

Effect of Inquiry Teaching Strategy on Students' Achievement in Nervous System in Jos-South Local Government Area of Plateau State, Nigeria

¹Ngufwan, Obed David & ²John, Friday

¹Hillcrest School, Jos.
ngufwano@gmail.com

²Department of Science & Technology Education.
Faculty of Education, University of Jos.
drfridayjohn@yahoo.com

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Abstract

This study examined the effect of the inquiry teaching strategy on students' achievement in the nervous system in Jos South Local Government Area of Plateau State, Nigeria. A quasi-experimental research design involving a pretest–posttest control group was adopted. Two research questions and two corresponding null hypotheses were formulated and tested at the 0.05 level of significance. The population of the study comprised of the 485 (264 male and 221 female) senior secondary two students offering Biology in the 13 co-educational secondary schools that met the criteria of the population. A sample of 80 students (31 males and 49 females) drawn from intact classes in two co-educational public secondary schools was selected using purposive sampling. The Nervous System Achievement Test (NSAT) was used for data collection. The instrument was validated by three experts, and a reliability coefficient of 0.64 was obtained using the Pearson Product-Moment Correlation Coefficient. Data collected were analysed using mean, standard deviation, and Analysis of Covariance (ANCOVA). The findings revealed that students who were taught the nervous system using the inquiry teaching strategy achieved significantly higher results than those taught using the lecture method. The results also showed a significant difference in achievement between male and female students taught using the inquiry teaching strategy. Based on these findings, it was recommended that Biology teachers should adopt inquiry-based instructional strategies alongside other gender-responsive teaching approaches to enhance students' achievement in Biology.

Keywords: Teaching Strategy, Inquiry Teaching Strategy, Achievement, Nervous System, and Gender

INTRODUCTION

Biology is relevant to applied sciences such as medicine, pharmacy, nursing, and many others. It is defined as a natural science that deals with the living world (Owolabi, Olanike, Babatunde & Gambari, 2019). Ozurumba-Dwight and Odu (2022) describe

Biology Education as a discipline that promotes awareness of critical issues such as food supply, environmental pollution and hereditary diseases. The nervous system is complex, abstract, and difficult for many students to understand, often leading to poor academic achievement in Biology. Students'

difficulties in understanding have often been attributed to teacher-centred instructional strategy (Kulachai, Benchakhan, & Homyamyen, 2025). The lecture method is a teacher-centered method where the teachers do most of the talking all the time, and the learners sit and listen (Abifarin, 2019). Consequently, there has been a growing emphasis on learner-centred teaching strategies that actively engage students and promote meaningful learning (Arifin, Sukarmin, Saputro & Kamari, 2025). Kulachai, Benchakhan and Homyamyen (2025) found in their study that instructional strategies which encourage interaction do lead to improvement in students' achievement.

Inquiry teaching strategy is a learner-centered method that engages the students and develops creativity and critical thinking. Polanin, Austin, Taylor, Steingut, Rodgers and Williams (2024) submitted that inquiry based teaching that incorporates the 5E (engage, explore, explain, elaborate and evaluate) model improves students' academic achievement in sciences. Students' active involvement in the learning process enhances their knowledge retention and improves (Zheng & Mustapha, 2022). In all this discussion, gender is a factor that cannot be ignored. Although sciences are dominated by males, Jia, Yang, Qian and Wu (2022) found that there are no gender differences in interest and achievement in Biology. This paper looks at the effect of inquiry teaching strategy on students' achievement in the nervous system in Jos-South Local Government Area of Plateau State, Nigeria.

LITERATURE REVIEW

Existing scholarly works on the effects of teaching strategies on students' academic achievement have been widely examined. This section reviews relevant empirical studies on instructional strategies (inquiry-based and 5 E-learning strategies) in order to identify gaps in knowledge, establish the relevance of the present study, and provide a framework for interpreting its findings.

A substantial body of literature supports the effectiveness of inquiry-based teaching strategies in improving students' academic achievement. For instance, Sever and Guven (2014) reported that students' achievement improves significantly when taught using inquiry-based strategies. Similarly, Ali (2014) found in his study that inquiry-based learners perform better. These findings suggest that inquiry approaches enhance students' understanding of scientific concepts. In the same vein, Duran and Dokme (2016) observed significant improvement in students' critical-thinking skills when inquiry-based teaching strategies were employed.

However, not all studies are in agreement. Rizzo and Taylor (2016) argued that inquiry-based instruction alone may not be sufficient to improve science achievement, indicating that additional instructional support may be necessary. Nonetheless, other studies continue to highlight the effectiveness of innovative instructional approaches. For example, Evrim (2016) found that the use of improved teaching strategies leads to higher academic achievement, while Senol and Ozyge (2017) reported that 5E inquiry learning activities significantly enhance

students' achievement and their ability to ask meaningful questions that promote deep learning. Further empirical evidence reinforces these findings. Jack (2017) reported significant differences between the post-test mean scores of experimental and control groups, with the experimental group outperforming the control group. Similarly, Artayasa, Susilo, Lestari, and Indriwati (2018) found that open inquiry produced the highest level of science concept understanding compared to the traditional lecture method.

Conversely, some studies present mixed results. Tuccaroglu and Simseklu (2018) found that only argument-based inquiry enhances students' participation in classroom discussions and possible higher achievement. It is important to note that their study focused on reproduction, whereas the present study concentrates on the nervous system, which may account for differences in outcomes. Additional studies further affirm the effectiveness of inquiry-based learning. Ekomaye (2019) found that the experimental group showed improved post-test scores compared to pre-test scores, indicating a positive effect of the treatment, while gender had no significant influence on achievement. Similarly, Karademir and Akman (2019) found no significant difference among groups, although there was a significant improvement between pre-test and post-test scores across all groups..

Studies focusing on the 5E learning cycle also demonstrate its effectiveness. Yakob, Kalum, Ahmad, Rashid and Abdillah (2020) found that the 5E model promotes deeper understanding of concepts and

sustained learning, as evidenced by improvements in delayed post-test scores. Hastuti, Surahmat, Sutarto, and Dafik (2020) also reported that guided inquiry enhances students' depth of understanding and awareness of their learning processes. Moreover, Cahaya, Suarni, Dantes and Margunayasa (2020) found a significant interaction between teaching models and social interaction abilities in enhancing creativity, while Muskita, Subali, and Djukri (2020) observed improvements in students' critical thinking, creativity, and scientific literacy through worksheet-based inquiry. Although similar to the present study, their approach differs in the use of worksheets rather than the 5E learning cycle.

Further supporting evidence is provided by Divrick, Pilten, and Tas (2020), who reported that inquiry methods improve students' scientific process skills, problem-solving abilities, and attitudes toward science. In summary, the reviewed literature largely supports the effectiveness of inquiry-based and 5E instructional strategies in improving students' academic achievement, critical thinking, and engagement in science. However, inconsistencies in some findings suggest the need for further investigation, particularly in specific subject areas such as the nervous system. This gap provides justification for the present study.

STATEMENT OF THE PROBLEM

Biology is a prerequisite subject to many fields of learning that contribute immensely to the growth of the nation. It is expected that students should have high achievement scores in Biology at the Senior School Certificate Examination. However, students'

achievement scores in Biology have not been positively stable over the years (Chief Examinations' Report, 2018). Although it cannot be said that the students are failing biology, there is a need for improvement and stability in the improvement. The lack of positive stability, as observed from the analysis of the Educational Resource Centre of Jos, can be corrected using teaching methods that deepen students' understanding (ERC Jos, 2018). In most Biology classrooms, teachers use the lecture method. Instead of the lecture method, this study proposes the use of the 5E instructional model, inquiry-based teaching. The 5E instructional model of inquiry-based teaching is a student-centred teaching method that engages the students at a deeper level with the learning material. The learners actively participate in the process of gathering and making meaning out of information. This makes the students remember what they have learned even after a long period.

In order to address the problem of academic achievement in Biology, this study, therefore, intends to investigate how students' academic achievement and attitude can be improved using inquiry-based teaching. The study will also look into the myth of the differences in achievement of the different genders in Biology.

OBJECTIVES OF THE STUDY

The objectives of this study are to examine the effectiveness of the inquiry teaching strategy on students' understanding and academic achievement in the nervous system. Specifically, the study seeks to:

1. determine the mean achievement scores of students taught the nervous system using the inquiry teaching strategy and those taught using the lecture method; and
2. determine the mean achievement scores of male and female students taught the nervous system using the inquiry teaching strategy.

RESEARCH QUESTIONS

The research questions were formulated to guide the investigation by providing focused inquiries into the problem under study and directing the collection and analysis of relevant data.

- (i) What is the difference in the mean achievement scores of students taught the nervous system using the inquiry teaching strategy and those taught using the lecture method?
- (ii) What is the difference in the mean achievement scores of male and female students taught about the nervous system using the inquiry teaching strategy?

HYPOTHESES

The hypotheses of the study were stated as testable predictions that establish possible relationships between variables, providing a basis for statistical analysis and decision-making regarding the effectiveness of the instructional strategy.

H₀₁ There is no significant difference between the mean achievement scores of students taught the nervous system using an inquiry teaching strategy and those taught using the lecture method.

H₀₂ There is no significant difference between the mean achievement scores of

male and female students taught the nervous system using the inquiry teaching strategy.

METHODOLOGY

The study adopted the quasi-experimental design, where intact classes were used. The population of the study consisted of the 485 (264 male and 221 female) students offering Biology in the 13 co-educational secondary schools in Jos-South Local Government Area of Plateau State that met the criteria of the population. The study sample comprised 80 students (49 females and 31 males) from two co-educational public senior secondary schools during the 2022/2023 academic session. Purposive sampling was used to select schools that offer Biology and have at least thirty students per class, ensuring relevant participants and sufficient numbers for group comparison. One school was randomly assigned to the experimental group and the other to the control group, reducing selection bias and enhancing group equivalence. The sample size was adequate for effective classroom management, feasible implementation of the inquiry strategy, and reliable statistical analysis. Including both genders ensured representation, while selecting public schools reflected typical classroom realities, improving the applicability of the findings. The researcher used the Nervous System Achievement Test (NSAT) to collect data. The NSAT was used to measure students' achievement in the nervous system, which was taught during the period of study. The test consists of 20 objective items and was adopted from the

1993-2022). The test items covered the concept of the Nervous System with four options (A-D), in which students are expected to choose the correct option in line with the West African Examinations Council (WAEC) standard. The mark allotted to each correct option is 5, and the total mark obtainable is 100. This instrument was subjected to scrutiny by three experts, two experts in Biology Education and one expert from the Measurement and Evaluation unit, all at the University of Jos. They scrutinised the instrument in terms of clarity, appropriateness and comprehensiveness.

NSAT was trial tested on a group of 20 (SSII) Biology students from a co-educational senior secondary school in Jos North Local Government Area, and the scores were subjected to the Pearson Product-Moment Correlation coefficient, which yielded a reliability index of 0.64 for the instrument. The pre-test was administered to both the experimental and control groups before the commencement of the four-week treatment to determine the equivalence of the groups in knowledge and ability. The experimental group was taught for four weeks using the inquiry teaching strategy, while the control group was taught using the lecture method. The post-test was administered after the four-week teaching exercise to both groups, and scores obtained were analysed, and the research questions and hypotheses were answered using mean and standard deviation, while analysis of covariance (ANCOVA) was used to test all hypotheses at a 0.05 level of significance.

RESULTS

The data analysed is presented and discussed as follows:

Research Question One: What is the difference in the mean achievement scores of students taught the nervous system using an inquiry teaching strategy and those taught using the lecture method?

Table 1: Mean and Standard deviation of pretest and posttest achievement scores of students taught the nervous system using the inquiry teaching strategy and those taught using the lecture method.

Variable Method of Teaching Gain	Pretest			Posttest			
	N	Mean	Sd	N	Mean	Sd	Mean
Inquiry Teaching Strategy	40	74.25	11.07	40	85.25	9.13	11
Lecture Method	40	69.93	10.59	40	77.38	8.62	7.45

Results in Table 1 showed that both teaching methods had a mean gain. The group that was taught using Inquiry Teaching Strategy had a higher Mean gain (11) than the mean gain (7.45) of the group that was taught

using Lecture Method. This is an indication that the inquiry teaching strategy has a greater effect on students' achievement in the nervous system than the lecture method.

Research Question Two: What is the difference in the mean achievement scores of male and female students taught the nervous system using the inquiry teaching strategy?

Table 2: Mean and standard deviation of pretest and posttest achievement scores of male and female students taught the nervous system using the inquiry teaching strategy.

Variable Gender	Pretest			Posttest			
	N	Mean	Sd	N	Mean	Sd	Mean
Male	19	73.16	13.25	19	88.95	8.91	15.79
Female	21	75.24	8.87	21	81.90	8.14	6.66

Results in Table 2 showed that both genders had a mean gain. There was a 15.79 mean gain for the males and 6.66 mean gain for females when taught the nervous system using the Inquiry Teaching Strategy. This

might be an indication that gender may have some effects on students' achievement in the nervous system when taught using an inquiry teaching strategy.

Hypothesis One Ho₁: There is no significant difference between the mean achievement scores of students taught the nervous system using an inquiry teaching strategy and those taught using the lecture method.

Table 3: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught the nervous system using the inquiry teaching strategy and those taught using the lecture method.

Source	Sum of Square	Df	Mean Square	F	Sig.
Intercept	3306.744	1	3306.744	81.417	.000
Pretest	2348.591	1	2348.591	57.826	.000
Gender	556.596	1	556.596	13.704	.000
Group	484.318	1	484.318	11.925	.001
Group gender	117.899	1	117.899	2.903	.093
Error	3046.130	75	40.615		
Total	536325.000	80			
Corrected Total	7387.187	79			

The result in Table 3 showed that an F-ratio of 11.93 was obtained with an associated probability value of .001. Since the associated probability value of 0.001 was less than 0.05, set as the level of significance, the null hypothesis (H01) is

rejected. Thus, the inference drawn is that there was a significant difference in the mean achievement scores of students taught the nervous system using the inquiry teaching strategy and those taught using the lecture method.

Hypothesis Two Ho₂: There is no significant difference between the mean achievement scores of male and female students taught the nervous system using the inquiry teaching strategy.

Table 4: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of male and female students taught the nervous system using an inquiry teaching strategy.

Source	Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	1740.591 ^a	2	870.296	21.369	.000
Intercept	1888.453	1	1888.453	46.368	.000
Pretest	1245.848	1	1245.848	30.590	.000
Gender	650.103	1	650.103	15.962	0.00
Error	1506.909	37	40.727		
Total	293950.000	40			
Corrected Total	7387.187	39			

The result in Table 4 showed that an F-ratio of 15.96 was obtained with an associated probability value of 0.00. Since the associated probability value of 0.00 was less than 0.05, set as the level of significance, the null hypothesis (H02), which stated that

there is no significant difference in the mean achievement scores of male and female students in the nervous system, is rejected. Thus, the inference drawn is that the mean scores of male and female students did differ significantly when taught the nervous system using an inquiry teaching strategy.

DISCUSSION

This study examined the effect of inquiry teaching strategy on Senior Secondary Two students' achievement in the nervous system in Jos-South, Plateau State. The findings from research question one revealed that students taught using the inquiry teaching strategy achieved higher academic scores than those taught using the conventional lecture method. This result underscores the effectiveness of learner-centered approaches in enhancing students' understanding of complex biological concepts such as the nervous system. The observed improvement may be attributed to the active engagement, exploration, and critical thinking opportunities inherent in inquiry-based learning. This finding is consistent with several empirical studies reviewed in the literature. For instance, Sever and Guven (2014) reported that students' achievement improves significantly when exposed to inquiry-based strategies. Similarly, Ali (2014) found that students taught using inquiry-based instruction performed significantly better than those taught using traditional approaches.

The result also aligns with Duran and Dokme (2016), who observed that inquiry teaching enhances students' critical-thinking skills, thereby contributing to improved academic performance. These converging findings suggest that inquiry-based strategies promote deeper conceptual understanding and meaningful learning, particularly in abstract topics like the nervous system. However, the findings contrast with Rizzo and Taylor (2016), who argued that inquiry-based instruction alone may not significantly

improve science achievement. This discrepancy may be due to variations in implementation, subject matter, or contextual factors such as students' prior knowledge and teacher effectiveness. Findings from research question two indicated that male students taught using the inquiry teaching strategy achieved higher academic scores than their female counterparts. This suggests a gender disparity in achievement under the inquiry-based approach. This result, however, contradicts the findings of Naidoo and Sibanda (2020), who reported that female students outperformed male students in science achievement. It also disagrees with Ekomaye (2019), who found no significant gender difference in students' achievement when taught using inquiry-based methods. The variation in findings may be attributed to differences in learning environments, cultural contexts, or students' attitudes toward science.

The test of hypothesis one further confirmed a statistically significant difference in achievement between students taught using inquiry teaching strategy and those taught using the lecture method ($F = 11.93$, $p < 0.05$). The null hypothesis was therefore rejected, indicating that inquiry teaching strategy has a significant positive effect on students' academic achievement. This result reinforces earlier findings and supports the position that inquiry-based instruction is more effective than traditional teaching methods. Studies such as Artayasa, Susilo, Lestari, and Indriwati (2018) and Yakob, Kalum, Ahmad, Rashid and Abdillah (2020) also reported that inquiry-based and 5E learning models enhance students' understanding and retention of scientific

concepts, further validating the present findings. In contrast, some studies such as Tuccaroglu and Simseklu (2018) and Karademir and Akman (2019) reported no significant differences between experimental and control groups, highlighting that the effectiveness of inquiry strategies may depend on factors such as implementation fidelity and instructional context.

The result of hypothesis two revealed a significant difference in the achievement scores of male and female students ($F = 15.96, p < 0.05$), leading to the rejection of the null hypothesis. This implies that gender significantly influences students' achievement when exposed to inquiry teaching strategies. This finding is in agreement with Sagala, Umam, Thahir, Saregar and Kurppa (2019), who reported that male students tend to perform better in science-related tasks. However, it contradicts Sofiani, Maulida, Fadhilah and Sihite (2017), who found no significant gender-based differences in students' attitudes toward science.

Overall, the findings of this study provide strong empirical support for the effectiveness of inquiry teaching strategy in improving students' academic achievement in Biology. While the results largely align with existing literature, the observed gender differences and inconsistencies with some studies indicate the need for further research to explore moderating variables such as gender, learning environment, and instructional design.

CONCLUSION AND RECOMMENDATIONS

Based on the outcome of this research, it is concluded that inquiry teaching strategy improves the achievement of students in the topic nervous system effectively than the conventional lecture method. Although inquiry teaching strategy improves academic achievement scores, the findings showed that it might not be a gender friendly method as male students achieved higher academic scores than the female students. It is noteworthy that inquiry teaching strategy improves students' confidence and enhances a deeper understanding of nervous system concepts. Based on the findings of this study and the discussion thereof, the following recommendations were made:

1. Biology teachers should adopt inquiry-based teaching strategies in the classroom, especially when teaching complex and abstract topics such as the nervous system, as it has been shown to significantly improve students' academic achievement.
2. Curriculum planners and policymakers should integrate inquiry-based approaches, such as the 5E instructional model, into the Biology curriculum to promote active learning, critical thinking, and deeper understanding among students.
3. Teachers should employ inclusive and gender-sensitive instructional strategies that encourage equal participation of both male and female students, in order to minimize the observed gender disparity in achievement.

4. Future studies should be conducted to explore the factors responsible for gender differences in achievement under inquiry-based instruction, as well as to examine the effectiveness of the strategy in other Biology topics and educational settings.

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