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EFFICACY OF GUIDED-INQUIRY INSTRUCTIONAL STRATEGY ON STUDENTS' ACADEMIC PERFORMANCE IN BASIC SCIENCE IN OTUKPO, BENUE STATE

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Abstract
This study investigated the effectiveness of guided inquiry instructional strategy on upper basic science students' academic performance in Otukpo LGA, Benue State. Quasi-experimental research design, specifically, pre-test post-test non-equivalent, non-randomized control group design was adopted. A sample of 72 students drawn from a population of 1,832 was used for the study. Two research questions were raised and answered in the study using mean and standard deviation while two hypotheses formulated were tested using Analyisis of Covariance (ANCOVA) at 0.05 level of significant. The instrument for data gathering was a validated Basic Science Performance Test (BSPT). It had reliability coefficient of 0.91 determined using Richard Kuderson 20 (K-R20) method. Students in both groups were given pre-test before instruction. During the instruction, the same content was presented to the two groups for a period of four weeks and thereafter, a post-test was administered. The findings of the study revealed that the students in guided inquiry strategy outperformed their counterparts in demonstration method. [F(1,69) = 15.915; p = 0.000 < 0.05], the results also showed that gender had no significant effect on mean performance scores of students taught Basic Science using guided inquiry strategy [F(1,35) = 0.223; p = 0.640 > 0.05]. Based on the findings, it was recommended among others that guided inquiry strategy should be employed for teaching Basic science to enhance their performance.

Keywords: Guided inquiry, Performance, Gender, Basic Science and Upper Basic Level

Introduction

Science education encompasses the teaching and learning of scientific concepts, principles, processes, and the nature of scientific inquiry. In the opinion of Taber (2017), the field of science education research focuses on understanding how science is taught and how students learn

scientific concepts. Bolaji (2019) views science education as a structured process of teaching, primarily within schools, aimed at increasing knowledge of the environment, fostering skills in organized inquiry, and nurturing a positive attitude toward nature. This makes science education fundamental not only for intellectual development but also for the acquisition of practical skills that benefit both individuals and society. Eya (2018) and Samba, Achor, Bash, and Iortim (2019) emphasized that national economic growth and productivity are closely linked to advances in science and technology. In Nigeria, the overarching goal of science education is to equip learners with the scientific literacy necessary to thrive in a world increasingly driven by science and technology (Babajide, 2015).

Basic Science, formerly known as Integrated Science, is the first form of science education students encounter in formal schooling. It serves as the foundation for advanced science subjects such as Biology, Chemistry, and Physics (Federal Republic of Nigeria [FRN], 2014; Enemarie, Ajayi, & Ogbeba, 2019; Ajio, Ode, & Kpiranyam, 2023). Chima (2020) noted that Basic Science adopts a multidisciplinary and student-centered approach that demystifies science and alleviates the fear often associated with it. Eya (2018) also described Basic Science as a subject that illustrates the unity and interrelatedness of scientific disciplines. The revised 2012 Basic Science curriculum highlights its importance, noting that it helps learners cultivate interest in science and technology, acquire fundamental knowledge, apply scientific skills to real-world challenges, and explore career opportunities in science and technology.

Despite its importance, Basic Science is often perceived by students as a difficult subject, leading to generally poor academic performance. For instance, data from 2020 to 2023 show that only in the 2019/2020 and 2021/2022 academic sessions did at least 50% of Basic Science students pass the Basic Education Certificate Examination (BECE) (BECE, 2020–2023). Agbiye, Tartenger, Ayua, and Akpoghol (2023) defined academic performance as the extent to which a student achieves educational objectives, typically measured through tests, examinations, or continuous assessments. Ode and Tartenger (2021), along with Ajio, Ode, and Kpiranyam (2023), reported that students performed poorly in both internal and external Basic Science assessments. They attributed this underperformance to several teacher-related factors, including reliance on teacher-centered methods, insufficient motivation for teachers, lack of laboratory facilities, and excessive workload. The teaching of Basic Science, especially at the foundational level, should reflect the nature of science, which emphasizes inquiry-based learning. Traditional, one-size-fits-all curricula and teacher-centered pedagogies no longer effectively meet the diverse needs of learners. This mismatch often leads to declining interest and inconsistent academic performance. Agbiye et al. (2023) argue that methods such as lectures and demonstrations make students passive recipients of information and hinder deep understanding of abstract scientific concepts. Given the critical role of Basic Science in national development, there is a pressing need to adopt innovative instructional strategies—such as guided inquiry, peer collaboration, role play, and mastery learning—that engage students actively and meaningfully.

Guided inquiry is one such strategy. Akerson, Hanson, and Cullen (2017) define it as a student-centered, activity-oriented method where teachers guide students through problem-solving processes to discover solutions independently. Nwanze (2016) describes it as a teaching approach in which learners, with minimal teacher guidance, actively seek answers through exploration

and investigation. Eche, Eriba, and Gyuse (2021) further characterize guided inquiry as involving classroom discussions, problem-solving, role plays, and collaborative learning, with students taking ownership of their learning. In this model, teachers pose carefully crafted questions that lead students to discover new knowledge themselves through observation, experimentation, and analysis.

Researches support the effectiveness of guided inquiry in science education in other locations. For example, Owolade, Salami, Kareem, and Oladipupo (2022) found a significant improvement in the academic performance of Biology students taught using guided inquiry compared to those taught through traditional lecture methods. Similarly, Odukwe and Nwafor (2020) reported that guided inquiry significantly enhanced the performance of Chemistry students in senior secondary schools in Anambra State. Their study also found no significant gender differences in academic outcomes.

Gender remains a notable factor in science education. It is a socio-cultural construct encompassing the roles and characteristics associated with being male or female. Studies investigating gender differences in science performance have yielded inconclusive results. For example, Murugan and Kamisah (2018), Ode, Ayua, and Alagwu (2019), and Odoh, Achor, and Egbodo (2021) reported that male students outperformed their female counterparts. In contrast, findings from Odukwe and Nwafor (2020), Ode and Tartenger (2021), and Tartenger, Enemarie, and Upu (2024) showed no significant gender-based performance differences. These inconsistencies highlight the need for further research.

In light of the challenges and gaps identified, this study examined the effectiveness of the guided inquiry instructional strategy on the academic performance of Upper Basic Science students in Otukpo Local Government Area of Benue State. It also sought to determine whether any significant performance differences exist between male and female students exposed to this teaching strategy.

Statement of the Problem

Students' performance in Basic Science in the Basic Education Certificate Examination (BECE) has been increasingly unsatisfactory in recent years, particularly in Otukpo Local Government Area. Research has linked this inconsistent performance to the continued reliance on teacher-centered instructional strategies, such as lecture and demonstration methods, commonly used in classrooms. If this trend of fluctuating performance in Basic Science persists, it may undermine the achievement of science education goals, especially at the foundational level. One significant implication is the potential decline in student enrollment in science-related courses at the senior secondary and tertiary levels, hindering national scientific and technological advancement.

In response to this concern, the present study aimed to investigate whether the guided inquiry instructional strategy could enhance students' academic performance in Basic Science. Based on this context, the central research problem of the study is: What is the effectiveness of the guided inquiry instructional strategy on the academic performance of Upper Basic Science students in Otukpo Local Government Area of Benue State?

Purpose of the Study

The objectives of the study were to:

1. examine the mean academic performance of students taught Basic

Science using guided-inquiry instructional strategy and demonstration strategy.
2. determine the mean academic performance of male and female students when taught Basic Science using guided-inquiry instructional strategy.

Research Questions

The study was guided by two research questions as follows:

1. What is the difference in the mean academic performance scores of students taught Basic Science using guided-inquiry instructional strategy and those taught with demonstration strategy?
2. What is the difference in the mean academic performance scores of male and female students' taught Basic Science using guided-inquiry instructional strategy?

Hypotheses

The following two hypotheses were formulated and tested at the 0.05 level of significance:

1. There is no significant difference in the mean academic performance scores of students taught Basic Science using guided-inquiry instructional strategy and those taught using demonstration strategy.
2. There is no significant difference in the mean performance scores of male and female students taught Basic Science using guided-inquiry instructional strategy.

Methodology

This study adopted a quasi-experimental research design, specifically the pre-test and post-test non-equivalent, non-randomized control group design. This design was selected because intact classes were used to avoid disrupting the normal academic schedule of the participating schools through random assignment of students into experimental and control groups. The suitability of this quasi-experimental design is supported by Emaikwu (2015).

The population for the study consisted of 1,588 students drawn from all 17 Universal Basic Education (UBE) schools in Otukpo Local Government Area (Otukpo Educational Area Office, 2023). A multistage sampling procedure was employed. First, purposive sampling was used to select only co-educational UBE schools. Then, a simple random sampling technique was applied to select two schools from this subset. A total of 72 Upper Basic II students from the two schools constituted the sample for the study. Intact classes were selected using the hat-and-draw method, with one class from each school randomly assigned to either the experimental or control group.

The instrument used for data collection was the Basic Science Performance Test (BSPT), comprising 30 multiple-choice questions with four options each. The test items focused on the topics of pollution and simple machines. Section A of the BSPT collected students' biodata, while Section B assessed their academic performance in Basic Science. The BSPT was validated by three experts: two science educators and one specialist in test and measurement. Their feedback was incorporated to enhance the quality of the instrument. It was then trial-tested on 30 Upper Basic II students from two schools not involved in the main study but with similar characteristics. Reliability was determined using the Kuder-Richardson Formula 20 (KR-20), which yielded a coefficient of 0.91, indicating high reliability.

The instrument was administered under standardized examination conditions by trained research assistants. Data were analyzed using mean and standard deviation to answer the research questions. Analysis of Covariance (ANCOVA) was employed to

test the null hypotheses at a 0.05 level of significance. ANCOVA was chosen to control for initial differences between the groups, given the use of intact classes. The decision rule for hypothesis testing was as follows: if the p-value is less than 0.05, the null hypothesis is rejected; if the p-value is equal to or greater than 0.05, the null hypothesis is not rejected.

Results

The results are presented following the order of research questions and hypotheses.

Research Question One: What is the difference in the mean academic performance scores of students taught Basic Science using guided-inquiry instructional strategy and those taught using demonstration strategy?

Table 1: *Mean and Standard Deviation of Academic Performance Scores of students taught Basic Science using Guided-inquiry Teaching Strategy and Demonstration Strategy*

		Pre–test		Post-test		
Strategy	n	Mean	Std. Dev	Mean	Std. Dev	Mean gain
Guided Inquiry	38	7.72	2.410	16.28	5.407	8.56
Demonstration	34	7.97	2.601	12.18	4.189	4.21
Mean difference						4.35

Table 1 reveals that the mean gain of students taught Basic Science using Guided Inquiry instructional strategy is 8.56 and those taught using demonstration method is 4.21. The difference in the mean gain in Academic performance scores of the students' taught is 4.35 in favour of students taught using Guided Inquiry instructional strategy.

Research Question Two: What is the difference in the mean academic performance scores of male and female students' taught Basic Science using guided-inquiry instructional strategy?

Table 2: *Mean and Standard Deviation of Academic Performance Scores of Male and Female Students Exposed to Guided-inquiry Instructional Strategy*

		Pre –test		Post-test		
Gender	n	Mean	Std. Dev	Mean	Std. Dev	Mean gain
Male	20	7.80	2.859	15.93	3.693	8.13
Female	18	7.91	2.214	16.83	6.250	8.92
Mean difference						0.79

Table 2 shows that the mean gain of male students taught Basic Science using Guided Inquiry teaching instructional is 8.13 while that of female students taught Basic Science

using Guided Inquiry instructional strategy is 8.92. The difference in the mean gain in Academic performance scores of male and female students taught Basic Science using Guided Inquiry instructional strategy is 0.79 in favour of female students.

Hypothesis One: There is no significant difference in the mean academic performance scores of students taught Basic Science using guided-inquiry instructional strategy and those taught using demonstration strategy.

Table 3: *ANCOVA of Academic Performance Scores of Students taught using Guided-Inquiry Teaching Strategy and Demonstration Strategy*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	491.204[a]	2	245.602	11.477	.000	.250
Intercept	623.002	1	623.002	29.113	.000	.297
Pretest	159.841	1	159.841	7.469	.008	.098
Group	**340.564**	**1**	**340.564**	**15.915**	**.000**	**.187**
Error	1476.574	69	21.400			
Total	16990.000	72				
Corrected Total	1967.778	71				

Table 3 reveals that $F(1,69) = 15.915$; $p = 0.000 < 0.05$. Thus, the null hypothesis is rejected. By implication that there is significant difference in the mean academic performance scores of students' exposed to Guided Inquiry instructional strategy and demonstration strategy. The partial Eta square of 0.187 was obtained for method meaning that only 18.7% of the Basic Science performance scores can be accounted for the effect of instructional strategy in Basic Science class when taught using Guided Inquiry teaching strategy.

Hypothesis Two: There is no significant difference in the mean performance scores of male and female students taught Basic Science using guided-inquiry instructional strategy.

Table 4: ANCOVA of Academic Performance Scores of Male and Female Students Exposed to Guided Inquiry Teaching Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	66.182[a]	2	33.091	1.168	.323	.063
Intercept	498.251	1	498.251	17.592	.000	.334
Pretest	58.946	1	58.946	2.081	.158	.056
Gender	**6.320**	**1**	**6.320**	**.223**	**.640**	**.006**
Error	991.292	35	28.323			
Total	11370.000	38				
Corrected Total	1057.474	37				

The data in Table 4 reveals that F(1,35) = 0.223; p = 0.640 > 0.05. Thus, the null hypothesis is not rejected. This implies that there is no significant difference in the mean academic performance scores of male and female students exposed to Guided Inquiry teaching strategy. The partial Eta square of 0.006 for gender means that only 0.6% of the Basic Science performance scores can be attributed to the effect of gender in Basic Science class when taught using Guided Inquiry strategy.

Discussion of Findings

The findings from hypothesis one showed a significant difference in the mean academic performance scores of students exposed to guided inquiry teaching strategy and the demonstration method. The students exposed to guided inquiry teaching strategy outperformed their counterparts exposed to demonstration method. This finding agrees with Owolade, Salami, Karem and Oladipupo (2022) study which found significant difference in the academic performance of Biology students taught using guided inquiry and those taught using conventional lecture method. The finding is also in line with that of Odukwe, and Nwafor (2020) who found that guided-inquiry method is more effective in improving academic achievement of chemistry students than the Conventional lecture method. This agreement of the findings may be because guided inquiry teaching strategy enables the teacher to provide temporary support to students individually or collectively to complete tasks that they might not be able to do without help thereby making it possible for the students to attained high performance.

The finding from hypothesis two indicated that there is no significant difference in the mean academic performance scores of male and female students exposed to guided inquiry teaching strategy. This implies that the performance of both male and female students exposed to guided inquiry teaching strategy is enhanced equally. This agrees with the findings of Odukwe and Nwafor (2020); Ode and Tartenger (2021) and Tartenger, Enemarie and Upu (2024), who found no difference in the performance between male and female students. According to the authors innovative teaching strategy such as guided inquiry improves learners' performance and generally helps students understand what they have learnt. This high and gender-free performance could be as a result of students' active participation in class as every student's is given an opportunity to make contribution during group discussions, both the intelligent, fast learners and the slow learners. Conversely, this finding disagreed with the findings of Murugan and Kamisah (2018); Ode, Ayua and Alagwu (2019) and Odoh, Achor and Egbodo (2021) who found in their separate studies that male students outperformed the female students. Such discrepancies may be due to variations in study location, cultural contexts, or the academic levels of the sampled learners. These differences underscore the potential of the guided inquiry method to bridge performance gaps in Basic Science, suggesting that its broader adoption could improve overall student outcomes at the basic education level.

Conclusion

The study established that students taught using the guided inquiry teaching strategy performed significantly better than those taught with the demonstration method. This supports previous research showing guided

inquiry's effectiveness in improving academic performance. Additionally, there was no significant difference in performance between male and female students using this strategy, indicating that guided inquiry benefits all students equally, promoting both high performance and gender equity in learning.

Recommendations

The following recommendations were made:

1. Basic Science teachers should employ guided inquiry instructional strategy when teaching Basic Science as the strategy provides opportunities for the teachers to guide students to learn Basic Science with improve performance.
2. In- service training, seminars and workshops should be organized by the State and Federal Ministries of Education to train Basic Science teachers on how to use guided inquiry instructional strategy in improving male and female students' performance in Basic Science.

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