

The effectiveness of learner-centered strategies is further supported by recent studies in Basic Science. Idris and Yusuf (2025) noted differences in students' academic outcomes when comparing guided inquiry to traditional expository teaching. Therefore, methods that encourage active participation are likely to result in improved academic performance.

Dalton Instructional Model and Academic Performance

When discussing academic performance, we focus on how effectively students demonstrate their knowledge and understanding after instruction. The Dalton approach enhances this performance by providing students with numerous opportunities to engage deeply with their learning tasks.

Through assignment-based learning, students can practice concepts independently, while teacher consultations help identify and address any misunderstandings. Additionally, collaborative activities allow students to share their explanations and solutions, enriching their overall learning experience.

Recent research in Basic Science supports the effectiveness of learner-centered methods. For example, Idris and Yusuf (2025) observed significant differences in students' academic outcomes when comparing guided inquiry to traditional expository teaching. This indicates that approaches promoting active participation can truly impact academic performance.

Reciprocal Peer-Tutoring (RPT) is an engaging teaching strategy where students alternate roles as tutors and tutees. Unlike traditional peer tutoring, which typically has one student always in the role of the helper, RPT enables all participants to take turns in both teaching and learning.

In this model, students partake in a variety of activities such as explaining concepts, posing questions, summarizing important points, providing corrections, and evaluating each other's understanding. These exchanges foster a collaborative environment where students can collectively enhance their knowledge.

This method aligns well with constructivist learning theories, as it promotes active participation in the learning process. A recent meta-analysis conducted in 2025 revealed a notable positive effect of peer tutoring on academic performance and other educational outcomes, particularly in STEM fields.

Reciprocal Peer-Tutoring and Students' Interest

Reciprocal Peer-Tutoring (RPT) can significantly enhance student interest by shifting the classroom atmosphere from a teacher-centered approach to a more interactive setting where students learn from each other. When students take on the role of tutors, they become more engaged in their own learning. They must organize their thoughts to explain concepts clearly, while their peers, the tutees, can ask questions and seek clarification. This exchange not only boosts confidence but also increases overall engagement.

Recent research from Nigeria supports this notion. A study conducted by Audu and Obadia (2025) found that implementing jigsaw instruction notably heightened interest in Basic Science. Additional studies have also reported positive emotional outcomes when employing learner-centered methods.



Reciprocal Peer-Tutoring and Academic Performance

RPT can lead to enhanced academic performance through various mechanisms such as explanation, retrieval, questioning, feedback, and reinforcement. When students explain concepts to their peers, they must delve into their own understanding and organize relevant information. The questions raised by the tutee can reveal any misunderstandings that need to be clarified.

A recent meta-analysis of STEM peer tutoring provides strong evidence for this. By analyzing 24 studies involving 3,311 participants, the findings indicated a significant positive effect of peer tutoring on academic achievement ($ES = 1.23$, 95% CI [0.75, 1.70], $p < .001$).

Therefore, reciprocal peer interaction could be particularly advantageous in Basic Science, where students are required to understand concepts, solve problems, and effectively apply scientific knowledge.

Theoretical Framework

This study is based on the Constructivist Learning Theory, which views learning as an active process where individuals construct knowledge through their experiences and interactions with their environment. It goes beyond the simple transfer of information from teacher to student; it's a much more interactive and engaging process.

This theory complements the Dalton Instructional Model, which encourages students to take responsibility for their own learning. It also relates to RPT, as students enhance their understanding through discussions, explanations, questions, and feedback. Both approaches foster an environment where learners actively participate in building their knowledge rather than relying solely on the teacher's input.

Empirical Review

Recent research in Nigeria has demonstrated the effectiveness of learner-centered strategies in Basic Science education. For example, Audu and Obadia (2025) investigated the jigsaw instructional strategy and found that students who engaged with this method displayed significantly higher levels of interest compared to those taught through traditional approaches.

In a similar vein, Chiekwene et al. (2025) examined the effects of guided discovery teaching on students' interest in Basic Science, revealing significant advantages for the guided discovery group. Additionally, Idris and Yusuf (2025) compared guided inquiry with expository methods and noted differences in both student interest and academic performance.

Peer tutoring has been a hot topic in recent research circles. A 2025 meta-analysis focused on STEM education pulled together findings from 24 studies with a total of 3,311 participants, revealing a significant positive impact of peer tutoring on academic success.

When it comes to Dalton instruction, Qi et al. (2025) took a closer look at how the Dalton Plan fosters learner autonomy, offering fresh evidence that the principles of Dalton are still very much applicable in today's learner-centered educational landscape.

Gap in Literature

The literature we've reviewed shows that learner-centered teaching methods can greatly enhance students' interest and academic results. However, there are still some notable gaps.

Firstly, there's a lack of research in Nigeria specifically exploring the Dalton Instructional Model in Basic Science. Secondly, while peer tutoring has been widely studied, there's a scarcity of research that zeroes in on Reciprocal Peer-Tutoring and its effect on Basic Science students' interest. Lastly, very few studies have directly compared the Dalton Instructional Model with Reciprocal Peer-Tutoring within the same research framework.



This study aims to fill these gaps by comparing these two teaching approaches and investigating their impact on students' interest and academic performance in Basic Science in the Akwanga Local Government Area.

METHODOLOGY

Research Design

This study employed a quasi-experimental pretest-posttest non-equivalent control group design. This method was chosen because intact classes were used, and random assignment of students would have disrupted the normal operations of the schools.

Three groups participated in the study: the Dalton Instructional Model, Reciprocal Peer-Tutoring, and traditional teaching methods.

Area of the Study

The research was conducted in the Akwanga Local Government Area of Nasarawa State, Nigeria. This region, located in the northern part of Nasarawa State, includes schools where Basic Science is taught at the junior secondary level. The selection of this area was deliberate, as it offers a practical educational setting where learner-centered instructional methods can be examined under typical school conditions.

Population of the Study

The population for this study included 13,200 students from the region.

Sample and Sampling Techniques

A sample of 388 students was used for the study. The manuscript employed a combination of cluster sampling and simple random sampling, after which intact classes were retained for the quasi-experimental treatment. Because the design was non-equivalent, individual random assignment was not undertaken. The final sample comprised 130 students in the Dalton Instructional Model group, 129 students in the Reciprocal Peer-Tutoring (RPT) group, and 129 students in the conventional teaching group. For transparency and reproducibility, the final submission should identify the number and names/codes of participating schools, the number of classes drawn from each school, the precise sequence used to select schools and classes, and the rule used to allocate intact classes to the three conditions. These administrative details were not fully specified in the supplied manuscript and should be supplied from the study records rather than inferred.

Table 1

Instructional Group	Sample Size
Dalton Instructional Model	130
Reciprocal Peer-Tutoring	129
Conventional Teaching	129
Total	388

Three hundred and eighty-eight (388) students used as sample size for data collection for the study. The study used a combination of cluster sampling and simple random sampling. First, schools were grouped into relevant geographical or administrative clusters. From these clusters, we selected specific schools using cluster sampling. Next, we employed a balloting method for simple random sampling to choose the participating schools, which helped reduce any potential selection bias.

Ultimately, our sample consisted of 388 students, distributed across three instructional groups as detailed below:



Table 1 Distribution of Sample by Treatment Group

Instruments for Data Collection

We used two primary instruments for collecting data:

Basic Science Interest Inventory (BSII)

The BSII was created to measure students' interest in Basic Science. It evaluated various factors, including their enjoyment, curiosity, participation, eagerness to learn, interest in problem-solving, and overall attitude towards Basic Science activities.

Basic Science Performance Test (BSPT)

The BSPT was used to assess students' academic performance in Basic Science, focusing on the concepts taught during the intervention.

Validity of the Instruments

To ensure the instruments met the necessary standards, we had them evaluated by experts in Science Education and Measurement and Evaluation. These specialists carefully examined the items, looking at their relevance, clarity, content coverage, and alignment with the study's goals. We made sure to integrate their suggestions before finalizing the instruments.

Reliability of the Instruments

For the BSII, we used an internal consistency reliability method appropriate for rating-scale items, while the BSPT underwent a reliability assessment designed for objective test items. We deemed a reliability coefficient of 0.70 or higher to be acceptable.

Treatment Procedure

The treatment lasted for six weeks.

Dalton Instructional Model

In the Dalton group, students received structured learning assignments. They were encouraged to work both independently and collaboratively, taking responsibility for their learning activities. The teacher primarily served as a facilitator, stepping in to provide guidance and clarification as needed.

Reciprocal Peer-Tutoring

Students in the RPT group were organized into peer-learning groups, where they alternated roles as tutors and tutees. Tutors explained concepts, asked questions, and provided feedback, while tutees engaged by responding, asking questions, and seeking clarification. The roles were rotated periodically to keep the process dynamic.

Conventional Teaching

In the conventional group, students experienced a traditional teacher-centered approach, which included teacher explanations, questioning, examples, board work, and individual exercises.

Data Collection Procedure

Before starting the intervention, we conducted the BSII and BSPT as pretests. The treatment lasted for six weeks, and after it concluded, we performed the posttests using the same instruments.

Data Analysis

To address the research questions, we calculated the mean and standard deviation. We used ANCOVA to test the null hypotheses at a significance level of 0.05, with pretest scores serving as covariates. If the probability value was less than 0.05, we rejected the corresponding null hypothesis.

RESULTS

Research Question 1 : What differences can we see in the mean interest scores of students taught Basic Science using the Dalton Instructional Model compared to those taught through traditional methods?

Table 2

Group	N	Pretest M	Pretest SD	Posttest M	Posttest SD	Mean Gain
Dalton	130	2.31	0.41	3.72	0.36	1.41
RPT	129	2.3	0.42	3.67	0.38	1.37
Conventional	129	2.29	0.4	3.08	0.43	0.79

Table 2 Pretest and Posttest Interest Scores

As illustrated in Table 2, the Dalton group showed a significant increase in interest, rising from 2.31 to 3.72, which corresponds to a mean gain of 1.41. In comparison, the conventional group improved from 2.29 to 3.08, leading to a mean gain of 0.79. Clearly, the Dalton group exhibited a more substantial improvement overall.

Research Question 2

The RPT group improved their pretest mean from 2.30 to a posttest mean of 3.67, resulting in a mean gain of 1.37. In contrast, the conventional group only achieved a mean gain of 0.79. This suggests that the RPT group showed a more significant increase in interest.

Research Question 3

Table 3

Group	N	Pretest M	Pretest SD	Posttest M	Posttest SD	Mean Gain
Dalton	130	28.46	7.24	68.41	8.16	39.95
RPT	129	28.61	7.18	70.26	7.72	41.65
Conventional	129	28.72	7.31	49.37	8.54	20.65

What differences can we see in the mean academic performance scores of students learning Basic Science through the Dalton Instructional Model compared to those taught with traditional methods?

Table 3 Pretest and Posttest Academic Performance Scores

The Dalton group achieved a mean gain of 39.95, while the conventional group only reached 20.65. This clearly indicates that the Dalton group made more significant progress in academic performance.

Research Question 4

The RPT group had a pretest mean of 28.61 and a posttest mean of 70.26, leading to a mean gain of 41.65. In comparison, the conventional group recorded a gain of 20.65. Thus, RPT showed a more substantial improvement.



Research Question 5

As shown in Table 2, the Dalton group had the highest posttest interest mean at 3.72, followed closely by RPT at 3.67, while the conventional group trailed with a mean of 3.08.

Research Question 6

Examining the data in Table 3, it is evident that the RPT group recorded the highest average score on the posttest, achieving a mean of 70.26. The Dalton group followed with a mean of 68.41, while the conventional group trailed with a mean of 49.37.

4.1 Test of Hypotheses

Table 4

Source	SS	df	MS	F	p
Pretest	1.82	1	1.82	12.64	0.001
Treatment	24.76	2	12.38	85.91	< .001
Error	55.47	384	0.14		
Total	82.05	387			

Table 5

Source	SS	df	MS	F	p
Pretest	2,846.21	1	2,846.21	52.37	< .001
Treatment	21,438.67	2	10,719.34	197.21	< .001
Error	20,879.45	384	54.37		
Total	45,164.33	387			

Table 4 ANCOVA of Students' Interest Scores

From Table 4, the treatment significantly influenced students' interest, $F(2,384) = 85.91$, $p < .001$. Based on the reported omnibus F statistic, the corresponding partial eta squared is approximately .309, indicating a large treatment effect. The descriptive posttest means were 3.72 for Dalton, 3.67 for RPT, and 3.08 for conventional teaching; these are unadjusted means and should not be described as adjusted ANCOVA means. The final manuscript should report the adjusted estimated marginal means and pairwise comparisons if these are available from the original analysis output.

Table 5 ANCOVA of Students' Academic Performance Scores

Table 5 indicates a significant effect of the treatment on students' academic performance, $F(2,384) = 197.21$, $p < .001$. From the reported omnibus F statistic, the corresponding partial eta squared is approximately .507, indicating a very large treatment effect. The descriptive posttest means were 68.41 for Dalton, 70.26 for RPT, and 49.37 for conventional teaching. These are unadjusted posttest means. Adjusted means, confidence intervals, and post-hoc pairwise comparisons require the original ANCOVA estimated-marginal-means output and cannot be reconstructed from the summary table alone.

Table 6. Derived Effect-Size Indicators for the Omnibus ANCOVA Tests

Outcome	F	df	Partial η^2
Interest	85.91	2, 384	0.309
Academic performance	197.21	2, 384	0.507



Note. Partial η^2 values were derived from the reported omnibus F statistic and degrees of freedom. They supplement, but do not replace, adjusted means, confidence intervals, and post-hoc comparisons.

DISCUSSION OF FINDINGS

The study found that students who participated in the Dalton Instructional Model displayed a significant increase in interest compared to those who underwent traditional teaching methods. Specifically, the pretest mean for the Dalton group rose from 2.31 to a posttest mean of 3.72, resulting in a remarkable gain of 1.41. In contrast, the conventional group only experienced a gain of 0.79.

This indicates that the aspects of learner responsibility, assignment-based activities, independence, and teacher consultation present in Dalton instruction likely enhanced students' engagement with Basic Science. When students are allowed to take control of their learning tasks, they often cultivate a stronger sense of ownership over their educational journey.

These results are consistent with recent studies that advocate for learner-centered instruction. For example, Audu and Obadiah (2025) found that Basic Science students taught using jigsaw instruction showed significantly higher levels of interest. Similarly, Chiekwene et al. (2025) discovered that guided discovery instruction also ignited greater interest in Basic Science among students.

Moreover, the study emphasized that Reciprocal Peer-Tutoring (RPT) had a positive effect on students' interest. The RPT group achieved a mean gain of 1.37, while the conventional group only reached 0.79. This improvement can likely be attributed to the social interactions involved in reciprocal tutoring, where students had opportunities to explain concepts, ask questions, share ideas, and receive constructive feedback.

The results are consistent with previous studies on peer tutoring. A 2025 meta-analysis in STEM education found that peer tutoring significantly enhances academic performance and various learning outcomes.

In terms of academic success, the Dalton group achieved an impressive mean gain of 39.95, compared to just 20.65 for the conventional group. This substantial difference suggests that the Dalton method enabled students to engage more deeply with their learning activities.

One possible explanation for this outcome is the structured assignments and opportunities for independent learning that the Dalton approach provides. Students were encouraged to take ownership of their learning tasks rather than relying solely on teacher-led explanations.

Interestingly, the RPT group recorded the highest gain in academic performance at 41.65. This indicates that factors such as peer explanation, questioning, correction, and reinforcement may have created additional learning opportunities.

These findings are further supported by the 2025 meta-analysis, which emphasized a significant positive effect of peer tutoring on academic success in STEM fields ($ES = 1.23$).

Moreover, the ANCOVA results confirmed that the treatment had a statistically significant effect on student interest, $F(2,384) = 85.91$, $p < .001$. This indicates that the differences in interest levels among the treatment groups were indeed statistically significant.

The ANCOVA results regarding academic performance indicated a significant difference among the instructional groups, with $F(2,384) = 197.21$ and $p < .001$. This strongly implies that teaching methods focused on active learning, collaboration, and student engagement yield better results than traditional, teacher-centered methods in Basic Science.

FINDINGS OF THE STUDY

The main findings from the study are as follows:



- i. Students taught using the Dalton Instructional Model showed a mean interest increase of 1.41, while those in the conventional group had a gain of only 0.79.
- ii. Participants in the Reciprocal Peer-Tutoring group experienced a mean interest gain of 1.37, surpassing the conventional group's 0.79.
- iii. In terms of academic performance, students utilizing the Dalton Instructional Model achieved a gain of 39.95, compared to 20.65 for those in the conventional group.
- iv. The highest academic performance gain was noted in the Reciprocal Peer-Tutoring group, with a score of 41.65.
- v. There was a statistically significant difference in interest levels among the three instructional groups, with $F(2,384) = 85.91$ and $p < .001$.
- vi. Likewise, a statistically significant difference in academic performance was found among the three instructional groups, with $F(2,384) = 197.21$ and $p < .001$.

METHODOLOGICAL LIMITATIONS

Although the study produced statistically significant differences, several methodological limitations should be recognised. The quasi-experimental non-equivalent-group design limits strong causal attribution because students were not individually randomised. The supplied manuscript does not contain sufficient detail to verify formal baseline-equivalence tests, the numerical reliability coefficients of the BSII and BSPT, construct-validity evidence, teacher allocation, treatment-fidelity procedures, adjusted ANCOVA means, confidence intervals, or post-hoc pairwise comparisons. Consequently, the inferential findings should be interpreted as evidence of differences associated with the instructional conditions within the study context rather than as definitive proof that one method is universally superior. These missing statistics and procedural details should be incorporated from the original study records before final publication.

CONCLUSION

The study concluded by emphasizing that both the Dalton Instructional Model and Reciprocal Peer-Tutoring are effective, student-centered strategies that can greatly enhance students' interest and academic performance in Basic Science. While both approaches demonstrated notable improvements, the Dalton Instructional Model achieved the highest posttest mean for student interest. Conversely, Reciprocal Peer-Tutoring excelled in academic performance, recording the highest posttest mean and mean gain. The significant findings from the ANCOVA further highlight the importance of selecting the right instructional strategy to boost both student interest and academic success. Therefore, it is evident that while traditional teacher-centered instruction has its merits, incorporating learner-centered methods like the Dalton Instructional Model and Reciprocal Peer-Tutoring can be extremely advantageous.

RECOMMENDATIONS

Based on the study's findings, the following recommendations are made:

Basic Science teachers should consider adopting the Dalton Instructional Model, as it promotes greater student responsibility, independence, and active participation in the learning process. Additionally, integrating Reciprocal Peer-Tutoring into classroom activities can improve students' academic performance through peer explanations, questioning, and constructive feedback. It is also essential to organize professional development programs for Basic Science teachers, providing them with the skills and knowledge needed to effectively implement both the Dalton and Reciprocal Peer-Tutoring methods. School administrators should ensure that sufficient instructional materials and a supportive learning environment are available to encourage learner-centered and collaborative teaching practices. Furthermore, teacher education institutions should introduce pre-service Basic Science teachers to these innovative instructional models during their training. Lastly, future research should explore...



Contribution to Knowledge

This research contributes to our knowledge by providing practical evidence on the effectiveness of the Dalton Instructional Model and Reciprocal Peer-Tutoring in teaching Basic Science in Nigeria. What stands out about this study is its direct comparison of these two student-centered approaches. The findings indicate that both methods can increase students' engagement and academic achievement, suggesting that the Dalton model may be more effective in generating interest, while Reciprocal Peer-Tutoring might enhance academic performance. In the end, this study is a valuable resource for educators and researchers interested in exploring various teaching strategies to improve learning outcomes in Basic Science.

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