Effects of Field Trip and Demonstration-Based Teaching Methods on Students' Academic Achievement in Basic Science

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Abstract

Background: *Persistent poor academic achievement in Basic Science among junior secondary school students in Nigeria has been attributed, in part, to the continued reliance on teacher-centred instructional approaches that provide limited opportunities for active learner engagement. Although field trip and demonstration-based teaching methods have been identified as learner-centred instructional strategies capable of enhancing science learning, empirical evidence comparing their effectiveness in Basic Science remains limited, particularly within the Nigerian junior secondary school context.*

Purpose: *This study investigated the effects of field trip and demonstration-based teaching methods on students' academic achievement in Basic Science in Nsukka Local Government Area, Enugu State, Nigeria. Specifically, the study compared students' achievement under the two instructional methods, examined the influence of gender on achievement, and determined whether teaching method and gender interacted to influence students' academic achievement.*

Method: *The study adopted a quasi-experimental pre-test post-test non-equivalent control group design. The population comprised 4,040 Junior Secondary School II students enrolled in 30 public secondary schools, of whom 68 were selected through a multistage sampling procedure. Data were collected using the Basic Science Achievement Test (BSAT), a 30-item multiple-choice instrument with a Kuder-Richardson 20 reliability coefficient of .84. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at the .05 level of significance.*

Results: *Students taught using the field trip method recorded a higher post-test mean score (*M *= 78.44,* SD *= 11.63) and greater mean gain (51.57) than those taught using the demonstration-based teaching method (*M *= 72.19,* SD *= 11.20; mean gain = 44.63). ANCOVA revealed a significant main effect of teaching method on students' academic achievement,* F*(1, 65) = 15.54,* p *< .001. Gender also had a significant main effect,* F*(1, 65) = 12.49,* p *= .001, whereas the interaction between teaching method and gender was not statistically significant,* F*(1, 65) = 2.25,* p *= .137.*

Conclusion: *The findings demonstrate that field-trip instruction is significantly more effective than demonstration-based teaching at enhancing students' academic achievement in Basic Science. Although gender significantly influenced achievement, the effectiveness of the instructional methods did not vary by gender. The study therefore recommends greater integration of field trips into Basic Science instruction to promote experiential learning and improve students' academic outcomes.*

Keywords: *Basic Science, academic achievement, demonstration method, experiential learning, field trip, gender*

1. Introduction

Science education is widely acknowledged as a critical driver of national development because it equips learners with the knowledge, skills, and competencies required to participate effectively in an increasingly technology-driven society. Across the world, governments continue to invest in science education as a means of fostering innovation, enhancing economic competitiveness, and preparing future generations for careers in science, technology, engineering, and mathematics (STEM) (OECD, 2023). At the foundation of science education in Nigeria is Basic Science, a compulsory subject offered at the junior secondary school level that integrates concepts from Biology, Chemistry, Physics, Earth Science, and Environmental Science. The subject is intended to develop scientific literacy, inquiry skills, critical thinking, and problem-solving abilities while preparing learners for further studies in science-related disciplines (Federal Republic of Nigeria [FRN], 2014; Nigerian Educational Research and Development Council [NERDC], 2020).

Despite the strategic importance of Basic Science, students' academic achievement in the subject remains unsatisfactory in many Nigerian secondary schools. Reports from national examinations and findings from empirical studies consistently indicate that many students fail to attain the expected level of competence in Basic Science, thereby limiting their progression into senior secondary science subjects and reducing the pool of learners prepared for STEM careers (Okoli & Ezeudu, 2021; OECD, 2023). Low achievement has been attributed to several school- and learner-related factors, including inadequate instructional resources, overcrowded classrooms, limited teacher competence, and the persistent use of teacher-centred instructional methods that encourage passive rather than active learning (Darling-Hammond et al., 2020).

Among the school-related variables influencing students' learning outcomes, instructional method has consistently emerged as one of the strongest predictors of academic achievement. Effective teaching methods influence not only what students learn but also how they construct knowledge, engage with learning activities, and retain scientific concepts over time. Contemporary science education therefore emphasizes learner-centred pedagogies that encourage inquiry, collaboration, experimentation, and authentic learning experiences rather than rote memorization and passive listening (Hattie, 2023; OECD, 2023).

Field trip instruction represents one of the most authentic learner-centred approaches employed in science education. A field trip involves taking learners beyond the conventional classroom to observe scientific concepts, processes, and phenomena within natural or industrial environments. Such experiences enable students to connect theoretical classroom instruction

with real-life situations, thereby enhancing conceptual understanding, motivation, curiosity, and long-term retention of scientific knowledge. Recent studies have demonstrated that field trips significantly improve students' engagement, scientific reasoning, and academic achievement because they provide opportunities for observation, inquiry, and contextualized learning (Behrendt & Franklin, 2014; Al-Balushi & Al-Aamri, 2014).

Another learner-centred instructional approach widely employed in science education is the demonstration method. Demonstration-based teaching enables teachers to illustrate scientific concepts, experiments, and procedures while learners observe, question, and participate in guided activities. The method is particularly valuable where laboratory facilities or instructional materials are limited because it enables students to visualize abstract scientific concepts through carefully planned demonstrations. Research has shown that demonstration-based instruction improves students' conceptual understanding and classroom participation compared with conventional lecture methods (Barka & Idris, 2023; Mayer, 2021). Nevertheless, demonstrations remain largely teacher-directed and may not provide learners with the same level of authentic engagement associated with direct experiential learning.

Several comparative studies have examined the effectiveness of learner-centred instructional approaches in science education. Although both field trips and demonstrations generally produce better learning outcomes than conventional lecture methods, findings regarding their relative effectiveness remain inconsistent across contexts and subject areas. While some studies report superior outcomes for field-based experiential learning, others indicate that demonstration methods can be equally effective when carefully implemented (Mohammed et al., 2023; Njoku & Mgbomo, 2021). Moreover, relatively few empirical studies have directly compared the two instructional approaches within the context of Basic Science among junior secondary school students in southeastern Nigeria.

Gender has also received considerable attention in science education research because of its potential influence on students' academic achievement. Previous studies have reported mixed findings regarding gender differences in science achievement. Whereas some studies suggest that male students outperform females in science-related subjects, others report either no significant differences or better performance among female students under learner-centred instructional conditions (Barka & Idris, 2023; Okoye & Onyeka, 2023). These inconsistent findings indicate that the influence of gender may depend largely on contextual factors, including instructional methods, learning environment, and subject content, thereby necessitating further investigation.

Theoretical Framework

This study is anchored primarily on **Kolb's Experiential Learning Theory (1984)**, which posits that effective learning occurs through the transformation of experience. According to Kolb, learning is a continuous process involving four interrelated stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Learners first engage in a direct experience, reflect on that experience, develop conceptual understanding, and subsequently apply the newly acquired knowledge in different contexts. The theory emphasizes active learner participation and regards knowledge as being constructed through experience rather than transmitted solely through verbal instruction.

Field trip instruction closely aligns with Kolb's experiential learning cycle because it provides students with authentic scientific experiences that stimulate observation, reflection, conceptual understanding, and practical application. Students participating in field trips directly observe scientific phenomena, interact with real-world environments, discuss their observations, and subsequently integrate these experiences into classroom learning. Demonstration-based teaching also reflects aspects of experiential learning by allowing students to observe scientific processes; however, learners remain largely observers rather than direct participants in the

learning experience. Consequently, Kolb's theory provides a strong theoretical justification for expecting field trips to produce greater improvements in students' academic achievement than demonstration-based instruction.

The study is further supported conceptually by **Dale's Cone of Experience** (Dale, 1969), which proposes that learners retain knowledge more effectively when instruction progresses from abstract verbal representations to direct, purposeful experiences. According to Dale, learning becomes increasingly meaningful as learners engage actively with concrete experiences rather than relying solely on verbal explanations or visual demonstrations. Although not a formal learning theory, the Cone of Experience provides a useful conceptual explanation for the potential superiority of field trip instruction because it emphasizes the educational value of firsthand experiences. Together, Kolb's Experiential Learning Theory and Dale's Cone of Experience provide complementary explanations for why experiential instructional approaches are expected to enhance students' academic achievement in Basic Science.

Although previous studies have established the effectiveness of learner-centred instructional strategies in science education, limited empirical evidence directly compares field trip and demonstration-based teaching methods in Basic Science within Nsukka Local Government Area. Furthermore, little is known about whether the effectiveness of these instructional methods varies according to students' gender in this context. Addressing these gaps is important because identifying more effective instructional approaches could contribute to improving students' academic achievement and strengthening science education at the basic education level. Consequently, this study investigated the effects of field trip and demonstration-based teaching methods on students' academic achievement in Basic Science, the influence of gender on achievement, and the interaction effect of teaching method and gender on students' academic achievement.

Research questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught Basic Science using the field trip method and those taught using the demonstration-based teaching method?
2. What are the mean achievement scores of male and female students taught Basic Science using the field trip method and those taught using the demonstration-based teaching method?
3. What is the interaction effect of teaching method and gender on students' academic achievement in Basic Science?

Hypotheses

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

$H0_1$: There is no significant difference in the mean achievement scores of students taught Basic Science using the field trip method and those taught using the demonstration-based method.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Basic Science using the field trip and demonstration-based methods.

$H0_3$: There is no significant interaction effect of teaching method and gender on students' achievement in Basic Science.

2. Method

Research Design

This study adopted a quasi-experimental research design, specifically the pretest-posttest non-equivalent control group design. The design was considered appropriate because the researchers used intact classes rather than randomly assigning individual students to treatment groups, thereby avoiding disruption of normal school activities while allowing comparison of the instructional interventions. The use of pretest scores as covariates further enabled the

researchers to control for initial differences in students' academic ability before determining the effectiveness of the instructional methods.

Study Area

The study was conducted in Nsukka Local Government Area of Enugu State, Nigeria. The area comprises 30 public secondary schools in which Basic Science is offered as a compulsory subject at the junior secondary school level. Nsukka Local Government Area was selected because reports have consistently indicated poor academic achievement in Basic Science among junior secondary school students within the area, thereby necessitating the investigation of more effective instructional approaches.

Participants

The population comprised 4,040 Junior Secondary School II (JSS II) students enrolled in the 30 public secondary schools in Nsukka Local Government Area during the period of the study. Of the population, 1,904 were males, and 2,136 were females. JSS II students were considered suitable because the selected instructional topics, namely Energy, Pollution, and Nutrition, are prescribed in the JSS II Basic Science curriculum.

A sample of 68 students participated in the study, consisting of 31 males and 37 females. A multistage sampling procedure was employed to select the participants. First, five co-educational public secondary schools were purposively selected because they possessed relatively adequate instructional facilities for implementing the treatments. Second, two schools were selected from the five using simple random sampling. Finally, one intact JSS II class was selected from each participating school through simple random sampling. The intact classes were subsequently assigned to either the field trip group (36 students) or the demonstration-based teaching group (32 students).

Instrument

Data were collected using the **Basic Science Achievement Test (BSAT)** developed by the researchers. The BSAT comprised 30 multiple-choice items with four response options (A-D), each carrying one mark. The instrument covered three Basic Science topics- Energy, Pollution, and Nutrition-and was developed using a table of specifications to ensure adequate representation of the instructional objectives and cognitive levels. The maximum obtainable score was 30.

Validity and Reliability

The BSAT was subjected to face and content validation. Their observations regarding the clarity, appropriateness, and adequacy of the instrument informed the revision of the test items and the accompanying lesson plans before the commencement of the study.

The reliability of the instrument was established through a pilot study involving 20 JSS II students from Igbo-Etiti Local Government Area, who were not part of the study sample but possessed similar characteristics. Internal consistency was determined using the Kuder-Richardson Formula 20 (KR-20), yielding a reliability coefficient of .84, indicating that the instrument possessed satisfactory reliability for measuring students' academic achievement in Basic Science.

Experimental Procedure

Before the commencement of the experiment, the researchers organized a pre-experimental conference during which the Basic Science teachers who served as research assistants were trained on the instructional procedures for the respective treatment groups. This training

ensured uniform implementation of the instructional packages and minimized teacher-related variations during the experiment.

The BSAT was administered to both groups as a pretest before the commencement of instruction. Thereafter, students in the first experimental group were taught the selected Basic Science topics using the **field trip method**, which involved organized visits to relevant learning environments where students observed scientific phenomena, interacted with authentic situations, and participated in guided learning activities. Reflective classroom discussions were conducted after each field experience to consolidate learning.

Students in the second experimental group received instruction using the **demonstration-based teaching method**, during which the teacher demonstrated scientific processes and experiments while students observed, asked questions, and participated in guided discussions. Both groups received instruction on the same content for five weeks following the regular school timetable. At the end of the treatment period, the BSAT was re-administered as a posttest using the same instrument with rearranged item order to minimize test familiarity.

Data Analysis

Descriptive statistics, specifically mean and standard deviation, were used to answer the research questions by comparing students' pretest and posttest achievement scores under the two instructional methods. The hypotheses were tested using Analysis of Covariance (ANCOVA) at the .05 level of significance, with the pretest scores serving as covariates to control for initial group differences. Decisions regarding the hypotheses were based on the probability (*p*) values generated from the ANCOVA analysis.

3. Results

Research Question 1: *What are the mean achievement scores of students taught Basic Science using the field trip method and those taught using the demonstration-based teaching method?*

Table 1: *Pre-test and Post-test Mean Achievement Scores of Students Taught Basic Science Using Field Trip and Demonstration-Based Teaching Methods*

Teaching Method	***n***	**Pretest *M***	**Pretest *SD***	**Posttest *M***	**Posttest *SD***	**Mean Gain**
Field Trip	36	26.87	9.13	78.44	11.63	51.57
Demonstration-Based	32	27.91	8.77	72.19	11.20	44.63

M = *Mean;* SD = *Standard deviation.*

As presented in Table 1, students exposed to the field trip method obtained a pretest mean score of 26.87 (*SD* = 9.13), which increased to a posttest mean score of 78.44 (*SD* = 11.63), resulting in a mean gain of 51.57. Students taught using the demonstration-based teaching method recorded a pretest mean score of 27.91 (*SD* = 8.77) and a posttest mean score of 72.19 (*SD* = 11.20), yielding a mean gain of 44.63. Although both instructional methods improved students' academic achievement, the field trip method produced a greater improvement than the demonstration-based teaching method.

Hypothesis 1

H_{01}: There is no significant difference in the mean achievement scores of students taught Basic Science using the field trip method and those taught using the demonstration-based teaching method.

Table 2: *Analysis of Covariance (ANCOVA) Summary of the Effects of Teaching Method and Gender on Students' Academic Achievement*

Source	SS	df	MS	*F*	*p*
Pretest	1478.548	1	1478.548	140.405	.001
Teaching Method	163.602	1	163.602	15.536	.001
Gender	131.496	1	131.496	12.487	.001
Teaching Method × Gender	23.703	1	23.703	2.251	.137
Error	1032.001	65	10.531		

The ANCOVA results in Table 2 revealed a statistically significant main effect of teaching method on students' academic achievement, $F(1, 65) = 15.54$, p .001. Consequently, the null hypothesis was rejected. The result indicates that students taught Basic Science using the field trip method achieved significantly higher scores than those taught using the demonstration-based teaching method after controlling for differences in pretest achievement.

Research Question 2: *What is the influence of gender on students' academic achievement in Basic Science?*

Table 3: *Pre-test and Post-test Mean Achievement Scores of Male and Female Students by Teaching Method*

Teaching Method	Gender	*n*	Pretest *M*	Pretest *SD*	Posttest *M*	Posttest *SD*	Mean Gain
Field Trip	Male	17	26.68	8.17	78.40	10.18	51.72
	Female	19	24.74	9.46	76.05	11.45	51.31
Demonstration-Based	Male	14	26.51	8.18	70.44	11.12	43.93
	Female	18	27.09	8.11	72.75	10.75	45.66

The descriptive statistics in Table 3 indicate that male students taught using the field trip method obtained a slightly higher mean gain (51.72) than female students (51.31). In contrast, among students taught using the demonstration-based teaching method, female students recorded a slightly higher mean gain (45.66) than their male counterparts (43.93). Overall, both male and female students achieved higher posttest scores under the field trip method than under the demonstration-based teaching method.

Hypothesis 2

H_{02}: Gender has no significant influence on students' academic achievement in Basic Science.

The ANCOVA results presented in Table 2 revealed a statistically significant main effect of gender on students' academic achievement, $F(1, 65) = 12.49$, $p = .001$. Since the probability value was less than the .05 level of significance, the null hypothesis was rejected. Therefore, gender significantly influenced students' academic achievement in Basic Science.

Hypothesis 3

H_{03}: There is no significant interaction effect between teaching method and gender on students' academic achievement in Basic Science.

The ANCOVA results further revealed that the interaction between teaching method and gender was not statistically significant, $F(1, 65) = 2.25$, $p = .137$. Since the probability value exceeded the .05 level of significance, the null hypothesis was not rejected. This finding indicates that the relative effectiveness of the field trip and demonstration-based teaching methods did not differ significantly for male and female students. Thus, the advantage of the field trip method over the demonstration-based teaching method was consistent across both genders.

4. Discussion

This study investigated the effects of field trip and demonstration-based teaching methods on junior secondary school students' academic achievement in Basic Science in Nsukka Local Government Area. Specifically, the study examined the comparative effectiveness of the two instructional methods, the influence of gender on students' academic achievement, and the interaction effect of teaching method and gender on achievement.

The findings showed that students taught Basic Science using the field trip method achieved significantly higher scores than those taught using the demonstration-based teaching method. Although both instructional approaches enhanced students' achievement, learners exposed to the field trip method recorded a higher posttest mean score (78.44) and a greater mean gain (51.57) than those taught using the demonstration-based method, who obtained a posttest mean score of 72.19 and a mean gain of 44.63. Furthermore, the ANCOVA results confirmed that the observed difference was statistically significant, indicating that field trip instruction was more effective in improving students' academic achievement than demonstration-based teaching.

The superior performance of students exposed to field trips may be attributed to the authentic and experiential nature of the instructional strategy. Field trips provide learners with opportunities to observe scientific concepts in their natural settings, interact with real-life phenomena, and relate classroom instruction to everyday experiences. Such learning experiences promote active engagement, encourage inquiry, and facilitate the construction of meaningful knowledge, leading to improved understanding and retention of scientific concepts. The finding supports Kolb's (1984) Experiential Learning Theory, which posits that knowledge is created through concrete experiences followed by reflection, conceptualisation, and active experimentation. It also aligns with Dale's Cone of Experience, which suggests that learners retain knowledge more effectively when they engage in direct and purposeful experiences than when learning occurs through indirect or abstract instructional approaches.

This finding is consistent with previous empirical studies reporting the educational benefits of experiential learning in science education. Behrendt and Franklin (2014) found that well-planned field trips enhance students' conceptual understanding and engagement by situating learning in authentic, real-world contexts, while Al-Balushi and Al-Aamri (2014) reported that involvement in hands-on, field-based science projects significantly improved students' science knowledge and attitudes. Similarly, Mohammed et al. (2023) reported that educational field trips significantly improved students' academic achievement and retention, while Njoku and Mgbomo (2021) observed that students taught Biology using the field trip method significantly outperformed those taught through demonstration. Collectively, these studies reinforce the growing evidence that instructional approaches involving authentic learning experiences produce superior learning outcomes compared with classroom-based instructional methods alone.

The study further revealed that gender had a significant influence on students' academic achievement in Basic Science. The ANCOVA analysis showed a statistically significant main effect of gender on achievement. However, the descriptive statistics indicated only slight differences in achievement between male and female students across the instructional methods. Under the field trip method, male students obtained a marginally higher mean gain than female students, whereas female students achieved a slightly higher mean gain than males under the demonstration-based teaching method. Despite these differences, students in both gender groups recorded higher achievement when taught using the field trip method.

The finding corroborates previous studies that have reported significant gender differences in science achievement under certain instructional conditions (Barka & Idris, 2023; Dawal, 2021). However, it differs from studies that found no significant gender differences following learner-centred instructional interventions (Ajayi & Ogbeba, 2017). The inconsistency among previous

findings suggests that gender differences in science achievement may be context-dependent and influenced by instructional approaches, subject matter, learner characteristics, and classroom environments. Consequently, gender should be considered when designing science instruction, although it should not be viewed as a determinant of students' learning potential.

Finally, the study found no statistically significant interaction effect between teaching method and gender on students' academic achievement. This indicates that the effectiveness of the instructional methods did not depend on students' gender. In other words, the superiority of the field trip method over the demonstration-based teaching method was evident for both male and female students.

The absence of a significant interaction effect suggests that learner-centred instructional approaches such as field trips are capable of improving academic achievement regardless of students' gender. This finding supports the position that instructional quality exerts a greater influence on learning outcomes than gender differences when effective teaching strategies are employed. The result agrees with Ajayi and Ogbeba (2017), who reported no significant interaction effect between instructional strategy and gender on students' achievement in Chemistry, and with Okoye and Onyeka (2023), who found that the effectiveness of demonstration-based instruction did not differ significantly between male and female students in Mathematics.

Overall, the findings of this study underscore the importance of adopting learner-centred instructional strategies in Basic Science classrooms. While both field trip and demonstration-based teaching methods improved students' academic achievement, field trip instruction produced significantly greater learning gains. The findings also demonstrate that although gender significantly influenced achievement, the instructional advantage of the field trip method was consistent for both male and female students. Consequently, integrating experiential learning opportunities into Basic Science instruction has the potential to improve students' academic achievement and strengthen science learning outcomes.

5. Conclusion

This study examined the effects of field trip and demonstration-based teaching methods on students' academic achievement in Basic Science among Junior Secondary School II students in Nsukka Local Government Area, Enugu State. The findings demonstrated that both instructional methods improved students' academic achievement; however, the field trip method was significantly more effective than the demonstration-based teaching method. Students exposed to field trip instruction recorded significantly higher posttest achievement scores than those taught using the demonstration-based approach, indicating that learning experiences situated in authentic environments enhance students' understanding of Basic Science concepts more effectively than classroom demonstrations alone.

The study further established that gender significantly influenced students' academic achievement. Nevertheless, the absence of a significant interaction effect between teaching method and gender suggests that the superiority of the field trip method was consistent for both male and female students. This finding implies that experiential instructional approaches can improve students' academic achievement irrespective of gender while providing equitable learning opportunities for all learners.

Overall, the study provides empirical evidence that field trip instruction constitutes a more effective learner-centred instructional strategy than demonstration-based teaching for improving students' academic achievement in Basic Science. The findings therefore underscore the need for greater integration of experiential learning into Basic Science instruction in Nigerian secondary schools. Promoting instructional practices that enable learners to interact directly with scientific concepts in authentic contexts may contribute to improved learning outcomes and strengthen the quality of science education.

Practical Implications

The findings of this study have important implications for science teaching, curriculum implementation, and educational policy.

1. The superior effectiveness of the field trip method suggests that Basic Science teachers should integrate structured educational field trips into classroom instruction where appropriate. Such experiences provide learners with opportunities to connect theoretical concepts with real-world applications, thereby fostering deeper conceptual understanding and improving academic achievement.
2. The findings provide empirical support for learner-centred instructional approaches advocated in the Nigerian Basic Science curriculum. Curriculum planners and educational authorities should therefore incorporate more field-based learning activities into curriculum implementation guidelines and encourage schools to establish partnerships with industries, research institutes, museums, botanical gardens, agricultural centres, environmental agencies, and other science-related institutions that can serve as learning sites.
3. School administrators should provide logistical and financial support to facilitate educational field trips. Transportation costs, safety concerns, and limited institutional support remain major barriers to implementing field-based instruction in many Nigerian public schools. Addressing these challenges would enable teachers to adopt more effective instructional strategies that improve students' learning outcomes.
4. Finally, because the instructional advantage of the field trip method was observed for both male and female students, teachers should focus on adopting evidence-based learner-centred pedagogies capable of improving learning outcomes for all students rather than designing instruction based primarily on gender differences.

Limitations of the Study

1. This study has several limitations that should be considered when interpreting the findings. First, the study involved only 68 Junior Secondary School II students selected from two public secondary schools in Nsukka Local Government Area. Consequently, caution should be exercised when generalising the findings to all secondary schools in Enugu State or Nigeria.
2. The study focused exclusively on students' academic achievement in three Basic Science topics: Energy, Pollution, and Nutrition. Other important learning outcomes, such as scientific process skills, critical thinking, motivation, attitude towards science, and knowledge retention, were not examined.
3. The intervention lasted for only five weeks. Although this duration was sufficient to evaluate immediate learning outcomes, it did not permit investigation of the long-term effects of field trip instruction on students' retention and transfer of learning.

These limitations provide opportunities for further research.

Suggestions for Future Research

Based on the findings and limitations of this study, future studies should:

1. Replicate the study using larger samples drawn from multiple states and different geopolitical zones to improve the generalisability of the findings.
2. Investigate the effects of field trip instruction on other learner outcomes, including retention, scientific process skills, critical thinking, problem-solving ability, motivation, attitude towards science, and environmental awareness.
3. Compare field trip instruction with other learner-centred instructional approaches such as inquiry-based learning, project-based learning, problem-based learning, and virtual field trips.

4. Conduct longitudinal studies to determine whether the learning gains associated with field trips are sustained over time.
5. Examine the cost-effectiveness and practical challenges associated with implementing field trips in public secondary schools, particularly in resource-constrained educational settings.

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