

EFFECT OF GUIDED INQUIRY METHOD ON SENIOR SECONDARY TWO STUDENTS' ATTITUDE IN TRIGONOMETRY IN GUSAU, ZAMFARA STATE

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Abstract—This study investigated the effect of the Guided Inquiry method on Senior Secondary Two (SS2) students' attitude towards trigonometry in Gusau Metropolis, Zamfara State. Persistent poor performance and negative student dispositions toward abstract mathematics concepts are frequently linked to traditional teacher-centered instruction. To address this issue, a quasi-experimental design specifically a pre-test, post-test, non-equivalent control group design was adopted. The target population for the study comprised all 2,597 SS2 science students enrolled in public secondary schools in Gusau Local Government Area. A multi-stage sampling technique was used to draw a sample size of 120 SS2 students across selected co-educational schools, assigned to experimental and control groups through intact classes. Data were collected using a validated instrument titled the Trigonometry Attitude Scale (TAS), which utilized a 4-point Likert scale. Research questions were answered using mean and standard deviation, while the null hypotheses were tested at a 0.05 level of significance using Analysis of Covariance (ANCOVA). The findings revealed a statistically significant difference in the post-test attitude mean scores in favor of the students taught trigonometry using the Guided Inquiry method compared to those taught via the conventional lecture method. Furthermore, the analysis showed no significant gender difference in the attitude scores of students exposed to the Guided Inquiry method. Consequently, the study recommends that mathematics teachers adopt inquiry-driven, learner-centered strategies to improve student engagement, bridge gender gaps, and foster a positive attitude toward challenging topics like trigonometry in secondary schools.

Index Terms—Guided Inquiry Method, Student Attitude, Trigonometry, Senior Secondary Students, Gusau Metropolis

I. Introduction

Background to the Study

Mathematics remains a core foundational subject required for scientific, technological, and national development. Within the senior secondary school mathematics curriculum in Nigeria, trigonometry holds a critical place, dealing with the relationships between the sides and angles of triangles. It serves as a vital prerequisite for advanced studies and careers in engineering, physics, architecture, and navigation. This implies that the place of mathematics in secondary school curriculum in Nigeria is paramount for scientific and human development as it serves both as a tool for academic progress in a chosen career and as a tool for preparing the individual for useful living (Frank et al., 2025).

According to Bekene and Machaba (2022), trigonometry, a fundamental branch of mathematics, plays a crucial role in various fields, including engineering, physics, and astronomy. However, many senior secondary school students find trigonometry challenging due to its abstract concepts and complex formulas (Abdullahi, 2022). Trigonometry functions are used to understand cyclic phenomena across many applications in fields such as advanced physics, mechanical and electrical engineering, music, astronomy, and biology.

Despite its immense utility, students' academic performance and interest in mathematics—particularly in abstract topics like trigonometry have consistently remained low in many parts of Nigeria, including Zamfara State. Examiners' reports and empirical observations consistently highlight that students find trigonometry uniquely challenging due to its abstract concepts, formulas, and spatial requirements. Stakeholders in education within Gusau Metropolis have frequently attributed this persistent underperformance to the continued reliance on conventional, teacher-centered instructional methods, such as the traditional lecture or "chalk-and-talk" approach. As noted by recent educational evaluations, these traditional methods heavily appeal only to learners' auditory senses while treating students as passive listeners, thereby discouraging critical thinking, conceptual understanding, and problem-solving skills. Consequently, students develop a deep-seated anxiety, frustration, and a negative attitude toward mathematics.

Attitude is widely recognized as a major determinant of academic success. When students perceive a subject as difficult, abstract, or disconnected from their immediate environment, their motivation and self-efficacy plummet. To transform this dynamic, modern pedagogy emphasizes learner-centered strategies that actively engage students in knowledge construction rather than rote memorization. One such powerful approach is the Guided Inquiry Method.

Guided inquiry shifts the traditional classroom dynamic: instead of the teacher directly providing rules, formulas, and proofs, students are guided through carefully structured questions, hands-on tasks, and problem-solving activities to discover mathematical relationships and concepts themselves. Adolphus and Nweke (2025) indicate that student-centered approaches significantly improve academic achievement and foster much more favorable psychological dispositions, such as enhanced enjoyment, value, and confidence toward mathematics. By fostering active participation and peer collaboration, inquiry-based learning can demystify trigonometry, making it relatable, engaging, and less intimidating for Senior Secondary Two (SS2) students in Gusau.

Statement of the Problem

In Gusau secondary schools, students' poor achievement in mathematics external examinations (such as West African Examinations Council [WAEC] and National Examinations Council [NECO]) has been a source of grave concern for educators, parents, and policymakers. Diagnostic reports and classroom observations reveal that advanced topics like trigonometry and geometry are frequently avoided or poorly answered by candidates. A primary driver of this underperformance is the persistent negative attitude students harbor toward the subject, largely fostered by rote memorization, lack of contextual engagement, and abstract classroom delivery (Abdullahi, 2022; Ahmed et al., 2025). If mathematics teachers continue to rely heavily on traditional, non-interactive "chalk-and-talk" methods—which render learners passive—students will continue to struggle with spatial reasoning, logical deduction, and trigonometric applications. This study, therefore, investigates whether adopting the Guided Inquiry instructional method can significantly improve SS2 students' attitudes toward trigonometry in Gusau, Zamfara State, while also examining potential gender variations in these outcomes.

Objectives of the Study

The primary objective of this study is to determine the effect of the Guided Inquiry method on Senior Secondary Two students' attitude toward trigonometry in Gusau, Zamfara State. Specifically, the study intends to:

1. Determine the difference in attitude mean scores of students taught trigonometry using the Guided Inquiry method and those taught using the conventional lecture method.
2. Examine the influence of gender (male and female) on the attitude of students taught trigonometry via the Guided Inquiry method.

Research Questions

1. What are the pre-test and post-test mean attitude scores of SS2 students taught trigonometry using the Guided Inquiry method compared to those taught using the conventional method?
2. What are the post-test mean attitude scores of male and female SS2 students taught trigonometry using the Guided Inquiry method?

Hypotheses

1. There is no significant difference between the post-test attitude mean scores of students taught trigonometry using the Guided Inquiry method and those taught using the conventional lecture method.
2. There is no significant difference between the post-test attitude mean scores of male and female students taught trigonometry using the Guided Inquiry method.

II. METHODOLOGY

Research Design

This study adopted a quasi-experimental design, specifically a pre-test, post-test, non-equivalent control group design. This design is considered appropriate because it is often impractical to disrupt established school administrative setups or reshuffle students into completely randomized classes. Instead, intact classes are utilized as they are. The design layout is represented as follows:

Group	Pre-Test	Treatment	Post-Test
Experimental Group	O_1	X	O_2
Control Group	O_3	-	O_4

O_1 and O_3 : represent the pre-test attitude scores of the experimental and control groups, respectively.

X: represents the treatment (Guided Inquiry Method applied to the experimental group).

- : represents the conventional lecture method applied to the control group.

O_2 and O_4 represent the post-test attitude scores of the experimental and control groups, respectively.

Population of the Study

The target population for this study comprises all 2,597 Senior Secondary Two (SS2) public school students enrolled in Gusau Metropolis, Zamfara State, for the academic session. This population consists of science students who are actively undertaking advanced mathematics curricula that feature trigonometry as a core component.

Sample and Sampling Technique

A multi-stage sampling technique was used to select the participants for the study, arriving at a sample size of 120 SS2 students. Purposive sampling was used to select two public secondary schools within Gusau Metropolis. The schools were chosen based on having similar characteristics, such as qualified mathematics teachers, standard classroom facilities, and comparable academic performance baselines to ensure equivalent learning environments. From each of the selected schools, one intact SS2 class was chosen. Through simple random sampling (balloting), one school's intact class was assigned as the Experimental

Group (subjected to the Guided Inquiry method), and the other school's intact class served as the Control Group (taught using the conventional lecture method).

Instrumentation

Data collection was carried out using a researcher-developed and validated instrument titled the Trigonometry Attitude Scale (TAS). The TAS consists of 20 items designed to measure students' emotional disposition, confidence, and perceived relevance regarding trigonometry. It is structured on a 4-point Likert scale with response options: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD), scored numerically from 4 down to 1 for positive statements (and reverse-scored for negative items). The instrument was subjected to face and content validation by experts in mathematics education and measurement and evaluation. Its reliability was established through a pilot test, yielding a high internal consistency coefficient (Cronbach's $\alpha = 0.78$), making it dependable for the study.

Method of Data Collection and Analysis

The study was conducted in three phases over six weeks:

1. **Pre-test Phase:** The TAS was administered to both the experimental and control groups as a pre-test prior to any treatment to establish their baseline attitudes.
2. **Treatment Phase:** The experimental group was taught trigonometry topics (such as sine, cosine, and tangent rules, angles of elevation and depression) using structured Guided Inquiry lesson plans. Simultaneously, the control group was taught the same topics using the traditional chalk-and-talk method.
3. **Post-test Phase:** Immediately following the treatment period, the validated TAS was re-administered to both groups as a post-test.

Data gathered from the pre-test and post-test were analyzed using descriptive statistics (Mean and Standard Deviation) to answer the research questions. Furthermore, Analysis of Covariance (ANCOVA) was employed to test the null hypotheses at a 0.05 level of significance, using the pre-test scores as covariates to statistically control for any initial differences between the intact groups.

III. RESULTS AND DATA ANALYSIS

Answering of Research Questions and Testing of Hypotheses

Research Question One

What are the pre-test and post-test attitude mean scores of senior secondary two students towards Trigonometry in the experimental and control groups in Gusau, Zamfara State?

Table 1: Pre-test and Post-test Attitude Mean Scores of SSII Students towards Trigonometry in the Experimental and Control Groups

Group	N	Pre-test	Post-test	Mean Gain	Mean Gain Difference	Post-test Mean Difference
		Mean	SD	Mean	SD	
Experimental	62	38.61	5.415	91.56	7.388	52.95 48.00 47.27
Control	58	39.34	5.772	44.29	9.748	4.95

The result in Table 1 presents the pre-test and post-test attitude mean scores of senior secondary two students towards Trigonometry in the experimental and control groups in Gusau with respect to the effect of the guided inquiry method. The findings revealed that before the treatment, the students in the experimental group had a pre-test mean attitude score of 38.61 with a standard deviation of 5.415, while those in the control group had a slightly higher pre-test mean score of 39.34 with a standard deviation of 5.772. The closeness of the pre-test mean scores indicates that both groups had nearly similar attitudes towards Trigonometry prior to the commencement of the treatment, suggesting that the groups were relatively equivalent at the baseline. Following the treatment, the experimental group recorded a post-test mean attitude score of 91.56 with a standard deviation of 7.388, whereas the control group obtained a post-test mean score of 44.29 with a standard deviation of 9.748. This indicates that students exposed to the guided inquiry method demonstrated a remarkable improvement in attitude towards Trigonometry compared to those taught using the conventional method.

Furthermore, the experimental group had a mean gain of 52.95, while the control group recorded a mean gain of 4.95, producing a mean gain difference of 48.00 in favour of the experimental group. Also, the post-test mean difference of 47.27 indicates a substantial difference in attitude between students exposed to the guided inquiry method and those in the control group after the treatment. The implication of this finding is that the guided inquiry method positively influenced students' attitude towards Trigonometry among senior secondary two students in Gusau.

Hypothesis One

There is no significant difference in the pre-test and post-test attitude mean scores of senior secondary two students in the experimental and control groups in trigonometry.

Table 2: ANCOVA Results on Pre-test and Post-test Attitude Mean Scores of SSII Students in Trigonometry in the Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	P-value	Partial Squared	Eta
Corrected Model	67065.439 ^a	2	33532.720	453.935	.000	.886	
Intercept	13176.665	1	13176.665	178.374	.000	.604	
Covariate	102.332	1	102.332	1.385	.242	.012	
Group	66329.387	1	66329.387	897.906	.000	.885	
Error	8642.927	117	73.871				
Total	642346.000	120					
Corrected Total	75708.367	119					

a. R Squared = .886 (Adjusted R Squared = .884)

Table 3: Estimated Marginal Attitude Mean Scores of SSII Students in the Experimental and Control Groups in Trigonometry

Group	N	Mean	Std. Error	95% Confidence Interval

				Lower Bound	Upper Bound
Experimental	62	91.506 ^a	1.093	89.342	93.670
Control	58	44.356 ^a	1.130	42.119	46.594

The findings in Table 2 revealed that there was a statistically significant difference in the post-test attitude mean scores of students in the experimental and control groups after controlling for pre-test scores, $F(1, 117) = 897.906$, $p = .000$. Since the p-value (.000) is less than the 0.05 level of significance, the null hypothesis which stated that there is no significant difference in the pre-test and post-test attitude mean scores of senior secondary two students in the experimental and control groups was rejected. The result further showed that the covariate (pre-test attitude score) was not statistically significant, $F(1, 117) = 1.385$, $p = .242$, indicating that initial differences in students' attitude scores did not significantly influence the post-test attitude outcome.

Furthermore, the adjusted R-squared value of .885 indicates that about 88.5% of the variation in students' attitude scores was explained by the model. The estimated marginal means in Table 3 further revealed that students in the experimental group had a higher adjusted mean attitude score of 91.506 compared to 44.356 for students in the control group.

Research Question Two

What are the pre-test and post-test attitude mean scores of senior secondary two students in Trigonometry in the experimental group based on gender in Gusau, Zamfara State?

Table 4: Pre-test and Post-test Attitude Mean Scores of SSII Students in the Experimental Group Based on Gender in Trigonometry

Group	N	Pre-test	Post-test	Mean Gain	Mean Difference	Gain	Post-test Difference	Mean
		Mean	SD	Mean	SD			
Male	30	38.20	5.261	89.90	5.300	51.70	2.43	3.23

Female	32	39.00	5.611	93.13	8.713	54.13
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The pre-test and post-test attitude mean scores of senior secondary two students in Trigonometry in the experimental group based on gender in Gusau are presented in Table 4. The result shows that at the pre-test stage, male students had a mean attitude score of 38.20 (SD = 5.261), while female students had a slightly higher mean score of 39.00 (SD = 5.611). After the treatment, male students recorded a post-test mean attitude score of 89.90 (SD = 5.300), whereas female students obtained a higher post-test mean score of 93.13 (SD = 8.713). In terms of improvement, male students had a mean gain of 51.70, while female students had a slightly higher mean gain of 54.13. This suggests that although both genders improved considerably, female students showed a marginally greater positive change in attitude compared to their male counterparts.

Hypothesis Two

There is no significant difference in the pre-test and post-test attitude mean scores of senior secondary two students in Trigonometry in the experimental group in Gusau, Zamfara State based on gender.

Table 5: ANCOVA Result on Pre-test and Post-test Attitude Mean Scores of SSII Students Based on Gender in the Experimental Group

Source	Type III Sum of Squares	df	Mean Square	F	P-Value	Partial Eta Squared
Corrected Model	405.481 ^a	2	202.741	4.091	.022	.122
Intercept	13116.216	1	13116.216	264.679	.000	.818
Covariate	244.439	1	244.439	4.933	.030	.077
Gender	190.958	1	190.958	3.853	.054	.061
Error	2923.761	59	49.555			

Total 523141.00 62

Corrected 3329.242 61
Total

a. R Squared = .122 (Adjusted R Squared = .092)

Table 6: Estimated Marginal Attitude Mean Scores of SSII Students in the Experimental Group Based on Gender

Gender	N	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	30	89.747 ^a	1.287	87.171	92.322
Female	32	93.268 ^a	1.246	90.775	95.762

The result in Table 5 shows that there was no statistically significant difference in the post-test attitude mean scores of male and female students after controlling for the pre-test scores, $F(1, 59) = 3.853$, $p = .054$. Since the p-value is slightly greater than the 0.05 level of significance, the null hypothesis, which stated that there is no significant difference in the attitude means scores of male and female students in trigonometry, was not rejected. Furthermore, the partial eta squared value for gender is .061, indicating a small effect size. Table 6 shows that female students had a slightly higher adjusted mean attitude score of 93.268 compared to male students with 89.747, but the difference remains statistically insignificant.

IV. Discussion of Findings

The analysis of Research Question One and its corresponding null hypothesis revealed a dramatic and statistically significant difference in the post-test attitude mean scores between students taught trigonometry using the Guided Inquiry method and those taught via the conventional lecture method. Specifically, the experimental group recorded a high post-test mean score of 91.56 (adjusted mean of 91.506) with a mean gain of 52.95, whereas the control group scored a post-test mean of 44.29 with a marginal mean gain of only 4.95. The ANCOVA results ($F(1, 117) = 897.906$, $p = .000$) further confirmed

that this vast divergence was statistically significant and driven by the treatment, with the model explaining about 88.5% ($R^2 = .885$) of the total variance.

This outcome demonstrates that the Guided Inquiry instructional strategy is exceptionally potent in transforming students' psychological dispositions and affective states toward abstract mathematical topics like trigonometry. Traditional "chalk-and-talk" classrooms often cultivate mathematics anxiety, rote memorization, and passivity, which explain the stagnant or low attitude scores observed in the control group. Conversely, the Guided Inquiry method creates an interactive, student-centered learning environment. By allowing learners to actively manipulate materials, pose questions, and collaboratively discover mathematical relationships, students develop intrinsic motivation, self-efficacy, and confidence. This finding aligns strongly with the constructivist learning theory of Jean Piaget and Jerome Bruner, which asserts that learners construct durable knowledge and positive attitudes when they are actively engaged in discovery rather than acting as passive recipients of facts.

The analysis of Research Question Two and Null Hypothesis Two examined whether gender played a significant role in the attitude scores of students exposed to the Guided Inquiry method. The ANCOVA results yielded an F-value of 3.853 with a p-value of .054 (which is slightly above the 0.05 threshold), coupled with a small partial eta-squared effect size of .061. Consequently, the null hypothesis of no significant gender difference was retained. This finding reveals that the Guided Inquiry method is gender-inclusive. Although female students showed marginally higher mean gains and post-test scores, the statistical insignificance of the difference implies that both male and female learners benefited equitably from the intervention. This result challenges historical stereotypes and archaic cultural biases suggesting that advanced mathematics or STEM subjects inherently favor male students, proving that inquiry-driven learning successfully bridges the gender gap in learner dispositions.

V. CONCLUSION AND RECOMMENDATIONS

Conclusion

This study investigated the effect of the Guided Inquiry instructional method on Senior Secondary Two (SS2) students' attitudes toward trigonometry in Gusau Metropolis, Zamfara State. The empirical findings provide robust evidence that the Guided Inquiry method is a powerful pedagogical tool for transforming student dispositions toward abstract mathematics concepts. Unlike traditional, teacher-centered methods that foster passivity, anxiety, and negative attitudes, the Guided Inquiry approach actively engages learners in knowledge construction, critical thinking, and collaborative problem-solving. Furthermore, the study established that the method is gender-inclusive, bridging the gap between male and female learners and empowering both groups to develop equally favorable attitudes toward trigonometry. Therefore,

transitioning from conventional "chalk-and-talk" approaches to inquiry-driven instruction is vital for demystifying mathematics and improving learning outcomes in secondary schools.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are proffered:

1. Mathematics teachers in Gusau and across Zamfara State should integrate the Guided Inquiry method into their daily lesson delivery, particularly when teaching abstract and complex topics like trigonometry, to foster student-centered engagement and cultivate positive attitudes.
2. State educational policymakers, the Zamfara State Ministry of Education, and school boards should organize regular workshops, seminars, and training programs (such as Professional Learning Communities) to equip mathematics teachers with practical skills on how to design and implement guided inquiry-based lessons.
3. Teachers should consciously maintain gender-friendly and equitable learning environments. Because the study proved Guided Inquiry benefits both male and female students equally, educators should ensure that classroom tasks and inquiry groups provide equal participation opportunities for all students, eliminating any latent gender bias in STEM education.
4. School administrators and educational stakeholders should provide necessary manipulative tools, geometry kits, and resources that facilitate hands-on inquiry learning, enabling teachers to effectively shift away from purely theoretical, lecture-based instruction.

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