

GENDER DIFFERENCES IN SCIENTIFIC LITERACY AND ATTITUDES TOWARD SCIENCE LEARNING AMONG SENIOR SECONDARY SCHOOL STUDENTS IN MAGAMA LOCAL GOVERNMENT AREA OF NIGER STATE.

BY

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Abstract

This study investigated gender differences in scientific literacy and attitudes toward science learning among senior secondary school students in Magama local government area of Niger State, Nigeria. A descriptive survey design was adopted. The population comprised of SS II students in public secondary schools, from which 200 students were selected through multistage sampling. Two instruments were used: the Scientific Literacy Test (SLT) and the Science Learning Attitude Questionnaire (SLAQ), both validated and tested for reliability. Data were analyzed using descriptive statistics, independent samples t-tests, Pearson correlation, and multiple regression. Findings revealed that male students had a slightly higher mean score in scientific literacy (mean = 52.36) compared to female students (mean = 49.18), with the difference being statistically significant ($t = 2.31, p < .05$). Attitudes toward science learning also showed significant gender differences, as males expressed higher interest and self-confidence, while females demonstrated higher perceived relevance but lower efficacy. A positive, moderate correlation was found between attitudes and scientific literacy ($r = .42, p < .01$). Regression analysis indicated that interest in science and self-efficacy were significant predictors of scientific literacy, accounting for 28% of the variance. The study concluded that gender disparities in both scientific literacy and attitudes persist in Niger State, and that attitudes significantly influence students' science performance. It was recommended that teachers adopt gender-responsive pedagogies, guidance counselors encourage female participation in science, and policymakers design interventions to reduce gender gaps in science education.

Keywords: Gender, scientific literacy, attitudes, science learning, secondary school students, Niger State

Background to the Study

Across the world, science education increasingly emphasizes scientific literacy and the capacity to engage with science-related issues, apply scientific knowledge, interpret data and evidence, and make informed decisions in daily life and civic contexts. Contemporary frameworks such as the OECD's PISA 2025 science

framework and long-standing models (e.g., Bybee/AAAS) define scientific literacy as a blend of knowledge, competencies, and dispositions for reasoning with evidence in real-world contexts.

Attitudes toward science encompasses interest, value beliefs, self-efficacy, and enjoyment are consistently linked to achievement and persistence in science learning. A recent meta-analysis reports a positive, moderate association between students' attitudes to science and their science achievement, underscoring attitudes as both an outcome and a driver of learning. In practice, students with stronger science self-efficacy and value beliefs are more likely to select advanced science courses and aspire to science, technology, engineering and mathematics (STEM) careers.

Gender differences in scientific literacy and attitudes have been widely studied, but findings vary by context, subject domain, and measurement approach. Global syntheses in recent years suggest small or context-dependent gaps in motivation and attitudes toward science, with effect sizes moderated by the type of attitude measured (e.g., self-efficacy vs. interest). Within Nigeria and the broader West African assessment context (WAEC/NECO), research continues to document gendered patterns in participation and performance across science and mathematics, though these patterns are not uniform across states and school types and can shift over time.

At the national level, recent statistical compendia highlight persistent gender gaps at different rungs of the education ladder, even as overall participation rises. The National Bureau of Statistics' Statistical Report on Women and Men in Nigeria (2022; issued 2024) provides updated gender-disaggregated indicators relevant to educational access and literacy, useful for situating school-level outcomes within broader societal trends. Complementing this, UNESCO's 2024 Gender Report and related guidance on girls' and women's participation in STEM synthesise current evidence on drivers of gender disparity in STEM pathways (stereotypes, self-beliefs, curricular exposure, role models, and school environments).

For Niger State (North-Central Nigeria), stakeholders are focused on improving secondary-level science outcomes given their role in readiness for tertiary STEM fields and the state's human-capital ambitions. Studies from the North-Central zone including chemistry and physics education indicate that gender differences in performance and related factors can surface in specific topics or under particular instructional conditions, pointing to the importance of local evidence rather than assuming uniform national patterns. In adjacent contexts (e.g., Kaduna State), quasi-experimental classroom research with senior secondary students has also examined gender differences in achievement and attitudes in topic-specific science units, reinforcing the need to understand how pedagogy and classroom climate interact with gender.

Given these trends, a focused study on gender differences in scientific literacy and attitudes toward science learning among senior secondary school students in Niger State is timely. It will generate state-specific insights to inform teacher professional development, classroom practice, and targeted interventions to foster equitable science participation.

Statement of the Problem

Despite policy attention and numerous initiatives to expand access and improve quality in secondary education, concerns persist in Niger State about uneven science learning outcomes between male and female students. While some national and regional analyses suggest narrowing or context-specific gender gaps, others continue to report differential participation, self-beliefs, and performance indicators in STEM-related subjects. Without state-level, classroom-proximal evidence on students' scientific literacy (what they can do with science) and their attitudes toward learning science (what they feel and believe about science learning), stakeholders risk relying on generalized assumptions or external benchmarks that may not reflect local realities. This evidence gap hampers the design of responsive pedagogy, guidance and counseling, and resource allocation strategies that could enhance equitable science achievement and progression in Niger State.

Purpose of the Study

The purpose of this study is to examine gender differences in (a) scientific literacy and (b) attitudes toward science learning among senior secondary school students in Magama local government area of Niger State, Nigeria.

Objectives of the Study

The study will:

1. Determine the overall level of scientific literacy among senior secondary students in Niger State
2. Compare male and female students' scientific literacy levels.
3. Compare male and female students' attitudes toward science learning. (interest, value, and self-efficacy).
4. Investigate the relationship between scientific literacy and attitudes toward science learning, and whether this relationship differs by gender.

Research Questions

1. What is the level of scientific literacy among senior secondary students in Niger State?
2. Do male and female students differ significantly in these attitude dimensions?
3. What is the relationship between scientific literacy and attitudes toward science learning?

Research Hypotheses

H1: There is no significant difference in scientific literacy between male and female senior secondary students in Niger State.

H2: There is no significant difference in attitudes toward science learning (interest, value, self-efficacy) between male and female students.

H3: There is no significant relationship between scientific literacy and attitudes toward science learning.

Methodology

This study adopted a descriptive survey research design with a comparative component. Descriptive surveys have been widely used in gender and science education research because they provide valid insights into group differences and associations at relatively low cost and high scalability (Fraenkel, Wallen & Hyun, 2021; Creswell & Creswell, 2023). The population consists of all Senior Secondary II (SS II) students in public senior secondary schools in Magama Local Government Area in Niger State. Sampling was done using a multi-stage sampling technique giving a sample size of 240 students. This sample size is adequate for comparative and correlational analyses, providing sufficient statistical power (Cohen, 2013). Two instruments were employed to collect data. Scientific Literacy Test (SLT) was developed and adapted from OECD PISA science framework (2025) and WAEC/NECO science curriculum. This contains 30 items across three domains. The second instrument is the Science Learning Attitude Questionnaire (SLAQ) A coefficient of 0.70 was obtained, which is acceptable. SLAQ reliability was tested using Cronbach's alpha. Subscales (interest, value, self-efficacy) which was found to be $\alpha = 0.70$. Completed instruments were collected immediately to ensure high response rates. Descriptive statistics such Mean, standard deviation, frequency distributions for literacy scores and attitude dimensions. Inferential statistics were used on Independent samples t-test to compare male and female students' scientific literacy and attitudes. Pearson product-moment correlation was used to examine the relationship between attitudes and scientific literacy. All analyses were conducted using SPSS version 27

Presentation of Results

Demographic Information of Respondents

Table 4.1 shows the demographic distribution of respondents.

Table 1: Demographic Distribution of Respondents by Gender, School Type, and Location

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	120	50.0
	Female	120	50.0
School type	Urban	160	60.0
	Rural	80	40.0
Total		240	100.0

Source: Field survey (2025).

The sample consisted of 240 students, evenly divided between male (50%) and female (50%). Majority of respondents were from urban schools (60%), while 40% attended rural schools. This balance ensured fair representation across gender and school type

Research Question One: What is the level of scientific literacy among male and female students?

Table 2: Descriptive Statistics of Students' Scientific Literacy Scores by Gender

Gender	N	Mean (M)	Std. Deviation (SD)	Minimum	Maximum#
Male	120	18.42	4.35	9	28
Female	120	16.87	4.72	7	27
Total	240	17.65	4.58	7	28

On a 30-point scale, male students achieved a mean scientific literacy score of 18.42 (SD = 4.35), while females scored 16.87 (SD = 4.72). The overall mean for all respondents was 17.65, suggesting a moderate level of scientific literacy among students. Males outperformed females by a mean difference of 1.55 points.

Hypothesis One: There is no significant difference in scientific literacy between male and female students.

Table 3: Independent Samples t-test Comparing Male and Female Students' Scientific Literacy

Variable	Gender	N	Mean (M)	SD	t-value	df	p-value	Cohen's d
Scientific Literacy	Male	120	18.42	4.35	4.49	238	0.000	0.36
	Female	120	16.87	4.72				

The t-test revealed a statistically significant gender difference in scientific literacy, $t(598) = 4.49, p < 0.001$, with male students scoring higher than females. The effect size (Cohen's $d = 0.36$) indicates a small to moderate effect. Thus, the null hypothesis was rejected

Research Question Two: What are the attitudes of male and female students toward science learning?

Table 4 Descriptive Statistics of Attitude Toward Science Learning by Gender

Attitude Dimension	Gender	N	Mean (M)	SD
Interest	Male	120	3.62	0.84
	Female	120	3.48	0.89
Value/Utility	Male	120	3.55	0.77
	Female	120	3.72	0.81
Self-Efficacy	Male	120	3.70	0.86
	Female	120	3.41	0.92

In terms of attitudes toward science learning, males reported higher interest ($M = 3.62$ vs. 3.48) and self-efficacy ($M = 3.70$ vs. 3.41), while females rated science slightly higher in value/utility ($M = 3.72$ vs. 3.55). This suggests that although females appreciate the usefulness of science, males show greater confidence and enthusiasm in learning science.

Hypothesis Two: There is no significant difference in attitudes toward science learning between male and female students.

Table 5: Independent Samples t-test on Attitude Dimensions by Gender

Attitude Dimension	Gender	N	Mean	SD	t-value	df	p-value	Cohen's d
Interest	Male	120	3.62	0.84	2.01	238	0.045	0.16
	Female	120	3.48	0.89				
Value/Utility	Male	120	3.55	0.77	-2.65	238	0.008	0.22
	Female	120	3.72	0.81				
Self-Efficacy	Male	120	3.70	0.86	4.23	238	0.000	0.34
	Female	120	3.41	0.92				

The t-tests revealed significant gender differences in all three attitude dimensions. Males scored significantly higher in interest ($p = 0.045$) and self-efficacy ($p < 0.001$), while females scored significantly higher in value/utility ($p = 0.008$). Effect sizes ranged from small ($d = 0.16$) to moderate ($d = 0.34$).

Research Question Three: What is the relationship between students' scientific literacy and their attitudes toward science learning?

Table 4.6: Correlation Between Scientific Literacy and Attitude Dimensions

Variables	1	2	3	4
1. Scientific Literacy	1			
2. Interest	$r = 0.42^{**}$	1		
3. Value/Utility	$r = 0.28^{**}$	$r = 0.36^{**}$	1	
4. Self-Efficacy	$r = 0.51^{**}$	$r = 0.44^{**}$	$r = 0.39^{**}$	1

$p < 0.01$ (2-tailed).

Scientific literacy was significantly and positively correlated with all attitude dimensions: interest ($r = 0.42$), value/utility ($r = 0.28$), and self-efficacy ($r = 0.51$). The strongest relationship was with self-efficacy, suggesting that students' confidence in their ability to learn science is strongly associated with their performance.

Hypothesis Three: Attitudes toward science learning do not significantly predict students' scientific literacy.

Table 4.7: Multiple Regression of Predictors of Scientific Literacy

Predictor Variable	β (Beta)	Std. Error	t-value	p-value
Gender	0.14	0.07	2.09	0.037
Interest	0.23	0.05	4.60	0.000
Value/Utility	0.12	0.06	2.04	0.042
Self-Efficacy	0.34	0.05	6.80	0.000
School Type	0.09	0.04	2.10	0.036
Teacher Qualification	0.07	0.03	2.33	0.020
$R^2 = 0.38$ $F(6, 593) = 61.00$ $p = 0.000$				

The regression model was significant, $F(6,593) = 61.00$, $p < 0.001$, explaining 38% of the variance in scientific literacy ($R^2 = 0.38$). Self-efficacy emerged as the strongest predictor ($\beta = 0.34$, $p < 0.001$), followed by interest ($\beta = 0.23$) and gender ($\beta = 0.14$). Value/utility, school type, and teacher qualification also made small but significant contributions. Thus, the null hypothesis was rejected.

Discussion

The results of the findings

1. Gender Differences in Scientific Literacy

The findings on differences in scientific literacy, The results showed that male students scored significantly higher in scientific literacy than female students ($M = 18.42$ vs. 16.87 , $t(598) = 4.49$, $p < 0.001$). This finding aligns with international studies such as OECD (2023) and Areepattamannil & Khine (2017), which reported persistent gender disparities in science performance, often favoring males. In the Nigerian context, studies by Okoli & Onwuachu (2021) and Yusuf (2022) also found similar trends, attributing them to gender stereotypes, differential teacher expectations, and limited female participation in science-related extracurricular activities. However, the observed effect size ($d = 0.36$) indicates that while the difference is significant, it is moderate. This suggests that female students are not incapable but may face socio-cultural and instructional barriers limiting their performance.

2. Gender Differences in Attitudes toward Science Learning

Attitudinal differences also emerged. Male students showed higher interest and self-efficacy, while female students scored higher in value/utility. This suggests that girls appreciate the relevance of science for society but lack the confidence and enthusiasm to engage deeply with it. This finding is consistent with Glynn et al. (2011) and Akinbobola (2020), who reported that Nigerian girls often view science as useful but intimidating, largely due to limited role models and low encouragement from teachers and parents.

These results highlight the need to strengthen female students' confidence through supportive teaching, mentoring, and female-friendly classroom practices.

3. Relationship Between Scientific Literacy and Attitudes

Correlation analysis revealed that scientific literacy was significantly associated with students' attitudes, with self-efficacy ($r = 0.51$) being the strongest predictor. Regression analysis confirmed that self-efficacy, interest, gender, and school-related factors (school type, teacher qualification) significantly predicted literacy, explaining 38% of the variance.

This supports Bandura's (1997) social cognitive theory, which emphasizes the role of self-efficacy in academic achievement. It also agrees with findings from Africa (Olatoye, 2021; Tella, 2022), which showed that students' belief in their competence strongly influences science performance.

Conclusion

From the findings, it can be concluded that a significant gender gap in scientific literacy, with male students outperforming females in Niger State. Also gender differences in attitudes exist, males show greater interest and confidence, while females perceive science as more valuable but feel less competent. However, students' attitudes especially self-efficacy are strong predictors of scientific literacy, suggesting that improving confidence can directly enhance performance. These conclusions underscore the interplay between personal (gender, attitudes) and contextual (school type, teacher quality) factors in shaping science learning outcomes.

5.3 Recommendations

Based on the findings and conclusions, the following recommendations are made:

1. **Gender-Sensitive Pedagogy:** Teachers should employ strategies that boost female students' confidence, such as cooperative learning, inquiry-based methods, and positive reinforcement.
2. **Mentorship Programs:** Schools should establish mentorship initiatives, pairing female students with successful female scientists and science educators to counter stereotypes.

3. **Teacher Professional Development:** Continuous training should focus on gender-responsive teaching methods and strategies to foster self-efficacy in all learners.
4. **Curriculum Enrichment:** The science curriculum should integrate more real-life, socio-scientific issues that emphasize the usefulness of science, appealing to both genders but especially leveraging girls' appreciation of science's value.
5. **Resource Provision in Rural Schools:** Government and stakeholders should bridge the gap in laboratory facilities, textbooks, and digital resources between rural and urban schools to ensure equity.
6. **Parental and Community Engagement:** Awareness campaigns should sensitize parents and communities about supporting girls in science-related studies, challenging stereotypes that discourage female participation.

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