

EXPLORING SOCIO-ECONOMIC AND CONTEXTUAL FACTORS CONTRIBUTING TO SCIENCE ANXIETY

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ABSTRACT

Science anxiety is a critical impediment to effective learning and engagement in science education, particularly within the domains of science, technology, engineering, and mathematics (STEM). This phenomenon encompasses heightened fear, negative emotional arousal, and avoidance behaviors associated with science-related tasks and environments. This study investigates the socio-economic and contextual determinants that exacerbate science anxiety among secondary school students in Nigeria. Utilizing a cross-sectional research design, data were collected from a sample of 500 students through validated survey instruments, including the Abbreviated Science Anxiety Scale, to measure anxiety levels alongside demographic variables such as age, gender, socio-economic status, urban or rural context, and educational level. The control-value theory of achievement emotions provided the theoretical lens, indicating how perceptions of control and value in academic settings influence emotional responses. Descriptive analyses revealed a mean science anxiety score of 74.02, with significant variations across groups: lower socio-economic status, rural residency, female gender, and junior secondary education were associated with elevated anxiety. Inferential statistics, including ANOVA, t-tests, and multiple regression, confirmed these factors as robust predictors, with low socio-economic status emerging as the strongest contributor. Implications underscore the need for equitable educational policies, while recommendations advocate for targeted interventions like resource enhancement in underserved areas and anxiety mitigation training for educators.

Keywords: Science Anxiety, Socio-Economic Status, Contextual Factors, Control-Value Theory, Stem Education.

INTRODUCTION

Science anxiety, a specialized form of academic anxiety, has been a subject of scholarly interest for decades, reflecting its profound impact on students' educational trajectories and broader societal advancements in scientific literacy. Initially conceptualized in the late 20th century, science anxiety refers to the emotional distress, fear, and physiological arousal experienced by individuals when engaging with science content, experiments, or assessments (Mallow, 1981). This distress often leads to cognitive interference, such as difficulty concentrating or recalling information, ultimately hindering performance and persistence in science-related pursuits (Udo *et al.*, 2001). Early investigations, such as those by Okebukola and Jegede (1989) emphasized how science anxiety manifests in classroom settings, where students perceive science as intimidating due to its abstract nature and perceived irrelevance to daily life. Over time, this concept has evolved to encompass not only individual psychological predispositions but also external influences, including socio-economic disparities and environmental contexts that shape educational experiences.

The background of science anxiety research reveals a historical progression from viewing it as a personal deficit to recognizing it as a multifaceted issue intertwined with systemic inequalities. In the 1980s and 1990s, studies predominantly focused on college-level populations in Western contexts, identifying factors like inadequate prior preparation and negative teacher interactions as key contributors (Mallow, 1994). For instance, Udo *et al.*, (2004) documented how physics anxiety, a subset of science anxiety, correlated with avoidance of advanced coursework among undergraduates. These works laid the groundwork for understanding anxiety as a barrier to STEM participation, particularly for underrepresented groups. More contemporary literature has broadened this scope to include younger learner and diverse global settings. Recent studies, such as those by Megreya, Szucs and Moustafa (2021), have linked science anxiety to math anxiety, showing moderate associations with reduced academic achievement and career aspirations in STEM fields. Furthermore, the COVID-19 pandemic has amplified these concerns, with research indicating heightened anxiety due to disrupted learning environments and increased reliance on digital platforms, which often

exacerbate disparities for students in resource-poor settings (Lin *et al.*, 2019 and Shala *et al.*, 2021).

The statement of the problem centers on the persistent and widening gaps in science education outcomes, where socio-economic and contextual factors play pivotal roles in perpetuating science anxiety. In many developing nations, including Nigeria, students from low-income backgrounds face chronic stressors such as financial instability and limited access to educational resources, which heighten vulnerability to anxiety disorders (Lund *et al.*, 2018). Contextual elements, like living in rural areas with inadequate infrastructure or urban overcrowding, further compound these issues by limiting exposure to hands-on science activities (Yang *et al.*, 2023). Despite evidence from meta-analyses showing that poorer neighborhood conditions increase the odds of mental health challenges, including anxiety (Richardson *et al.*, 2015), there remains a paucity of research specifically examining science anxiety through a socio-economic lens in non-Western contexts. This gap is particularly acute given the global emphasis on STEM equity; unaddressed science anxiety not only impairs individual achievement but also contributes to broader societal losses in innovation and workforce diversity.

Relevant current literature underscores the additive effects of Socio-economic and contextual variables on anxiety. For example, a large-scale study by King *et al.*, (2022) found that adolescents in disadvantaged neighborhoods exhibited high levels of depression and anxiety, with implications for academic engagement. Similarly, Brenes *et al.*, (2008) reported that adults with lower education and disability status were more prone to anxiety, patterns that likely originate in school years. Some literature complements this by highlighting gender differences; Misra and McKean (2000) observed that females report higher science anxiety than males, potentially due to societal stereotypes and lower self-efficacy in STEM domains. Recent investigations, such as those by England *et al.*, (2019), confirm these disparities persist, with first-generation and minority students experiencing compounded effects. In educational settings, active learning approaches have been shown to both alleviate and, in some cases, intensify anxiety depending on implementation (Cooper *et al.*, 2018). A systematic review by Barroso *et al.*, (2021) synthesized data from 372 studies, revealing small-to-moderate negative correlations

between math/science anxiety and performance, moderated by demographic factors.

Integrating these insights, the study addresses the problem by conducting a primary investigation into socio-economic and contextual contributors to science anxiety among Nigerian secondary students. Nigeria provides a compelling case study, with its diverse socioeconomic landscape and educational challenges where science literacy is crucial for national development yet hampered by inequities. By merging historical and contemporary perspectives, this research aims to elucidate how factors like family income, parental education, and geographic location interact to exacerbate anxiety, informing targeted interventions. The literature gap in primary data from African contexts necessitates this approach, as most existing studies rely on Western samples or secondary analyses. For instance, while Okebukola *et al.*, (1989) linked education levels to anxiety regulation, applications to science-specific anxiety in resource -constrained environments are limited. This study thus contributes by employing empirical methods to test these relationships, building on foundational works like Mallow (2006), who advocated for anxiety reduction clinics in science teaching, and newer frameworks emphasizing contextual moderation (Pekrun & Loderer, 2020).

The evolution of science anxiety research also highlights methodological advancements. Early studies often used qualitative observations or basic surveys (Okebukola 1986), while recent ones incorporate psychometric tools and longitudinal designs (Dakar *et al.*, 2021). However, few integrate socio economic metrics with anxiety measures in a holistic model. This oversight is problematic, as socio economic status influences not only access but also psychological resilience; lower SES correlates with chronic stress, impairing cognitive functions essential for science learning (Esch *et al.*, 2014). Contextual factors, such as neighborhood safety and school quality, add layers of complexity, as evidenced by Yang *et al.*, (2023), who associated environmental pollutants in disadvantaged areas with increased anxiety risk. In Nigeria, where urban-rural divides are stark, rural students often contend with outdated curricula and teacher shortages, fostering a sense of helplessness that aligns with anxiety theories (King *et al.*, 2022).

Moreover, the intersectionality of these factors with demographics like gender and age warrants attention. Older literature, such as Maloney (2015), noted intergenerational transmission of anxiety, where parental attitudes influence children. Newer studies extend this to cultural contexts, showing that with patriarchal societies, females may internalize STEM as male dominated, heightening anxiety (Carey *et al.*, 2016). Age-related Patterns suggest that anxiety peaks in early adolescence due to developmental transitions (England *et al.*, 2019). These elements form the crux of the problem: without addressing socio-economic and contextual roots, efforts to mitigate science anxiety remain superficial.

This article's structure reflects a standard journal format, beginning with this integrated introduction, followed by methodology, results, discussion, and conclusion. By citing both seminal works e.g., (Mallow, 1981) and recent analyses (e.g., Megreya *et al.*, 2021), it bridges temporal gaps in the literature, emphasizing the enduring relevance of science anxiety amid evolving educational landscapes.

Theoretical Framework: The theoretical foundation for this study is anchored on the control-value theory of achievement emotions, proposed by Pekrun (2006), which posits that academic emotions like anxiety stem from subjective appraisals of control over outcomes and the intrinsic or extrinsic value assigned to those outcomes. In the context of science education, students appraise their ability to master concepts (control) and the relevance of science to their goals (value). Low perceived control, often stemming from socio-economic constraints like limited access to tutors or materials can trigger anxiety, especially when high value is placed on success for future opportunities (Pekrun *et al.*, 2007). This theory integrates cognitive and emotional processes, explaining why students from disadvantaged backgrounds experience heightened distress in science classes, where failure perceptions are amplified by resource scarcity.

Complementing this is Bandura's (1997) social cognitive theory, which emphasizes self-efficacy as a mediator between environmental factors and emotional responses. Self-efficacy, the belief in one's capability to execute tasks, is eroded in low-SES contexts due to vicarious experiences of failure or lack of mastery opportunities, fostering anxiety (Gaudier-Diaz *et al.*, 2019). For rural students, contextual isolation reduces modeling from successful

peers, further diminishing efficacy. The theory also accounts for reciprocal determinism, where anxiety influences behavior (e.g., avoidance) and environment (e.g., poor grades reinforcing low SES cycles).

These frameworks are supported by older anxiety models, such as Spielberger's (1972) state-trait anxiety distinction, where trait anxiety (stable predisposition) interacts with state anxiety (situational) in educational settings. Recent applications, like in Hartanto and Yanga (2022), link this to cognitive load in science tasks. In Nigeria, where educational inequities are pronounced, these theories illuminate how socio-economic factors reduce control appraisals, while contextual variables like school infrastructure affect value perceptions.

The integration of these theories provides a robust lens for examining science anxiety. Control value theory guides the hypothesis that low SES and rural contexts lower control, increasing anxiety, while social cognitive theory explains efficacy's role. This dual approach addresses literature gaps, where older studies focused on individual traits (Mallow 1981) and newer ones on contextual moderation (Disentangling the individual and contextual effects of math anxiety, 2022).

METHODOLOGY

This study adopted a quantitative, cross-sectional research design to explore the relationships between socio-economic, contextual factors, and science anxiety. Cross-sectional designs are appropriate for capturing prevalence and associations at a specific time, allowing for efficient data collection from diverse groups. The design facilitated the examination of demographic variations without longitudinal demands, aligning with resource constraints in the study setting.

Participants were 500 secondary school students from public schools in Ogun State, Nigeria, selected via stratified random sampling to ensure representation across socio-economic strata, urban/rural divides, and education levels. Inclusion criteria included ages 12-18 and enrollment in science courses. The sample's demography reflected national trends: mean age 14.97 years (SD=2.04), with balanced gender distribution (45.4% male, 54.6% female). Socio-economic status was categorized based on parental occupation, income, and education: 43.4% low, 35.2% medium, 21.4% high. Contextual distribution was

55.8% urban, 44.2% rural, and education levels split between junior (54.6%) and senior secondary (45.4%).

Primary data collection employed a self-administered questionnaire, the preferred method for sensitive topics like anxiety to ensure anonymity and reduce bias. The instrument comprised two sections: demographics (age, gender, SES proxy questions, context, education level) and the Abbreviated Science Anxiety Scale (ASAS; Megreya *et al.*, 2021), a JO-item Likert-scale measure (1=strongly disagree to 5=strongly agree) assessing learning and evaluation anxiety (e.g., "I won't worry about failing science tests"). The ASAS has demonstrated reliability ($\alpha=0.82-0.89$) and validity in similar populations. Scores were summed (range 1-50), then scaled to 0-100 for interpretability. Pilot testing with 50 students confirmed clarity and cultural appropriateness, with minor wording adjustments.

Data collection occurred in classrooms during school hours, following ethical approval from the local education board and informed consent from participants and guardians. Teachers facilitated distribution, ensuring

voluntary participation. Response rate was 92%, with incomplete forms excluded.

Data analysis used descriptive statistics for demographics and anxiety levels, inferential tests (tests for binary variables like gender/context, ANOVA for SES, Pearson correlation for age), and multiple linear regression to predict anxiety from predictors. Analyses were conducted in Python with libraries like pandas and scikit-learn, with significance at $p<0.05$. Assumptions (normality, homoscedasticity) were verified via Shapiro-Wilk and Levene's tests.

RESULTS

The demographic profile of the 500 participants is summarized in Table I, illustrating a diverse sample representative of Nigerian secondary students. The mean age was 14.97 years ($SD=2.04$), ranging from 12 to 18. Gender distribution showed a slight female majority (54.6%), consistent with enrollment patterns in the region. Socio-economic status revealed 43.4% in the low category, reflecting prevalent economic challenges. Contextual factors indicated 55.8% urban residents, while education levels were nearly evenly split between junior and senior

Table 1: Demographic Characteristics of Participants

Variable	Count/Mean	Percentage
Gender: Female	273	54.60%
SES:Low	217	43.40%
SES: Medium	176	35.20%
SES: High	107	21.40%
Context: Urban	279	55.80%
Context: Rural	221	44.20%
Education Level: Junior Secondary	273	54.60%
Education Level: Senior Secondary	227	45.40%

Table 2. Science Anxiety Scores by Socio-Economic Status

SES	Mean	SD	Count
Low	82.39	12.03	217
Medium	71.43	12.26	176
High	61.32	12.66	107

Table 3. Science Anxiety Scores by Context

Context	Mean	SD	Count
Rural	80.83	13.47	221
Urban	68.63	13.40	279

Table 4. Science Anxiety Score by Gender

Context	Mean	SD	Count
Female	76.24	14.52	273
Male	71.35	14.55	227

Table 5. Science Anxiety Scores by Education Level

Education level	Mean	SD	Count
Junior Secondary	75.43	14.29	273
Senior Secondary	72.32	15.09	227

The overall mean science anxiety score was 74.02 ($SD=14.72$), indicating moderate to high levels across the

sample. Group comparisons revealed significant differences, By SES (Table 2), low SES students had the highest mean (82.39, SD = 12.03), followed by medium (71.43, SD = 12.26) and high (61.32, SD = 12.66). ANOVA confirmed these differences ($F = 112.09$, $p < 0.001$).

Contextual differences, Table 3 showed rural students with higher anxiety, 80.83 (SD = 13.47) than urban (68.63, SD = 13.40), $t = -10.09$, $p < 0.001$.

Gender analysis, Table 4 indicated females had higher scores (76.24, SD = 14.52) than males (71.35, SD = 14.55), $t = -3.75$, $p < 0.001$.

Education level (Table 5) showed junior students more anxious (75.43, SD = 14.29) than seniors (72.32, SD = 15.09), $t = 2.36$, $p = 0.019$.

Age correlated weakly and non-significantly with anxiety ($r = -0.06$). Multiple regression (Table 6) explained 55% variance (adjusted R^2 approximate from model fit). Low SES ($\beta = 21.41$) and rural context (negative urban $\beta = -12.63$) were strongest predictors, followed by female gender (negative male $\beta = -4.64$) and junior level (negative senior $\beta = -4.24$).

Age had minor negative effect ($\beta = -0.76$).

These results demonstrate clear patterns, with socio-economic and contextual factors exerting substantial influence.

DISCUSSION

The findings illuminate the significant role of socio-economic and contextual factors in science anxiety, aligning with and extending existing literature. The elevated anxiety in low SES students mirrors Richardson *et al.*, (2015), where neighborhood has disadvantages incremental depression odds, applicable to science-specific distress. This may stem from chronic stressors like financial instability, reducing cognitive resources for science engagement (Esch *et al.*, 2014). Rural contexts' higher scores support Yang *et al.*, (2023), attributing anxiety to environmental and infrastructural deficits.

Gender differences, with females more anxious, echo Misra and McKean (2000) and recent works (England *et al.*, 2019), possibly due to stereotype threat. Junior students' higher anxiety suggests developmental vulnerability, consistent with Pekrun (2006). The weak age correlation indicates other factors dominate.

Regression results affirm the theoretic framework: low control from SES/context predicts anxiety. Compared to older studies (Okebukola, 1986), this highlights persistent issues, while new insights (Megreya *et al.*, 2021) suggest interventions targeting efficacy. Limitations include self-report biases and generalizability beyond Nigeria. Future research should use longitudinal designs.

CONCLUSION AND RECOMMENDATIONS

This study conclusively demonstrates that socio-economic disadvantages and rural contexts significantly contribute to science anxiety, impacting educational equity. By integrating primary data with theoretical insights, it advances understanding of these dynamics in Nigeria.

Recommendations include policy reform for resource equalization, teacher training in anxiety reduction (e.g., active learning per Cooper *et al.*, 2018), and community programs to boost self-efficacy. Also, schools should implement screening and support for high-risk groups.

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