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Article

Effect Of Guided Discovery Teaching Strategy on Students' Achievement In Basic Science, Federal Capital Territory, Abuja

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Abstract: The study examined effect of guided discovery teaching strategy on students' achievement in basic science, Federal Capital Territory, Abuja. The study employed a quasi-experimental design with pre-test, post-test, and non-equivalent control groups. Intact classes were used, divided into experimental and control groups, where guided discovery and conventional teaching methods were applied, respectively. The sample comprised 104 JSS II students from Gwagwalada Area Council, selected using a multi-stage sampling process involving purposive and random sampling. Data collection instruments included the Basic Science Achievement Test (BSAT), validated by two lecturers and tested for reliability using KR-21 which gave index of (0.76). Lessons spanned eight weeks with distinct lesson plans for each group. Data collection occurred over three phases: pre-test, treatment, and post-test. Descriptive statistics and ANCOVA were employed for analysis using SPSS version 21, with hypotheses tested at a 0.05 significance level. The study found that students taught Basic Science using the guided discovery method had significantly higher academic achievement than those taught with conventional methods. It was concluded that guided discovery method significantly enhanced students' academic achievement in Basic Science, aligning with constructivist learning theories. Therefore, the study made recommended among others that teachers should incorporate the guided discovery method into Basic Science teaching to foster active engagement and improve achievement.

Keywords: Guided Discovery Teaching Strategy, Basic Science Academic Achievement, Quasi-Experimental Research in Education

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1. Introduction

Education plays a pivotal role in nation-building through the acquisition and application of knowledge that transforms individuals into valuable assets rather than liabilities to society. A teacher's unique responsibility lies in fostering scholastic skills and promoting students' academic achievement to ensure their success. This role is emphasized in the National Policy on Education (FRN, 2014), which underscores the importance of science and technology education in preparing learners for the demands of a modern, technologically-driven world. Science is recognized as the cornerstone of contemporary scientific and technological advancements. It is a systematic endeavor aimed at understanding the natural world through evidence-based explanations and predictions. As an interdisciplinary subject, Basic Science, previously known as Integrated Science, eliminates traditional subject boundaries, presenting science holistically. It forms the foundation for advanced science subjects like biology, chemistry, and physics in secondary education. Agbidye (2015) emphasized that Basic Science equips students with essential scientific skills to meet societal needs, making early engagement crucial for developing lasting interest and competence in science.

Despite its significance, the implementation of the Basic Science curriculum in Nigeria faces challenges, particularly due to inadequate teacher competencies and ineffective teaching methods. Studies reveal that traditional lecture methods hinder students' interest and achievement in Basic Science (Almaz, 2019; Arriassecq & Guridi, 2020). The Federal Ministry of Education (FRN, 2014) advocates for student-centered, activity-based teaching strategies such as guided discovery, cooperative learning, and simulation games to address these issues. Guided Discovery is a learner-centered approach where students actively engage in exploring concepts and solving problems, with teachers serving as facilitators. This method encourages critical thinking, curiosity, and deeper understanding, making learning more interactive and enjoyable. Research by Olorode and Jimoh (2016) and Oyewole (2017) supports its effectiveness in fostering students' academic achievement, regardless of gender. However, persistent reliance on traditional teaching methods continues to limit students' active participation in Basic Science, contributing to poor achievement. Anibueze (2017) attributes poor academic outcomes to ineffective pedagogy, overcrowded classrooms, and insufficient instructional materials, necessitating a shift towards more effective teaching strategies. Given the alarming rate of poor achievement in science and the declining educational standards in Nigeria, this study aims to investigate the effect of guided discovery teaching strategy on students' achievement in Basic Science in the Federal Capital Territory, Abuja.

Purpose of the Study

The purpose of this study is to investigate the effect of guided discovery teaching strategy on students' achievement in Basic Science in Federal Capital Territory, Abuja. The specific objectives are to:

i. determine the difference in the mean achievement scores of students taught Basic Science using guided discovery teaching strategy and their counterparts taught using conventional teaching method in Federal Capital Territory, Abuja;

ii. find out the difference in the mean achievement scores of male and female students taught Basic science using guided discovery teaching method;

Research Questions

The following research questions were raised to guide the study;

i. What is the difference in the mean achievement scores of students taught basic science using guided discovery method and their counterparts taught using Conventional method in Federal Capital Territory, Abuja?

ii. What is the difference in the mean achievement scores of male and female students taught basic science using guided discovery teaching strategy?

Hypotheses

The following null hypothesis were formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean achievement scores of students taught basic science using guided discovery method and their counterparts taught using Conventional method.

$H0_2$: There is no significant difference between the mean achievement scores of male and female students taught basic science using guided discovery strategy.

Literature Review

This study is grounded in two complementary learning theories: Jerome Bruner's study on the Constructivism Theory (1960) and Social Constructivism Theory (Vygotsky**,** 1978)**.** These theories collectively emphasize the active construction of knowledge through meaningful engagement, exploration, and social interaction, making them a strong foundation for this research. Bruner's Constructivism Theory, introduced in 1960, posits

that learning is an active, dynamic process where learners construct new knowledge by building upon their prior experiences. Bruner argued that students learn best through discovery, which involves actively engaging with content, solving problems, and drawing their own conclusions. This idea is central to the guided discovery teaching strategy, where students are encouraged to explore scientific concepts through hands-on activities, experiments, and inquiry-based learning rather than passively receiving information from the teacher. Additionally, Bruner's notion of a spiral curriculum where complex concepts are introduced progressively and revisited at deeper levels aligns well with guided discovery, as it enables students to incrementally build on their knowledge. Furthermore, Bruner emphasized the importance of intrinsic motivation in learning, which is fostered when students are given opportunities to discover and solve problems independently, thereby enhancing their engagement and long-term retention of scientific concepts.

Complementing Bruner's ideas, Social Constructivism Theory, articulated by Lev Vygotsky in 1978, emphasizes that knowledge is constructed through social interactions and collaborative processes. Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which refers to the range of tasks learners can perform with guidance but not yet independently. The Guided Discovery approach capitalizes on the ZPD by offering structured support through teacher facilitation and peer collaboration. This scaffolding allows students to tackle more complex problems and reach higher levels of understanding than they could achieve on their own. Moreover, Vygotsky underscored the role of language and dialogue in learning. In the context of Guided Discovery, students engage in group discussions, share ideas, and receive feedback from both peers and teachers. This collaborative process not only enhances their conceptual understanding but also refines their critical thinking and problem-solving abilities. Vygotsky's emphasis on social interaction is particularly relevant in science education, where collaborative experimentation and shared inquiry are key to mastering scientific concepts.

Integrating Bruner's and Vygotsky's theories, the Guided Discovery Teaching Strategy fosters a learning environment where students are actively involved in both individual exploration and social collaboration. While Bruner's theory highlights the cognitive process of discovery, Vygotsky's theory emphasizes the social dynamics of learning, making their combined application highly effective in enhancing students' academic achievement in Basic Science. The teacher's role in this strategy is to facilitate learning by providing appropriate guidance and scaffolding, enabling students to navigate their ZPD and progressively develop a deeper understanding of scientific concepts. In summary, the theoretical framework underpinning this study demonstrates that the Guided Discovery Teaching Strategy is not only rooted in sound pedagogical theories but also well-suited to improving students' achievement in Basic Science. Teaching Basic Science involves using various methods to effectively deliver scientific knowledge and skills. The teaching approach is influenced by the content, students' aptitude, and enthusiasm (Agbai, 2014). Teaching is not merely transmitting facts but fostering lasting changes in students' thinking, behavior, and emotions.

Effective teaching strategies aim to nurture scientific literacy and critical thinking, equipping students with the knowledge and skills needed for real-world applications (Afzal, 2021). Poor academic achievement in science is often attributed to ineffective teaching strategies (Kayode, 2020). This has spurred the Federal Ministry of Education since (2014) to recommend student-centered, activity-based approaches like the guided discovery method. Guided discovery teaching strategy is student-centered and involves problem-solving, where students discover content with guidance from the teacher (Akanmu & Fajemidagba, 2016). This strategy encourages active learning through intuition, imagination, and creativity, fostering a deeper understanding of concepts (Olorode & Jimoh, 2016). Despite the need for careful preparation, success depends on students' prior knowledge and problem-solving skills. The teacher's role is to facilitate, while students make intuitive guesses and explore solutions (Aregbesola, 2023 & Maikudi,

2015). Academic achievement in basic science refers to how well students meet the educational objectives and standards within the subject, assessed through tests, assignments, practical experiments, and continuous evaluations (Bossaert, Doumen, Buyse, & Verschueren, 2014). It includes both short-term accomplishments, such as performing well on a specific test, and long-term goals, like mastering key scientific concepts or earning a science-related qualification. Ojelade, et al (2017) and Songu (2016) explain that academic achievement in science measures students' ability to meet set standards by performing scientific tasks, conducting experiments, solving problems, and understanding theoretical concepts. Pruett (2016) emphasizes that academic achievement is influenced by factors such as student interest, behavior, and their capacity to complete both theoretical and practical tasks.

Tofi, Achor, & Eje (2022) examined the impact of the guided discovery method on secondary school students' Biology achievement in Makurdi, Benue State, using a quasi-experimental design with a non-randomized pretest-posttest control group. The sample comprised 47 SS2 students from a population of 8,670. Data collection involved the *Biology Academic Achievement Test* (BAPT), validated by experts with a reliability of 0.79. Results showed a significant achievement difference favoring the guided discovery group but no gender-based differences. Descriptive statistics and independent t-tests were used for analysis. The study's findings highlight the effectiveness of guided discovery over traditional lectures. The present study differs in population, method, and focus on interest and achievement in Basic Science. The present study differs in location, student level, and the use of interest as a variable. Inyang, Utibe, Uko, & Uboh (2023) explored the impact of guided discovery and expository methods on Physics achievement among SS2 students in Ikot Abasi, Akwa Ibom State. The quasi-experimental design involved pretest-posttest non-randomized groups with 182 students. The *Physics Achievement Test on Waves* (PATW), validated by experts, had a reliability index of 0.85. ANCOVA analysis revealed a significant achievement difference favoring the guided discovery method. The study emphasizes guided discovery's effectiveness in teaching complex concepts. Differences between this and the present study include location, subject area, and focus on interest as a variable in JSS students in Abuja.

Peter and Philip (2016) compared the effects of guided discovery and discussion methods on Basic Science and Technology students' achievement and retention in Keffi, Nigeria. A quasi-experimental design with pre-and post-tests was employed on 98 JSS II students. Two intact classes were used: one experimental group taught with guided discovery and one control group with the discussion method. A 30-item test validated by experts was used. Over six weeks, both groups were taught three topics each in science and technology. ANCOVA analysis revealed that although students in the guided discovery group performed slightly better and retained more, the differences were not statistically significant. The study recommends using both methods interchangeably. The current study differs in location, population, and its focus on interest and achievement. Bamidele and Ariyo (2017) investigated the relative effectiveness of guided discovery, demonstration, and expository methods on Chemistry students' achievement in senior secondary schools in Ile-Ife, Nigeria. Using a non-equivalent pretest-posttest control group design, 84 students from three randomly selected schools participated. The Chemistry Achievement Test (CAT) and a questionnaire on student attitudes were used. Data analysis via ANCOVA and ANOVA showed significant differences in achievement among the three teaching methods, with guided discovery yielding the best results. Both male and female students performed better with guided discovery, showing improved retention. The study concludes that guided discovery is superior to demonstration and expository methods. The present study differs in location, student level, subject, and inclusion of interest and achievement as key variables.

2. Materials and Methods

The study employed a quasi-experimental design with pre-test, post-test, and non-equivalent control groups. Intact classes were used, divided into experimental and control groups, where guided discovery and conventional teaching methods were applied, respectively. The sample comprised 104 JSS II students from Gwagwalada Area Council, selected using a multi-stage sampling process involving purposive and random sampling. Data collection instruments included the Basic Science Achievement Test (BSAT), validated by two lecturers and tested for reliability using KR-21 which gave index of (0.76). Lessons spanned eight weeks with distinct lesson plans for each group. Data collection occurred over three phases: pre-test, treatment, and post-test. Descriptive statistics and ANCOVA were employed for analysis using SPSS version 21, with hypotheses tested at a 0.05 significance level.

3. Results

Presentation of Data

Groups	No. of Students	Percentage (%)
Experimental	40	38.46
Control	64	61.54
Total	**104**	**100.0**

Table 1 presents the distribution of the sample according to groups. Out of the 104 students, 40 (38.46%) were assigned to the experimental group, while 64 (61.54%) were in the control group. This indicates that the control group had a larger proportion of students compared to the experimental group, comprising over 60% of the total sample.

Table 2: Distribution of Sample according to Gender

Gender	No. of Students	Percentage (%)
Male	58	55.77
Female	46	44.23
Total	**104**	**100.0**

Table 2 shows the gender distribution of the sample population. Out of the 104 students, 58 (55.77%) were male, while 46 (44.23%) were female. This indicates a slightly higher representation of male students compared to female students, making up more than half of the total sample.

Answers to Research Questions

Research Question One: What is the difference in the mean achievement scores of students taught basic science using guided discovery method and their counterparts taught using conventional method?

Table 3. Mean and Standard Deviation of Students Experimental and Control Group

Groups	No. of Students	Mean	SD
Experimental	40	18.75	1.51
Control	64	16.31	2.30
Mean difference		2.44	

The table presents the mean and standard deviation of achievement scores for students in the experimental and control groups. The experimental group, consisting of 40 students taught using the guided discovery method, achieved a mean score of 18.75 with a standard deviation of 1.51. This relatively low standard deviation indicates that the scores in the experimental group were closely clustered around the mean, reflecting consistent achievement among students. In contrast, the control group, which included 64 students taught using the conventional method, had a lower mean score of 16.31 with a

standard deviation of 2.30. The higher standard deviation in the control group indicates a wider range of scores, suggesting more variability in student achievement. The mean difference between the two groups is 2.44, showing that students taught with the guided discovery method outperformed those taught with the conventional method. This result implies that the guided discovery approach is more effective in enhancing student achievement in basic science.

Research Question Two:

What is the difference in the mean achievement scores of male and female students taught basic science using guided discovery method?

Table 4: Achievement Scores of Male and Female Students in Experimental Group

Groups	Gender	No. of Students	Mean	SD
Experimental	Male	23	18.65	1.58
Control	Female	17	18.88	1.45
Mean difference			0.23	

The table 2 presents the achievement scores of male and female students in the experimental group, who were taught using the guided discovery method. There were 23 male students and 17 female students in this group. The mean achievement score for male students was 18.65, with a standard deviation of 1.58, indicating a slightly wider range of scores. Female students had a mean score of 18.88, with a standard deviation of 1.45, showing a slightly more consistent achievement compared to their male counterparts. The mean difference between the two groups was 0.23, with female students achieving marginally higher scores than male students. However, this difference is minimal, suggesting that both male and female students performed similarly under the guided discovery teaching method. Therefore, gender did not have a significant impact on the achievement scores in the experimental group.

Test of Hypotheses

HO1: There is no significant difference in mean achievement scores of students taught basic science using guided discovery and their counterparts using conventional method.

Table 5: ANCOVA Achievement Scores of Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	219.777[a]	4	54.944	15.554	0.000
Intercept	521.365	1	521.365	147.589	0.000
Pretest	0.386	1	0.386	0.109	0.742
Group/Method	130.446	1	130.446	0.109	0.000
Gender	30.771	1	30.771	8.711	0.004
group * gender	21.836	1	21.836	6.181	0.015
Error	349.723	99	3.533		

Sig. at $p < 0.05$

The ANCOVA results reveal key insights into the achievement scores of students in the experimental and control groups after adjusting for pretest scores. The corrected model is statistically significant, with an F-value of 15.554 and a p-value of 0.000 ($p < 0.05$), indicating that the combined factors in the model explain a significant portion of the variance in students' achievement. The intercept is also highly significant ($F = 147.589$, $p = 0.000$), confirming a strong baseline effect. However, the pretest scores do not have a significant impact on post-test achievement, as shown by an F-value of 0.109 and a p-value of 0.742. This suggests that initial differences in pretest scores did not influence the outcome. The teaching method, categorized as group/method, significantly affects student achievement ($F = 36.92$, $p = 0.000$). Students in the experimental group, who were taught using the guided discovery method, outperformed those in the control group who were

taught using conventional methods. Gender also plays a significant role in determining achievement (F = 8.711, p = 0.004), indicating achievement differences between male and female students. Furthermore, there is a significant interaction between the teaching method and gender (F = 6.181, p = 0.015), suggesting that the effectiveness of the guided discovery method varies based on gender. Overall, the analysis confirms that both teaching method and gender significantly influence students' achievement, with the guided discovery method being more effective. Additionally, the interaction between gender and teaching method highlights differing impacts on male and female students, emphasizing the need to consider gender dynamics in instructional strategies.

HO2: There is no significant difference between the mean achievement scores of male and female students taught basic science using guided discovery teaching strategy.

Table 6: ANCOVA Results of Achievement Scores of male and female students taught Basic Science using Guided discovery.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	0.638[a]	2	0.319	0.133	0.876
Intercept	147.837	1	147.837	61.556	0.000
Pretest	0.120	1	0.120	0.050	0.824
Gender	.382	1	0.382	0.159	0.692
Error	88.862	37	2.402		
Total	14152.000	40			
Corrected Total	89.500	39			

Sig. at p < 0.05

The ANCOVA results in Table 6 present the analysis of achievement scores of male and female students taught Basic Science using the guided discovery method. The corrected model, which accounts for pretest scores and gender, is not statistically significant, with an F-value of 0.133 and a p-value of 0.876. This indicates that the combined influence of pretest scores and gender does not significantly explain the variation in students' achievement. The intercept is highly significant (F = 61.556, p = 0.000), demonstrating a substantial overall effect independent of the factors considered in the model. This suggests that baseline achievement across the sample was notably consistent. Pretest scores show no significant impact on post-test achievement (F = 0.050, p = 0.824), implying that students' initial knowledge did not affect their post-intervention achievement.

Gender also does not significantly influence achievement, with an F-value of 0.159 and a p-value of 0.692. This suggests that male and female students performed similarly when taught using the guided discovery method. In conclusion, neither pretest scores nor gender significantly affected the achievement of students taught with the guided discovery method. This indicates that the method was equally effective across gender groups, providing a balanced learning outcome.

4. Discussion

The findings of this study revealed a significant difference in the mean achievement scores of students taught Basic Science using the guided discovery method compared to those taught using conventional methods. This aligns with studies by Bamidele and Ariyo (2017), who demonstrated that guided discovery improves academic achievement and retention in Chemistry. Similarly, Inyang, Utibe, Uko, & Uboh (2023) found significant achievement improvements in Physics students taught using guided discovery. Furthermore, Vygotsky's concept of the Zone of Proximal Development (ZPD) supports this study's findings, as the teacher's guidance within the ZPD enabled students to solve complex problems collaboratively, thereby enhancing their critical thinking and problem-solving skills. This is supported by Tofi, Achor, & Eje (2022), who noted that students

taught with guided discovery performed significantly better in Biology. Therefore, the present study underscores the efficacy of guided discovery in fostering active learning, critical thinking, and deeper comprehension of scientific concepts.

The analysis of male and female students' achievement scores indicated no significant gender difference in achievement when taught Basic Science using the guided discovery method. Although male students had a slightly lower mean score (18.65) compared to female students (18.88), the difference was not statistically significant ($p > 0.05$). This supports Vygotsky's emphasis on social interaction and collaborative learning, where both genders benefit equally from peer discussions and teacher scaffolding. These findings are consistent with Tofi, Achor, & Eje (2022), who found no significant gender-based differences in Biology achievement when using the guided discovery approach. Similarly, Peter and Philip (2016) concluded that both male and female students achieved comparable results and retained knowledge effectively through guided discovery in Basic Science and Technology. Despite previous concerns about gender disparities in science education (Kayode, 2020), this study demonstrates that guided discovery fosters an inclusive learning environment where both genders thrive. This suggests that gender-based achievement gaps can be minimized by adopting interactive, student-centered teaching strategies that emphasize collaboration and problem-solving.

The findings of this study reinforce the Federal Ministry of Education's (2014) recommendation for student-centered, activity-based approaches in science education. Guided discovery not only improves academic achievement but also promotes scientific literacy and critical thinking, as emphasized by Afzal (2021). Implementing this strategy across different levels of education could address issues of poor academic achievement often attributed to traditional, lecture-based methods (Kayode, 2020). This study concludes that the guided discovery method significantly enhances students' academic achievement in Basic Science, regardless of gender. The theoretical foundation provided by Bruner's and Vygotsky's learning theories, along with empirical support from previous studies, confirms that guided discovery is a highly effective instructional strategy. Consequently, educators are encouraged to adopt this approach to foster deeper understanding, critical thinking, and equitable learning outcomes in science education.

5. Conclusion

i. The guided discovery method significantly enhanced students' academic achievement in Basic Science, aligning with constructivist learning theories.
ii. No gender-based differences were found in achievement, indicating that both male and female students benefited equally from the method.
iii. The study highlights the effectiveness of guided discovery in improving student engagement in Basic Science.

Recommendations

i. Teachers should incorporate the guided discovery method into Basic Science teaching to foster active engagement and improve achievement.
ii. Teachers need professional development to effectively implement guided discovery and provide appropriate student support.
iii. Further research should explore the impact of teaching methods on gender differences in Basic Science achievement.

Implications for the Study

i. The study suggests integrating student-centered methods like guided discovery into Basic Science curricula to enhance engagement and learning outcomes.
ii. Gender-inclusive teaching strategies should be emphasized to ensure equal opportunities for both male and female students in Basic Science.

iii. Adopting guided discovery could lead to improved academic achievement and better preparation of students for real-world challenges.

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