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Comparative Analysis Of Guided Inquiry And Brainstorming Teaching Strategies On Students' Academic Achievement And Interest In Basic Science

MAKINDE, Olamide Philips1, Associate Prof. OYOVWI, Edarho Oghenevwede2

1Department of Science Education, Delta State University, Abraka
2Department of Science Education, Delta State University, Abraka
+2348034847923
oyovwieo@delsu.edu.ng

Abstract: This study investigated how two instructional strategies, guided inquiry and brainstorming, affect students' achievement and interest in Basic Science. A quasi-experimental pretest–posttest design was used, with participants placed in either a Guided Inquiry or a Brainstorming group. The Basic Science Achievement Test (BSAT) and the Basic Science Interest Scale (BSIS) used for data collection were administered before and after instruction, and ANCOVA was employed to control for initial differences and evaluate the effects of each method. Results showed that learners taught via the Brainstorming technique achieved significantly higher posttest scores for both achievement and interest than those taught through Guided Inquiry. The advantage observed for the Brainstorming group was linked to its interactive, collaborative format, which better motivated students and enhanced learning outcomes. These findings underscore the value of active, student-centered teaching strategies for improving academic performance and fostering interest in science. Based on these results, it is recommended that educators incorporate Brainstorming techniques into science instruction to enhance student engagement, critical thinking, and academic success.
Keywords: Guided Inquiry, Brainstorming, Academic Achievement, Interest in Basic Science, Active Learning, Teaching Strategies.

Introduction

Science education plays an essential influence on learners' academic achievement and cognitive growth, particularly in the early years of secondary education. However, despite its importance, many students face difficulties in mastering scientific concepts and in developing a genuine interest in the subject. These challenges highlight the need for instructional strategies that can improve academic performance and increase student engagement in Basic Science. Several studies have shown that the effectiveness of teaching methods significantly influences students' academic outcomes (Oruakpor & Oyovwi, 2024; Oyovwi, 2012). Among the various strategies, Guided Inquiry and Brainstorming have emerged as promising methods to improve both academic achievement and student interest in science. However, the comparative impact of these two teaching strategies on Basic Science outcomes remains underexplored.

Academic achievement, particularly in science, is a key indicator of students' overall learning success. Studies consistently highlight that teaching methods have a crucial influence on students' academic performance. Oyovwi and Iroriteraye-Adjekpovu (2021) emphasize that academic achievement is influenced by instructional methods that encourage active engagement, critical thinking, and problem-solving. In contrast to traditional methods, which often rely on rote memorization and passive learning, strategies like Guided Inquiry focus on fostering higher-order thinking skills. Such methods allow students to engage with the material more actively by prompting them to ask questions, analyze data, and formulate hypotheses (Anyaegbunam & Onyemaechi, 2020). Research further suggests that Guided Inquiry improves students' understanding and retention of scientific concepts, which ultimately contributes to better academic achievement (Babatunde & Ibrahim, 2022). As such, exploring the role of Guided Inquiry in enhancing academic success in Basic Science is essential, particularly in the context of Nigerian secondary schools where traditional methods still dominate classroom instruction.

Engagement with science is also a key factor in promoting academic achievement. Students who have a strong interest in the subject are more inclined to interact with the material, take part in classroom discussions, and seek a deeper understanding of the topic. Motivation and interest are key factors in academic performance, as they directly influence the level of engagement and persistence students exhibit in their learning (Oruakpor & Oyovwi, 2024). However, cultivating and maintaining students' interest in science can be challenging, particularly in environments where the curriculum is perceived as detached from students' everyday experiences. Traditional teaching methods often fail to create meaningful connections with students, leading to a decline in interest over time (Mohammed & Afolabi, 2021). In contrast, Brainstorming offers a dynamic alternative that encourages creative thinking and collaboration. By engaging students in generating ideas and solving problems together, Brainstorming stimulates interest and fosters a more interactive learning environment (Akinyemi & Oladipo, 2019). This method makes science more relatable and enjoyable, helping to reignite students' curiosity about the subject. Similarly, Guided Inquiry fosters interest by allowing students to investigate scientific concepts at their own speed through organized explorations. This approach aligns with studies indicating that students who take a more active role in their learning are more likely to cultivate a lasting interest in science (Oruakpor & Oyovwi, 2024).

Guided Inquiry is an instructional strategy that places the responsibility for learning in the hands of the students. It stimulates active involvement and enhances critical thinking by prompting students to create questions, design experiments, and independently analyze data. This method enhances conceptual understanding and promotes retention, as students are required to think critically about the material they encounter. Studies by Liu (2021) and Suleiman & Aluko (2023) show that Guided Inquiry significantly improves students' academic performance by fostering an interactive learning environment. This student-focused method not only aids students in grasping scientific concepts but also fosters the development of crucial skills like problem-solving and independent learning, which are essential for achieving success in science education. Furthermore, the inquiry process nurtures students' curiosity and interest, making science a more engaging and meaningful subject to learn (Babatunde & Ibrahim, 2022).

On the other hand, Brainstorming is a team-based teaching technique that motivates students to come up with ideas, engage in discussions, and work together to solve problems. This approach promotes a cooperative classroom climate that encourages learners to engage actively in their own learning. By making lessons more interactive and lively, brainstorming tends to increase students' interest in science and reduce passive learning (Liu, 2021). Akinyemi and Oladipo (2019) argue that the interactive nature of Brainstorming promotes greater motivation among students, as it provides them with opportunities to express their ideas and collaborate with peers. This approach helps make scientific content more accessible and relatable, encouraging students to think critically and creatively about the material. Research indicates that Brainstorming, by creating an open and inclusive learning environment, increases students' motivation and interest in science, which directly correlates with improved academic performance (Oruakpor & Oyovwi, 2024).

The impetus for this research is the limited comparative evidence on how Guided Inquiry and Brainstorming influence students' academic outcomes and interest in Basic Science at the junior secondary level in Nigeria. While individual studies have evaluated each strategy on its own, few have directly compared their relative effectiveness within Nigerian Basic Science classrooms. The shortage of studies focused on the Delta Central Senatorial District further underscores the need for a localized empirical investigation. This study therefore aims to close that gap and broaden the Nigerian science-education literature by delivering evidence-based guidance on which active teaching approaches most effectively boost both achievement and student interest in Basic Science.

Statement of the Problem

The status quo in Basic Science education, particularly in the Delta Central Senatorial District, reveals significant challenges in both academic achievement and student engagement. Despite ongoing efforts to improve science education, many students continue to struggle with understanding key scientific concepts, leading to poor academic performance. Traditional teaching methods, which focus on rote learning and passive instruction, are unable to fully address the diverse learning needs of students, often leaving them disengaged and uninterested in the subject. This lack of effective instructional strategies has led to a stagnation in academic outcomes, with students failing to develop critical thinking skills necessary for success in science.

Another pressing issue is the lack of innovation in teaching strategies aimed at increasing students' interest in Basic Science. The conventional methods used in many schools do not make the subject matter relatable or engaging, which discourages students from pursuing science-related careers. As a result, students often find the subject boring and irrelevant to their daily lives, leading to a lack of motivation and, ultimately, poor academic performance. This disengagement is further compounded by the absence of strategies that encourage active participation and collaborative learning, leaving students with a passive learning experience that fails to ignite their curiosity or foster a deeper understanding of scientific principles.

If these issues remain unaddressed, the consequences will be far-reaching. The continued lack of interest and academic underachievement in Basic Science will perpetuate a cycle of poor academic outcomes, limiting students' future opportunities in science and technology fields. This situation not only affects the individual students but also has a broader impact on the nation's ability to develop a skilled workforce capable of contributing to scientific innovation and technological advancement. The failure to implement more effective teaching strategies may lead to a generation of students who are ill-prepared to meet the demands of an increasingly knowledge-driven world, further hindering national development in the areas of science and technology. Therefore, addressing these challenges by exploring more effective teaching approaches is critical to ensuring a brighter future for both the students and the nation as a whole.

Purpose of the Study

The study set out to compare the effects of Guided Inquiry and Brainstorming on Basic Science students' achievement and interest. Specifically, it aimed to:

1. establish whether there is a difference in achievement in Basic Science between students taught by Guided Inquiry and Brainstorming;

2. determine whether there is a difference in interest in Basic Science between students instructed with Guided Inquiry and Brainstorming.

Research Questions

In directing the research, it was designed to address the following questions:

1. What is the difference in students' academic achievement in Basic Science between those taught using Guided Inquiry and those taught using Brainstorming teaching strategies?
2. What is the difference in students' interest in Basic Science between those taught using Guided Inquiry and those taught using Brainstorming teaching strategies?

Hypotheses

The study examined the following hypotheses:

1. There is no significant difference in students' academic achievement in Basic Science between those taught using Guided Inquiry and those taught using Brainstorming teaching strategies.

2. There is no significant difference in students' interest in Basic Science between those taught using Guided Inquiry and those taught using Brainstorming teaching strategies.

Methodology

The study adopted a pretest–posttest quasi-experimental framework to compare the effects of Guided Inquiry and Brainstorming on students' achievement and interest in Basic Science. The research was conducted in junior secondary schools within the Delta Central Senatorial District of Nigeria, with a focus on schools in the Ethiope East Local Government Education Zone.

The study involved two treatment groups: one taught using the Guided Inquiry method and the other using Brainstorming. A non-equivalent group design allowed for comparison of the two methods while controlling for pre-existing differences between the groups. Both groups were tested at the start and end of the intervention.

The target population consisted of JSS3 students from public secondary schools in the district. Approximately 250 students from six selected schools participated, chosen based on accessibility and willingness. The study employed simple random sampling, assigning students to either the Guided Inquiry group or the Brainstorming group without considering gender stratification.

Data were collected using two instruments:

- **Basic Science Achievement Test (BSAT)**: This assessed students' academic performance in Basic Science, with multiple-choice questions, short answers, and practical assessments.

- **Basic Science Interest Scale (BSIS)**: This measured students' interest in Basic Science, including Likert-type items on their enthusiasm, motivation, and engagement.

Both instruments were subjected to expert evaluation and pilot trials to confirm item clarity, relevance, and construct validity. The Basic Science Achievement Test (BSAT) had its reliability estimated using the Kuder–Richardson Formula 20 (KR-20), with a coefficient of 0.75 or higher deemed acceptable. Reliability for the Basic Science Interest Scale (BSIS) was determined via Cronbach's alpha, with a value of 0.80 or above considered satisfactory.

The teaching strategies were implemented over six weeks. In the Guided Inquiry group, students formulated questions, hypothesized, designed experiments, and analyzed data with teacher support. In the Brainstorming group, students generated ideas and solutions collaboratively, with the teacher facilitating the discussions.

Data obtained from the BSAT and BSIS were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA) to evaluate the impact of the teaching strategies while accounting for pretest differences. ANCOVA helped determine whether the methods led to significant differences in academic achievement and interest.

Ethical guidelines were followed throughout the study, with informed consent obtained from students and their guardians. Participants' anonymity and confidentiality were maintained, and they were notified that taking part was optional and that they could discontinue their participation at any point without facing any consequences.

Results

Table 1: **Descriptive Statistics of Students' Achievement Scores by Teaching Strategy**

Method	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Difference
Guided Inquiry	148	15.57	4.58	46.06	10.42	30.49
Brainstorming	102	15.93	5.48	56.33	14.61	40.40

As shown in Table 1, learners instructed through Guided Inquiry recorded a pretest mean score of 15.57, which rose to 46.06 in the posttest, reflecting a gain of 30.49. Conversely, those taught with the Brainstorming strategy achieved a pretest mean of 15.93 and a posttest mean of 56.33, resulting in a mean improvement of 40.40. These results suggest that while both teaching methods produced notable gains in academic achievement, the Brainstorming approach led to a greater improvement in students' performance compared to Guided Inquiry.

Table 2: **Descriptive Statistics of Students' Interest Scores by Teaching Strategy**

Method	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Difference
Guided Inquiry	148	33.30	8.45	64.08	9.59	30.78
Brainstorming	102	32.08	6.44	71.24	4.02	39.16

As indicated in Table 2, students instructed through Guided Inquiry obtained a pretest mean score of 33.30, which increased to 64.08 in the posttest, giving a mean gain of 30.78. In contrast, those taught with the Brainstorming approach recorded a pretest mean of 32.08 and a posttest mean of 71.24, producing a mean improvement of 39.16. Both instructional methods significantly increased students' interest in Basic Science, but Brainstorming produced a more substantial improvement in students' interest than Guided Inquiry.

Table 3: ANCOVA Analysis of Students' Achievement Scores Across Instructional Strategies

Source	Type III Sum of Squares	df	Mean Square	F	p-value
Corrected Model	182553.091	2	91276.545	24.62	0.000
Intercept	215445.031	1	215445.031	57.99	0.000
Method	31998.911	1	31998.911	8.55	0.004
Error	135679.915	247	548.69		
Total	167678.83	249			
Corrected Total	318232.92	249			

The ANCOVA analysis for academic achievement (as shown in Table 3) reveals a significant impact of the teaching method on students' performance ($F = 8.55$, $p = 0.004$). Because the p-value is under .05, the null hypothesis is dismissed, implying a significant difference in academic achievement between learners taught by Guided Inquiry and those instructed using Brainstorming. Specifically, the Brainstorming method led to a significantly greater academic achievement compared to the Guided Inquiry method.

Table 4: **ANCOVA Results on Students' Interest by Teaching Method**

Source	Type III Sum of Squares	df	Mean Square	F	p-value
Corrected Model	233308.444	2	116654.222	30.87	0.000
Intercept	349109.234	1	349109.234	90.58	0.000
Method	25268.821	1	25268.821	6.62	0.011
Error	373039.561	247	1509.38		
Total	398308.38	249			
Corrected Total	606348.05	249			

The ANCOVA results for interest in Basic Science (see Table 4) show that the difference in students' interest is statistically significant ($F = 6.62$, $p = 0.011$). The p-value being less than 0.05 leads to the rejection of the null hypothesis, indicating a statistically significant

difference in students' interest in Basic Science between the two groups. The Brainstorming method resulted in significantly higher levels of interest compared to the Guided Inquiry method.

Discussion of Findings

The primary finding indicated that learners taught using the Brainstorming technique attained higher academic achievement in Basic Science than those instructed via Guided Inquiry. ANCOVA analysis confirmed this as a statistically significant difference, with the Brainstorming cohort demonstrating a larger improvement in performance. This finding aligns with the notion that Brainstorming enhances student engagement through collaborative idea generation and problem-solving. Working in groups allows students to collaborate, exchange ideas, and gain a deeper understanding of the material. This approach encourages active learning, where students are not just passive listeners but actively participate in the learning process. Consequently, they are more likely to retain and use the knowledge they have gained.

Several reasons could explain why Brainstorming outperformed Guided Inquiry in improving academic achievement. First, Brainstorming fosters an environment where students feel more confident in expressing their ideas and discussing concepts openly with their peers. This collaborative atmosphere may encourage greater participation and retention of information, leading to better academic performance. On the other hand, Guided Inquiry often involves students working independently, which may not be as engaging for some learners, especially in subjects like Basic Science, where complex concepts benefit from more interactive teaching strategies.

Supporting past research, studies by Akinyemi and Oladipo (2019) and Liu (2021) have shown that Brainstorming strategies significantly improve academic performance, particularly in science subjects, by promoting student interaction and active problem-solving. Similarly, Mohammed and Afolabi (2021) found that collaborative teaching methods like Brainstorming enhance student performance by fostering deeper engagement with the material. In contrast, Oyovwi and Iroriteraye-Adjekpovu (2021) found that Guided Inquiry could also lead to improvements in academic performance. However, the findings of this research indicate that within the context of Basic Science, Brainstorming may offer more benefits in terms of academic achievement than Guided Inquiry, possibly due to the higher level of interaction and student involvement it promotes.

The second outcome revealed that learners exposed to the Brainstorming approach demonstrated considerably greater interest in Basic Science than their counterparts taught through Guided Inquiry. The ANCOVA analysis confirmed that the Brainstorming group recorded a more pronounced rise in interest scores. This implies that Brainstorming is more successful in stimulating students' engagement and enthusiasm toward learning. By encouraging active participation, the Brainstorming strategy makes the learning experience more interactive, relatable, and enjoyable for students. The interactive and collaborative nature of Brainstorming likely contributes to a more stimulating learning environment, which, in turn, increases students' interest in the subject.

Several reasons might explain why Brainstorming had a stronger effect on student interest. The method encourages creativity and allows students to explore topics through discussion and group-based problem-solving, which can be particularly motivating. This active participation contrasts with Guided Inquiry, where students may feel more passive, particularly if the inquiry process is more teacher-directed or requires students to work independently. Brainstorming also creates a more dynamic and less structured environment, which can help maintain students' attention and spark their curiosity.

Supporting past findings, Akinyemi and Oladipo (2019) and Babatunde and Ibrahim (2022) found that interactive strategies like Brainstorming can significantly boost students' interest in science by encouraging them to engage more deeply with the material. Similarly, Liu (2021) highlighted that active learning strategies, which include methods like Brainstorming, enhance student interest by making learning more interactive and enjoyable. Furthermore, Oruakpor and Oyovwi (2024) reported that interactive strategies improve student engagement and motivation, leading to increased interest in science subjects. While Guided Inquiry has been shown to increase interest in other studies (e.g., Babatunde and Ibrahim, 2022), this study suggests that Brainstorming might be more effective in fostering interest, particularly in the context of Basic Science.

Conclusion

The results of the study demonstrate that both Guided Inquiry and Brainstorming teaching approaches significantly improve students' achievement and interest in Basic Science. However, Brainstorming emerged as the more effective method in improving both academic performance and student engagement. The Brainstorming method, with its focus on collaborative learning and active participation, fostered greater interaction among students, leading to better academic outcomes and higher levels of interest in the subject. In contrast, while Guided Inquiry was beneficial, it did not produce as significant improvements as Brainstorming, particularly in terms of student interest.

These results suggest that Brainstorming can be a valuable teaching strategy in Basic Science classrooms, especially in fostering creativity, critical thinking, and group collaboration. The study provides strong evidence that interactive teaching strategies are crucial for improving students' academic success and motivating them to engage more deeply with the subject matter.

Based on the findings, it is clear that Brainstorming can play a significant role in improving both students' academic achievement and their enthusiasm for learning Basic Science. As such, it offers a promising alternative to more traditional teaching methods, such as Guided Inquiry, in the context of this study.

Recommendations

Drawing from the outcomes of this research, the following recommendations are proposed:

1. Teachers should incorporate Brainstorming as a core teaching strategy in Basic Science classrooms. This method not only improves students' academic achievement but also enhances their interest and engagement with the subject. The interactive, collaborative nature of Brainstorming enables learners to engage actively in the learning process, thereby enhancing comprehension and long-term retention of scientific ideas.
2. It is essential for teachers to be trained in active learning strategies such as Brainstorming. Teachers should be equipped with the necessary skills to facilitate group discussions, encourage creative thinking, and manage classroom dynamics effectively. Professional development programs and workshops should focus on these interactive teaching techniques to ensure that educators can effectively implement them in their classrooms.
3. Schools should promotes a cooperative classroom atmosphere where learners are motivated to collaborate and exchange their ideas. This can be achieved by adopting teaching strategies like Brainstorming that emphasize teamwork and collective problem-solving. Such environments not only improve academic outcomes but also contribute to the development of important social and communication skills.

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