

Research Article

Exploring the correlation between students' attitudes and academic achievement in Mathematics and Physics: A study of senior secondary school students in Gombe and Bauchi States, Nigeria

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Abstract

This study investigated the correlation between students' attitudes and academic achievement in Mathematics and Physics among senior secondary school students in Gombe and Bauchi States, Nigeria. Four research objectives, research questions, and corresponding null hypotheses were formulated to guide the study. A correlational research design was adopted for the study. The sample comprised 364 students selected from ten public senior secondary schools, five from each state, using multistage sampling procedures. Data were collected using the Secondary School II Mathematics Performance Test (SSII MPT), Secondary School II Physics Performance Test (SSII PPT), and Students' Attitude Questionnaire towards Mathematics and Physics. The instruments were validated by experts in Mathematics Education, Physics Education, and Measurement and Evaluation who assessed the items for clarity, relevance, and alignment with the study objectives. Reliability analysis was conducted to determine the internal consistency of the instruments before their administration. Data collected were analysed using descriptive statistics, Spearman's rank-order correlation, and Pearson Product Moment Correlation (PPMC) to test the null hypotheses at a 0.05 level of significance. The findings revealed a significant positive correlation between students' attitudes toward Mathematics and Physics. The study also found a significant positive correlation between students' academic performance in Mathematics and Physics. In addition to that, significant positive correlations existed between students' attitudes and their academic achievement in Mathematics and Physics. The findings indicate that students' attitudes represent an important factor associated with achievement outcomes in both subjects. The study recommends that Mathematics and Physics teachers should adopt learner-centred instructional strategies, practical demonstrations, and real-life applications to strengthen students' positive attitudes and improve academic performance in both subjects.

Keywords: Students' Attitudes, Mathematics, Physics, Academic Achievement, Correlation, Senior Secondary Schools

1. Introduction

Physics ranks among the core science subjects within Nigerian senior secondary education because of its contribution to knowledge production, technological advancement, and innovation. The discipline maintains strong conceptual relationships with astronomy, geology, chemistry, and biology, positioning it as both a mathematical and experimental field of study. Through its principles, laws, and theories, Physics provides explanations of natural phenomena and supports applications across engineering, medicine, and other applied sciences. Consequently, Physics serves as a major prerequisite for tertiary programmes in engineering, technology, medicine, and related scientific

fields. Scholars argue that Physics remains fundamental to technological development because its principles and applications contribute significantly to national innovation and scientific progress (Alabi et al., 2023; Mamedu et al., 2024).

Closely connected to Physics is Mathematics, which serves as a fundamental language for scientific reasoning, quantitative analysis, and technological advancement. Mathematics occupies a central position in Nigerian senior secondary education, with the curriculum comprising General Mathematics, which is compulsory for all learners, and Further Mathematics, which is designed for students

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pursuing advanced science-related pathways (Abdullahi et al., 2026). Beyond serving as a university admission requirement, General Mathematics provides a foundation for scientific development, innovation capacity, and problem-solving competence (Mosia & Egara, 2024). Achievement in Mathematics influences students' academic progression and future career opportunities, reflecting not only cognitive ability but also emotional, social, and developmental dimensions of learning (Nitzan-Tamar & Kohen, 2023). Therefore, effective mathematics learning requires more than theoretical understanding; learners must develop the ability to apply mathematical knowledge to practical and real-world contexts.

Given the importance of Mathematics and Physics in scientific learning, understanding factors that influence students' achievement in these subjects remains essential. Among such factors, student attitude has emerged as a critical variable in educational research. Attitude represents a psychological construct involving emotional, cognitive, and behavioural components, although it cannot be directly observed (Mashwama et al., 2025). Instead, learners' behaviours, levels of engagement, responses to instruction, and willingness to participate provide indications of their underlying attitudes. Negative attitudes may be reflected through resistance to learning activities and reduced engagement, whereas positive attitudes often enhance motivation, confidence, persistence, and academic achievement (Díez-Palomar et al., 2020, p. 2).

The relevance of student attitudes becomes particularly important when examining Mathematics and Physics together because both disciplines share strong cognitive and conceptual foundations. Existing studies have primarily examined attitudes toward Mathematics, while the relationship between mathematical attitudes and Physics achievement continues to attract increasing scholarly attention. Evidence suggests that positive attitudes toward Mathematics may strengthen students' engagement with Physics because mathematical competence supports understanding of scientific concepts, calculations, and problem-solving processes (Ajisukmo & Saputri, 2017, p. 487; Magallon, 2025). This interconnectedness suggests that students' perceptions and dispositions toward one subject may influence their learning experiences and achievement in the other.

Despite the significant roles of Mathematics and Physics in scientific and technological development, students' performance in Physics continues to present challenges within educational systems. Difficulties associated with abstract concepts, mathematical applications, and limited exposure to effective instructional resources contribute to students' struggles in understanding Physics principles. Furthermore, instructional limitations and excessive reliance on abstract teaching approaches may reduce conceptual understanding and negatively affect achievement outcomes

(Laguindab & Cagas, 2026; Antonio & Castro, 2023). Educational performance reflects the extent to which learners attain expected learning outcomes within established academic standards (Werang et al., 2023). However, empirical studies continue to report low Physics achievement at school certificate levels, despite the subject's importance for national development and technological advancement (Belay et al., 2022, p. 233; Kusumaningtyas et al., 2024, p. 25; Mirafuentes et al., 2025, p. 35).

The persistent challenges in Mathematics and Physics achievement highlight the need to examine non-cognitive factors that may contribute to students' learning outcomes. Previous studies indicate that positive attitudes toward Mathematics are associated with improved Physics performance, whereas negative attitudes are linked with weaker achievement outcomes (Veloo, Nor and Khalid, 2015). Additional research has reported similar associations between students' attitudes and achievement across both disciplines (ABDULLAHI et al., 2026; GÜRLER & Baykara, 2020, p.7; Quimbo, 2025). Furthermore, gender differences have been identified in mathematics attitudes, with female students often reporting higher levels of anxiety and lower confidence, patterns that may influence achievement outcomes in science-related disciplines.

Although previous studies have examined attitudes and achievement in Mathematics or Physics separately, limited attention has been given to understanding the relationship between students' attitudes and academic performance across both subjects within the Nigerian senior secondary school context. Exploring these relationships is important because Mathematics and Physics share interconnected knowledge structures and contribute jointly to scientific literacy and technological preparation. Therefore, this study examines the relationships between students' attitudes and academic performance in Mathematics and Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.

This study investigates relationships between student attitudes and academic performance in mathematics and physics among senior secondary school students in Gombe and Bauchi States, Nigeria.

- (i) To determine the correlation between students' attitudes toward Mathematics and their attitudes toward Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.
- (ii) To examine the correlation between students' academic performance in Mathematics and their academic performance in Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.
- (iii) To assess the correlation between students' attitudes and their academic performance in Mathematics among senior secondary school students in Gombe and Bauchi States, Nigeria.

- (iv) To evaluate the correlation between students' attitudes and their academic performance in Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.

The following are the research questions

- (i) What relationship exists between students' attitudes toward Mathematics and their attitudes toward Physics among senior secondary school students in Gombe and Bauchi States, Nigeria?
- (ii) What relationship exists between students' academic performance in Mathematics and their academic performance in Physics among senior secondary school students in Gombe and Bauchi States, Nigeria?
- (iii) What relationship exists between students' attitudes and their academic performance in Mathematics among senior secondary school students in Gombe and Bauchi States, Nigeria?
- (iv) What relationship exists between students' attitudes and their academic performance in Physics among senior secondary school students in Gombe and Bauchi States, Nigeria?

The hypotheses were tested at 0.05 level of significance.

- (i) H_{01} : There is no significant relationship between students' attitudes toward Mathematics and Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.
- (ii) H_{02} : There is no significant relationship between students' academic performance in Mathematics and Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.
- (iii) H_{03} : There is no significant relationship between students' attitudes and their academic performance in Mathematics among senior secondary school students in Gombe and Bauchi States, Nigeria.
- (iv) H_{04} : There is no significant relationship between students' attitudes and their academic performance in Physics among senior secondary school students in Gombe and Bauchi States, Nigeria.

2. Methodology

2.1 Research Design

This study adopted a correlational research design to investigate relationships between students' attitudes toward Mathematics and Physics and their academic achievement in both subjects. The design was appropriate because it facilitates the determination of the direction and strength of associations among variables without experimental manipulation. The study was carried out in Gombe and Bauchi States, Nigeria, both of which operate comparable public senior secondary education systems governed by standardized curricula in Mathematics and Physics.

2.2. Population of the Study

The population consisted of all senior secondary school

students in public secondary schools in Gombe and Bauchi States who were offering both Mathematics and Physics. This population frame ensured inclusion of learners directly engaged with the variables of interest, thereby enhancing construct relevance and ecological validity of the study.

2.3. Sample and Sampling Technique

A total of 364 students were selected for the study. A multistage probability sampling technique was employed to enhance representativeness and minimise selection bias.

In the first stage, educational zones within each state were treated as clusters. In the second stage, four schools were selected from the clusters using simple random sampling. In the final stage, proportionate stratified sampling was applied within the selected schools to identify students offering Mathematics and Physics. This approach ensured that eligible students had a known and non-zero probability of selection, thereby strengthening external validity and generalisability.

2.4. Research Instruments

Two instruments were used for data collection. The first instrument was the Secondary School II Physics Performance Test (SSII PPT), adapted from WAEC and NECO examination standards. It comprised 30 multiple-choice items with four response options (A–D), with one correct answer for each item. The instrument was designed to assess students' cognitive achievement in Physics.

The second instrument was the Secondary School II Mathematics and Physics Attitude Questionnaire (SSII MPAQ), developed based on the cognitive, affective, and behavioural components of attitude. The questionnaire consisted of 20 Likert-scale items designed to measure students' attitudes toward Mathematics and Physics. Responses were rated on a four-point scale ranging from Strongly Agree (4) to Strongly Disagree (1).

2.5. Reliability of the Instruments

The reliability of the Students' Attitude Questionnaire towards Mathematics and Physics was established through a pilot study conducted among senior secondary school students who were not included in the main study. Cronbach's Alpha coefficient was used to determine the internal consistency reliability of the questionnaire items. The reliability analysis produced a Cronbach's Alpha coefficient of $\alpha = 0.82$, indicating that the instrument had an acceptable level of internal consistency and was suitable for measuring students' attitudes toward Mathematics and Physics.

2.6. Data Collection Procedure and Analysis

Data collection was conducted under controlled classroom conditions. Instruments were administered directly to respondents following a standard briefing to ensure consistent understanding of instructions and to reduce response bias.

Data were analysed using both descriptive and inferential

statistical techniques. Mean and standard deviation were used to summarise response distributions. Spearman's rank correlation was employed for attitude-related variables due to their ordinal scale nature, while Pearson Product Moment Correlation (PPMC) was used for continuous achievement scores. All hypotheses were tested at a 0.05 level of significance using SPSS version 26.

3. Results

3.1. Answers to Research Questions

3.1.1. Research Question 1

What is the correlation between students' attitudes in Mathematics and their attitudes in Physics among senior

secondary school students in Gombe State and Bauchi State?

Attitude Level Interpretation Criteria

Students' attitudes toward Mathematics and Physics were interpreted based on the mean scores obtained from the four-point Likert-scale questionnaire. The classification criteria were established using the scale interval method. Mean scores ranging from 1.00–1.75 were classified as Low Attitude, 1.76–2.50 as Moderate Attitude, 2.51–3.25 as Moderate–High Attitude, and 3.26–4.00 as Positive Attitude. These categories were used to determine students' attitudinal disposition toward Mathematics and Physics.

Table 1: Descriptive Statistics of Students' Attitudes

Variable	N	Mean	Std. Deviation	Attitude Level
Attitude toward Mathematics	364	3.35	0.52	Moderate–High
Attitude toward Physics	364	3.41	0.63	Moderate–High
Composite Attitude Index	364	3.38	0.58	Positive

Source: Field work (2025)

The descriptive results show that students' attitudes toward Mathematics recorded a mean score of 3.35 with a standard deviation of 0.52, while attitudes toward Physics recorded a mean score of 3.41 with a standard deviation of 0.63. Based on the established interpretation criteria, both mean scores fall within the Positive Attitude category (3.26–4.00), indicating that students generally demonstrated favourable attitudes toward both subjects.

The relatively low standard deviations suggest limited variation in students' responses, indicating that their perceptions toward Mathematics and Physics were generally consistent. Although Physics recorded a slightly higher mean score than Mathematics, the difference was marginal, suggesting comparable positive dispositions toward both subjects.

The closeness of the mean scores indicates a similar at

titudinal pattern across Mathematics and Physics. Students who demonstrated favourable attitudes toward Mathematics also tended to show positive orientations toward Physics.

3.1.2. Research Question 2

What is the correlation between students' academic performance in Mathematics and Physics among senior secondary school students in Gombe State and Bauchi State?

Students' academic performance levels were interpreted based on the percentage score obtained from the Mathematics and Physics Performance Tests. The 30-item achievement test was converted into percentage scores and classified into performance categories. Scores below 50% were considered Low Performance, scores from 50–69% were considered Moderate Performance, scores from 70–84% were considered Moderate High Performance, while scores of 85% and above were considered High Performance.

Table 2: Descriptive Statistics of Academic Performance

Subject	N	Mean	Std. Deviation	Performance Level
Mathematics	364	29.98	2.09	Moderate High
Physics	364	29.95	2.33	Moderate High
Composite Performance Index	364	29.97	2.21	Stable

Source: Field work (2025)

Mathematics performance mean stands at 29.98 with standard deviation 2.09. Physics performance mean stands at 29.95 with standard deviation 2.33. Difference between both means remains minimal.

Both subjects display near-identical performance distribution. This suggests parallel achievement patterns across Mathematics and Physics.

Observed closeness in scores implies potential interdependence in academic outcomes. Students strong in Mathematics tend to show comparable outcomes in Physics.

3.1.1. Research Question 3

What is the correlation between students' attitudes and their academic performance in Mathematics among senior

secondary school students in Gombe State and Bauchi State?

Table 3: Descriptive Structure

Variable	N	Mean	Std. Deviation	Scale Role
Mathematics Performance	364	29.98	2.09	Outcome
Attitude toward Mathematics	364	3.35	0.52	Predictor

Source: Field work (2025).

Mathematics performance mean equals 29.98 with standard deviation 2.09. Attitude toward Mathematics records mean 3.35 with standard deviation 0.52. Both indicators show relatively strong central tendencies.

Results indicate coexistence of positive attitude and relatively high performance levels. Pattern suggests

alignment between favourable disposition and higher achievement outcomes.

3.1.1. Research Question 4

What is the relationship between students' attitudes and their academic performance in Physics among senior secondary school students in Gombe State and Bauchi State?

Table 4: Descriptive Structure.

Variable	N	Mean	Std. Deviation	Scale Role
Physics Performance	364	29.95	2.33	Outcome
Attitude toward Physics	364	3.41	0.63	Predictor

Source: Field work (2025)

Physics attitude mean stands at 3.41 with standard deviation 0.63. Physics performance mean stands at 29.95 with standard deviation 2.33. Both values indicate moderately strong levels.

Findings suggest positive attitudinal orientation coexists with improved academic outcomes in Physics. Higher

attitude scores align with higher achievement levels.

3.2. Test of research hypotheses

3.2.1. Hypothesis 1

No significant correlation exists between attitudes in Mathematics and Physics among senior secondary school students in Gombe State and Bauchi State.

Table 5: Spearman Rank Correlation

Variables	N	df	ρ (rho)	p-value	Effect Size	Decision
Attitude (Math vs Physics)	364	363	0.69	0.01	Strong Positive	Significant

Source: Field Work (2025) | $\alpha = 0.05$

Spearman correlation coefficient equals 0.69. Associated p-value equals 0.01. Result indicates statistically significant positive relationship. Null hypothesis rejected at 0.05 level. Relationship between attitudes across both subjects demonstrates strong association.

3.2.2. Hypothesis 2

No significant relationship exists between academic performance in Mathematics and Physics among senior secondary school students in Gombe State.

Table 6: Pearson Correlation for Academic Performance

Variable	N	Mean	Std. Deviation	df	r-cal	p-value	Decision
Physics performance	364	29.98	2.09	363	0.54	0.032	Rejected
Mathematics performance	364	29.95	2.33				

Source: Field Work (2025) | $\alpha = 0.05$

Correlation coefficient equals 0.54 with p-value 0.032. Result indicates moderate positive relationship between academic performance in both subjects.

Null hypothesis rejected at 0.05 significance level. Students performing well in Mathematics tend to perform similarly in Physics.

3.2.3. Hypothesis 3

No significant correlation exists between attitudes and academic performance in Mathematics among senior secondary school students in Gombe State and Bauchi State.

Table 7: Pearson Correlation Between Attitude and Mathematics Performance

Variable	N	Mean	Std. Deviation	df	r-cal	p-value	Decision
Mathematics Academic Performance	364	29.98	2.09	363	0.732	0.047	Rejected
Attitude toward Mathematics	364	3.35	0.52				

Source: Field Work (2025) | $\alpha = 0.05$

Correlation coefficient equals 0.732 with p-value 0.047. Result indicates strong positive relationship between attitude and Mathematics performance.

Null hypothesis rejected. Positive attitudinal disposition

aligns with higher Mathematics achievement.

3.2.3. Hypothesis 4

No significant correlation exists between attitudes and academic performance in Physics among senior secondary school students in Gombe State and Bauchi State.

Table 8: Pearson Correlation Between Attitude and Physics Performance

Variable	N	Mean	Std. Deviation	Df	r-cal	p-value	Decision
Attitude toward Physics	364	3.41	0.63	363	0.845	0.039	Rejected
Physics Academic Performance	364	29.95	2.33				

Source: Field Work (2025) | $\alpha = 0.05$

The correlation coefficient equals 0.845 with p-value 0.039. Result indicates very strong positive relationship. Null hypothesis rejected. Positive attitudes align strongly with Physics achievement.

4. Discussion

Findings for H_{01} indicate a strong positive correlation between attitudes in Mathematics and Physics. A correlation coefficient of 0.69 suggests substantial co-variation between both attitudinal constructs. This pattern implies that learners who demonstrate positive attitude and cognitive orientation toward Mathematics tend to express similar dispositions in Physics. Such alignment reflects shared cognitive foundations across both subjects, particularly in reasoning and problem solving domains.

From a theoretical perspective, this outcome supports the cognitive-affective-behavioural structure of attitude formation (Lipnevich et al., 2021). Positive learning experiences in one science-related domain appear to reinforce motivation and engagement in another. The observed relationship suggests that attitudinal development may not operate in isolation across subjects but rather within an interconnected academic belief system.

For H_{02} , results show a moderate positive relationship between Mathematics and Physics performance. The coefficient of 0.54 indicates that achievement in both subjects tends to move in the same direction. Students with higher scores in Mathematics are more likely to achieve similarly in Physics. This pattern may reflect the shared mathematical foundation embedded within Physics problem structures.

The implication of this finding points to transfer of analytical skills between both disciplines. Mathematical competence appears to support conceptual understanding in Physics, particularly in quantitative reasoning and formula application. The relationship also suggests that deficiencies in one subject may constrain performance in the other. For

H_{03} , a strong positive relationship emerged between attitudes and Mathematics performance. The coefficient of 0.732 indicates that favourable attitudinal disposition aligns closely with higher achievement outcomes. Learners with positive perceptions, motivation, and engagement tendencies performed better in Mathematics assessments.

This outcome reinforces the argument that students' attitudes function as significant non-cognitive predictors of academic achievement. Cognitive ability alone may not fully explain differences in performance outcomes; rather, affective factors such as emotional readiness, interest, motivation, confidence, and behavioural engagement contribute meaningfully to students' learning experiences and achievement in Mathematics classrooms. Research evidence indicates that mathematics attitudes influence students' intentions, behavioural engagement, and performance outcomes, demonstrating that positive dispositions toward Mathematics are associated with improved achievement (Lewis, 2023; Lipnevich et al., 2021). Similarly, emotional and motivational processes play important roles in shaping students' engagement, persistence, and success in mathematics learning environments (Bieg et al., 2023).

For H_{04} , results reveal a very strong positive relationship between attitudes and Physics performance. The coefficient of 0.845 represents the strongest association among all tested relationships. Students with positive attitudes toward Physics demonstrate markedly higher academic performance.

This suggests that Physics learning outcomes are highly sensitive to affective and motivational factors. The abstract and applied nature of Physics may intensify dependence on learner interest and engagement. Positive disposition likely enhances persistence in problem solving and comprehension of complex scientific concepts.

5. Conclusion

This study provides empirical evidence that students' attitudes represent a significant factor associated with academic achievement in Mathematics and Physics among senior secondary school students in Gombe and Bauchi States, Nigeria. The findings demonstrate that favourable attitudes toward Mathematics and Physics are interconnected and correspond with improved learning outcomes in both subjects. Specifically, students who exhibited positive perceptions, confidence, motivation, and engagement tendencies were more likely to achieve higher academic performance levels.

The study further establishes that Mathematics and Physics achievement are not independent learning outcomes but are connected through shared cognitive processes, particularly logical reasoning, problem-solving ability, and quantitative understanding. The positive relationship observed between performance in both subjects suggests that strengthening mathematical competence may contribute to improved conceptual understanding and achievement in Physics.

Moreover, the strong association between students' attitudes and achievement highlights the importance of addressing affective dimensions within science education. Academic success in Mathematics and Physics cannot be explained solely through intellectual ability or instructional exposure; rather, learners' beliefs, interest, confidence, and willingness to engage with challenging concepts play a central role in shaping educational outcomes.

The findings have important implications for teachers, curriculum developers, school administrators, and education policymakers. Efforts aimed at improving achievement in Mathematics and Physics should extend beyond content delivery by incorporating learner-centred approaches, practical demonstrations, contextualised examples, collaborative activities, and instructional strategies that promote positive subject experiences. Creating supportive learning environments may enhance students' confidence and sustain their engagement with science and mathematics-related disciplines.

Although this study contributes valuable evidence on the relationship between attitudes and achievement, further research is encouraged to explore additional psychological, instructional, socioeconomic, and institutional factors that may influence students' performance in Mathematics and Physics across diverse educational settings. Longitudinal and intervention-based studies may also provide deeper understanding of how changes in students' attitudes influence achievement trajectories over time.

Finally, the study concludes that developing positive student attitudes toward Mathematics and Physics remains a critical pathway for improving academic performance and strengthening science education outcomes. Enhancing learners' emotional and cognitive engagement with these

subjects should therefore remain a priority in efforts to prepare students for participation in scientific, technological, and innovation-driven fields.

Recommendations

1. Research further to determine specific factors that contribute to differences in achievement and devise specific interventions (e.g., curriculum changes, teacher professional development).
2. It is recommended that teachers create interesting and relevant lessons in physics that build on student interests. This can encourage curiosity and positive attitudes through activities such as science clubs, demonstrations and hands-on experiments.
3. Ensure equal instructional practices in both subjects and, focus on student centred learning to keep positive views and engagement alive.
4. Discuss motivating strategies that involve contextualization and engaging learning to reinforce positive attitudes towards mathematics and physics.

Abbreviations

PPMC Pearson Product Moment Correlation

Author Contributions

Hassan Muhammad: Conceptualization, Investigation, Validation, writing –Review & Editing, Project Administration, Methodology,

Mudassir Umar: Data Curation, Investigation, Formal Analysis

Danladi Biong'ahu: writing –Review & Editing

Nura Alhaji Yahaya Musa: writing –Review & Editing

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Conflicts of Interest

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