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Academic Stress and Students' Achievement in Chemistry: A Predictive Study

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A B S T R A C T

The study examined the prediction of secondary school students' achievement in Chemistry by academic stress in Anambra State, Nigeria. The study also investigated the moderating influence of gender on the prediction between the study variables. Using a correlation research design, 320 SSII students were randomly chosen to make up the study's sample size. The Chemistry Achievement Scores (CAS) proforma and Chemistry Students' Academic Stress (CSAS) survey served as the study's guiding instruments. While linear regression and the Hayes Macro Process were utilized to assess the hypotheses at the 0.05 significance level, the research problems were addressed using the Pearson Product-Moment Correlation Coefficient (r) and coefficient of determination (r^2). The study's findings showed that academic stress is not a significant predictor of secondary school students' achievement in chemistry. Moreover, an insignificantly low positive predictive power exists between academic stress and secondary school students' achievement in Chemistry as moderated by gender. Based on the results, it was suggested, among other things, that government agencies and school administrators offer tools to help students manage their academic stress and that chemistry teachers employ teaching strategies that have been shown to reduce students' academic stress.

INTRODUCTION

Natural scientists study substances' qualities, their changes, and the laws governing them. One area of study that focuses on these topics is chemistry. Given its role in helping us comprehend the natural world from all angles, it can be explained in various ways. Chemistry, therefore, affects almost every aspect of our lives and is involved in them all. Science that studies the makeup, structure, characteristics, and changes that substances go through is called chemistry (Shakhashiri, 2020). In order to solve real-world problems, one needs a solid understanding of chemistry. Geology, engineering, biology, astronomy, and other disciplines all use chemistry, which is recognized as a basic science (Nwafor, Eke, & Ibe, 2023). Chemistry provides all man's necessities, including clean air, water, soil, food, clothing, shelter, health, and energy. This helps to raise man's standard of living.

It is clear from the above that chemistry is essential for every country's advancement in science, technology, and the economy. Consequently, the secondary school of learning urgently needs a strong foundation. Therefore, Nwafor, Okonkwo, and Onuigwe (2023) demanded that the current chemistry curriculum be immediately changed to assist students in meeting their individual and societal needs. However, the existing research indicates that students' achievement in Chemistry is unsatisfactory. For instance, the Chief Examiner for the West African Examination Council (WAEC) 2016–2022 reports showed that student achievement in Chemistry fluctuates. Eight categories of factors were found to have an impact on students' achievement in Chemistry in a study by Sibomana, Karegeya, and Sentongo (2021): students' factors, school factors, innovative teaching approaches, leadership styles, content area factors, class size, teachers, and family socioeconomic status. Onyi and Nwafor (2022) asserted that teaching strategies had an impact on students' achievement in chemistry, while Nwafor, Odukwe, and Achugbu (2024) claimed that psychological factors such as self-esteem have a significant role in students' achievement in the subject. Test anxiety, academic self-concept, and motivation are significantly correlated with secondary school students' academic achievement in mathematics, according to research by Onoshakpokaiye (2024). Additionally, prior research indicated a substantial correlation between academic achievement and test anxiety (Nwafor, Eke & Ibe, 2023), peer relationships (Filade et al, 2019), and depression (Bisson, 2017). In a similar vein, Wondu (2018) asserted that test anxiety, self-efficacy, motivation, and academic stress are psychological variables that can influence students' achievement in school. Thus, psychological factors like academic stress may affect students' performance in Chemistry.

The term "academic stress" describes the uncomfortable psychological circumstances brought on by peers, parents, instructors, and other family members' academic demands. According to Sun et al. (2013), academic stress is not a result of a collection of stressors but rather a subjective psychological suffering resulting from several components of academic learning. It is a psychological discomfort related to some expected annoyance from academic failure, or even the knowledge that such failure may occur. Academic stress is linked to detrimental psychological effects like unpleasant emotional states,

despair, tearfulness, even self-harm and suicidal thoughts in certain situations, according to Lotz and Sparfeldt (2017) and Soares and Woods (2020). Students usually experience academic stress due to expectations from parents, instructors, and themselves to perform well (Ang & Huan, 2006). According to Park et al. (2020), students who experience high levels of stress also demonstrate poor achievement in school, low self-efficacy, and low involvement in physical education. Therefore, the most stressors related to school include constant pressure to study, time limits, writing term papers, competing with other students, excessive work in one or more subjects, and expectations from teachers and family.

The link (correlation) between students' achievement and academic stress has been the subject of empirical research. In order to determine the relationship between students' academic stress and performance, Khabirul and Ujjwal (2018) conducted a study to examine the differences in academic stress and performance among higher secondary students based on gender. It was found that the gender of the students significantly affects their academic performance. Additionally, it was found that students' academic achievement and academic stress are negatively correlated. A study by Subramani and Kadhiravan (2017) investigated the relationship between high school students' mental health and academic stress. The findings showed that students attending private schools have better mental health than their public school peers and that they have faced higher levels of academic stress. Additionally, a noteworthy correlation was discovered between high school students' mental health and academic stress. Younger students reported higher levels of academic stress than older students, according to research by Khan, Altaf, and Kausar (2013). Additionally, when students' Perceived Stress Scale (PSS) levels were compared at the start and end of the semester, there was no significant difference. According to Olape, Lasiele, Chiaka, and Abidoye (2017), a significant relationship exists between students' academic performance and stress levels. Academic performance and the degree of personal, interpersonal, environmental, and achievement stress are also significantly correlated. A study by Cornelius-Ukpepi and Ndifon (2014) examined the connection between junior secondary school students' academic achievement in integrated science and stress at home. It was discovered that there is a strong correlation between students' performance in integrated science and home stress. Hence, stress may have an impact on students of any gender.

There are other contradictory claims that males achieve more than females and vice versa, and males face more academic stress than females. Singh and Upadhyay (2008) discovered that female students experience higher levels of academic stress than their male counterparts, and that male students also exhibit higher levels of success. However, according to Jayanthi, Thirunavukarasu, and Rajkumar (2015), teenage girls experience more academic stress than boys, and the primary causes are expectations from parents and teachers. In a study by Prabu (2015) involving higher secondary students, male students experience higher levels of stress than female students, and urban students experience higher levels of academic stress than rural students. Yet, Khan Altaf and Kausar (2013) concluded that there is no significant difference in

the academic stress experienced by males and females. In a study conducted by Bartwal and Raj (2013) to ascertain the relationship between academic stress and emotional intelligence of school-going adolescents, it was discovered that both male and female adolescents experience academic stress in similar amounts and that individuals with high emotional intelligence scores are better able to manage this stress. In a similar vein, Mathew and Jayan (2006) found that there was no significant difference in the type of academic stress reported by boys and girls. Furthermore, research by Kaur and Kaur (2015) and Agarwal (2011) revealed no significant difference between male and female students' levels of academic stress.

Given the contradictory reports regarding the relationship between academic stress and students' achievement and the fact that the majority of studies were conducted in other academic subjects, the current researchers are well-positioned to draw attention to the psychologically-based factor of academic stress as a predictor of secondary school students' achievement in Chemistry. In addition, the researchers hope to advance the understanding of whether male and female students in Anambra State, Nigeria, differ significantly in the two variables' predictions from one another. Thus, the purpose of the study is to close this gap.

METHODOLOGY

For this study, a correlational survey research design was adopted. The study's population comprised the 1,352 senior secondary II Chemistry students in the Orumba North Local Government Area of Anambra State, Nigeria. 320 Chemistry SSII students made up the study's sample. The researchers randomly chose ten coeducational institutions of the fourteen government-owned secondary schools in the Local Government Area. Additionally, the students utilized a simple random sampling method called balloting without replacement to select participants for the study.

Chemistry Students' Academic Stress (CSAS) and the Chemistry Achievement Scores (CAS) Proforma were the two instruments employed in the study. The Educational Stress Scale for Adolescents (ESSA), created by Sun et al. (2011), served as the basis for the CSAS. On a four-point Likert scale of Strongly Disagree (1), Disagree (2), Agree (3), and Strongly Agree (4), there were sixteen items total. Conversely, the results of the first term of the sampled schools were obtained using the CAS proforma. Because the state's ministry of education regulates them, the first term results in Anambra State, Nigeria, being often uniform and standardized. Three experts from Nnamdi Azikiwe University's Faculty of Education in Awka, Anambra State, Nigeria—two from the Department of Science Education (Chemistry Unit) and one from the Department of Educational Foundation (Measurement & Evaluation Unit)—validated the instruments. Cronbach's Alpha was used to determine the internal consistency reliability of the CSAS, yielding a reliability index of 0.79. To achieve a 100% return, the CSAS was distributed to the students in the ten sampled schools and immediately collected.

The Pearson Product-Moment Correlation Coefficient (r) and coefficient of determination (r^2) were used to answer the research questions. Three

relationships were identified based on the interpretation of r: low (r=±0.30 and below), moderate (r=±0.30 to below ±0.80), and high (r=±0.80 and above). The hypotheses were tested at the 0.05 significance level using Hayes Macro Process and simple linear regression (Regression ANOVA).

RESEARCH RESULT

Research Question One: What is the predictive power of academic stress on secondary school students' achievement in Chemistry?

Table 1. Regression analysis of the predictive power of academic stress on secondary school students' achievement in Chemistry

Model	r	r^2	Std. Error of the Estimate	Decision
1	.044[a]	.002	16.10199	Low positive relationship

a. Predictors: (Constant), CSAS

The correlation coefficient between academic stress and secondary school students' achievement in Chemistry is .044, as indicated in Table 1. This suggests that the relationship between academic stress and secondary school students' achievement in Chemistry has a low positive predictive power. The information in the table also showed that the correlation coefficient of.044 has a coefficient of determination (r^2) of.002. According to the coefficient of determination (r^2), academic stress accounts for 0.2% of the variation in secondary school students' achievement in Chemistry. Furthermore, to ascertain whether academic stress is a significant predictor of secondary school students' achievement in Chemistry, hypothesis one below was developed and evaluated at the 0.05 level of significance.

Hypothesis One: Academic stress is not a significant predictor of secondary school students' achievement in Chemistry

Table 2. ANOVA Regression analysis of the prediction of academic stress on secondary school students' achievement in Chemistry.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	161.336	1	161.336	.622	.431[b]
	Residual	82449.161	318	259.274		
	Total	82610.497	319			

a. Dependent Variable: CAS

b. Predictors: (Constant), CSAS

According to the result in Table 2, a probability value of.431 was obtained at a.622 F-value, greater than the significance level of 0.05. Consequently, the null hypothesis was not rejected. Therefore, academic stress does not significantly predict secondary school students' achievement in Chemistry (P>0.05). This suggests that students' achievement in Chemistry in secondary schools was not significantly influenced by academic stress.

Research Question Two: What is the moderating influence of gender on the prediction of academic stress on secondary school students' achievement in Chemistry?

Table 3. Hayes' process analysis of the moderating influence of gender on the prediction of academic stress on secondary school students' achievement in Chemistry

Model Summary

r	r^2	MSE	F	df1	df2	p
.1306	.0170	256.9693	1.8267	3.0000	316.0000	.1422

Table 3's result indicates that the moderating influence of gender on the correlation coefficient between academic stress and secondary school students' achievement in Chemistry is .1306, with a coefficient of determination (r^2) of.0170. This suggests that, when controlling for gender, there is low predictive power (correlation) between academic stress and secondary school students' achievement in chemistry. On the other hand, the gender-moderated coefficient of determination (r^2) suggests that the 1.70% variation in secondary school students' achievement in Chemistry can be linked to their academic stress. Moreover, the hypothesis demonstrates that gender has no significant moderating influence on the predictive power of academic stress on secondary school students' achievement in Chemistry (P =.1422). Thus, the null hypothesis, which claims that gender has no significant moderating influence on the ability of academic stress to predict secondary school students' achievement in Chemistry, was not rejected. This is because the p-value of .1422 is higher than the significance level of 0.05. This suggests that, in Anambra State, Nigeria, secondary school students' achievement in Chemistry is not significantly influenced by their gender in terms of predicting academic stress.

DISCUSSION

The study's findings showed a low correlation (predictive power) between secondary school students' achievement in Chemistry and academic stress. Additional investigation, however, revealed that academic stress is not a significant predictor of secondary school achievement in Chemistry. This may be because Chemistry students experience significant levels of academic stress, which makes them less likely to be motivated to learn the subject, causing them to perform worse academically. Since academic stress only contributes a small percentage of the variation in students' academic results, this conclusion is consistent with Rehman, Shah, and Bano (2023), who found that academic stress had little or no significant effect on students' academic achievement. In a similar vein, Manju (2017) discovered that students under much stress performed worse on the test, while those under less stress performed better. Conversely, Habibah et al. (2011) discovered a marginally significant inverse correlation between students' stress levels and academic performance. Furthermore, the results

contradict those of Anooradha and Navneet (2023), who demonstrated a statistically significant negative correlation between students' academic progress in upper secondary school and school stress.

The study's results also showed that, when controlling for gender, there is a weak (low) positive predictive power between academic stress and secondary school students' achievement in Chemistry. Furthermore, there is no significant moderating influence of gender on the predictive capacity of academic stress on the accomplishment of secondary school students in Chemistry. This indicates that the academic stress of both male and female students is not a direct function of their achievement in Chemistry. These results are in line with Panma's (2021) findings, which showed that learning achievement, academic stress, and gender do not significantly correlate. Additionally, the results support the hypothesis by Attah and Ita (2017) that students' gender has no significant influence on their level of academic stress or English achievement. Similarly, gender has no significant relationship with students' academic stress or achievement, according to Lam et al. (2012). On the other hand, this study's findings contradict those of Rowan and Kaisa (2023), who claimed that females experience higher amounts of stress than males.

CONCLUSIONS AND RECOMMENDATIONS

The researchers concluded that students' achievement in Chemistry at secondary schools is not significantly affected by academic stress. Furthermore, there is no moderating influence of gender on the correlation between students' achievement in Chemistry and academic stress. Because the results showed a low positive prediction, lowering students' academic stress is necessary to increase their achievement in Chemistry. This implies that creating strategies to lessen students' academic stress and guarantee a stress-free Chemistry class should be an urgent concern for educators, parents, and other stakeholders in education. The study's conclusions led to the following recommendations being made: teachers of chemistry should employ teaching strategies that help students feel less stressed about their academic work; it is important to provide students the chance to gain the information and abilities they need to reduce the stress they experience in the classroom; resources for efficiently managing academic stress should be made available by the government and school administration; there is a need for communities and schools to be aware of the connection between achievement and academic stress and counselors and guidance should be available in every school. This will make it easier to identify students who are under much academic stress and guarantee that they receive therapy. The study was conducted in only the Orumba North Local Government Area of Anambra State, Nigeria, which could limit the generalizability of the findings to other areas not covered in this study. Hence, future researchers should use a large population to explore the correlation between students' achievement in Chemistry and their academic stress. Also, they can offer interventions to reduce academic stress among students.

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