



Psychological Factors as Predictors of High-Quality Achievement in Biology

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Article Information	ABSTRAK
Submitted: 24 – 05 – 2025 Accepted: 27 – 10 – 2025 Published: 31 – 10 – 2025	Salah satu tantangan terbesar yang dihadapi Nigeria adalah mencapai Tujuan Pembangunan Berkelanjutan (Sustainable Development Goal/SDG) 4, yaitu menyediakan pendidikan yang inklusif dan berkualitas secara adil serta mempromosikan kesempatan belajar sepanjang hayat bagi semua orang, bahkan dengan hadirnya teknologi Kecerdasan Buatan (Artificial Intelligence). Penelitian ini menyelidiki bagaimana faktor-faktor psikologis memengaruhi keberhasilan belajar siswa dalam mata pelajaran biologi, sebagai salah satu bidang ilmu pengetahuan yang penting. Penelitian ini menggunakan pendekatan korelasional dengan desain penelitian non-eksperimental, melibatkan 400 siswa sekolah menengah atas di Negara Bagian Oyo, Nigeria. Empat instrumen yang digunakan yaitu: Biology Interest Scale (BIS) dengan reliabilitas $\alpha = 0,91$; Anxiety Traits Inventory (ATI) dengan $\alpha = 0,74$; Academic Motivation Scale (AMS) dengan $\alpha = 0,87$; dan Biology Achievement Test (BAT) dengan $\alpha = 0,80$. Hasil penelitian menunjukkan adanya hubungan yang signifikan antara pencapaian biologi dan motivasi ($r = 0,187$, $p < 0,01$), minat ($r = 0,253$, $p < 0,01$), serta kecemasan ($r = -0,272$, $p < 0,01$). Selain itu, terdapat pengaruh yang signifikan antara variabel-variabel tersebut ($F(3, 396) = 16,748$, $p < 0,001$). Siswa yang memiliki antusiasme tinggi cenderung menunjukkan kinerja lebih baik ($\beta = 0,058$, $F(3, 396) = 0,556$), meskipun hubungan positif antara skor pencapaian dan motivasi tidak menunjukkan pengaruh yang signifikan secara statistik. Untuk mencapai SDG 4 yang menekankan pentingnya pendidikan yang inklusif dan berkualitas, perlu diperhatikan faktor-faktor afektif yang memengaruhi partisipasi siswa dalam pembelajaran biologi, seperti kecemasan dan minat belajar. Lingkungan belajar yang mendukung—yang menumbuhkan pemahaman, rasa ingin tahu, dan perkembangan pribadi—perlu diciptakan oleh para pendidik dan pembuat kebijakan. Mengintegrasikan aplikasi biologi dalam kehidupan nyata ke dalam kurikulum juga dapat meningkatkan relevansi mata pelajaran ini terhadap kehidupan sehari-hari dan karier masa depan, sehingga dapat mempertahankan motivasi dan minat siswa terhadap biologi. Kata kunci: Kecemasan; Motivasi; Minat; Prestasi Biologi; Sekolah Menengah Atas; Nigeria.
Publisher	ABSTRACT
Program Studi Pendidikan Biologi, Fakultas Sains dan Teknologi, UIN Walisongo Semarang	<i>One of Nigeria's biggest challenges is achieving Sustainable Development Goal (SDG) 4, which calls for providing inclusive and equitable quality education and promoting lifelong learning opportunities for all even with onboarding of Artificial Intelligence. This study investigates how psychological factors influence student success</i>

in biology, an important scientific field. The study considered three research questions using non experimental research design of correlational approach, conducted with 400 senior secondary school students from Oyo State, Nigeria. Four instrument used are: Biology Interest Scale (BIS) with $\alpha=0.91$, Anxiety Traits Inventory (ATI) $\alpha=0.74$, Academic Motivation Scale (AMS) $\alpha=0.87$ and Biology Achievement Test (BAT) with 0.80. Result revealed a high link between biology achievement and motivation ($r = .187$, $p < .01$), interest ($r = .253$, $p < .01$), and anxiety ($r = - 0.272$, $p < .01$). Moreover, there was significant effect ($F(3, 396) = 16.748$, $p < 0.001$) between variables. Students that were enthusiastic performed better, ($\beta= 0.058$, $F(3, 396)=.556$), indicates no statistically significant effects despite the positive relationship between achievement scores and motivation. In order to achieve Sustainable Development Goal 4 (SDG 4), which calls for inclusive and equitable quality education, affective elements that affect the participation of learners in biology, such as anxiety and interest, must be addressed. Supportive learning environments that prioritize understanding, curiosity, and personal development should be created by educators and policymakers. Integrating real-world biological applications into the curriculum can further enhance the subject's relevance to everyday life and future careers, thereby sustaining students' motivation and interest in biology.

Keywords: Anxiety; Motivation; Interest; Biology achievement; Senior Secondary; Nigeria.

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INTRODUCTION

Most people acknowledged education as an essential human right that plays a major role in advancing society. Particularly, secondary schools have a critical role in influencing young students' intellectual, social, and emotional growth. Secondary education in Nigeria fills the knowledge and skill gap between elementary and higher education by providing students with the fundamental knowledge as well as the skills needed for both personal and societal development.

Notwithstanding the importance of education, the academic performance of students in Oyo State, Nigeria, is a continuous source of concern to education stakeholders especially in subject like Biology. The importance of biology cannot be over-emphasized as it's study to humanity includes learning about life, provision of an in-depth, scientific understanding of how all living and nonliving organisms interact with each other and how diverse life forms are. This might be one of the motives why secondary school students in Nigeria are mandated to register it in all secondary school senior certificate examination (Arsal, 2019). As important as the subject is to humanity and national development, national examination results from examining bodies like the National Examination Council (NECO) and the West African Examination Council (WAEC) regularly demonstrate that students' performance in Biology is below expectations (UNESCO, 2019). This tendency casts doubt on the quality of education being offered in addition to undermining students' hopes for further education and future professions. The fact that many studies have looked at the pedagogical and instructional issues that affect biology students' performance (e.g., Gambari, 2014; Bichi, 2019; Nwankwo, 2024), relatively few have concentrated on the psychological factors—such as anxiety, interest, motivation, and self-

efficacy—that affect students' performance and engagement in the subject. While studies examining affective predictors of biology achievement, particularly at the secondary school level, are still scarce, existing research tends to focus on curriculum implementation and teaching practices (England et al., 2017; Cooper et al., 2023; Tracy et al., 2022).

Designing successful treatments and interventions including the use of Artificial Intelligence (AI) and blended learning involving the use of Information and Communication Technology (ICT) to enhance educational results in line with Sustainable Development Goal 4 (SDG-4) which requires an understanding of how these psychological elements interact to influence students' Biology achievement, SDG-4 emphasizes ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, underscoring the need to address both technological and psychological dimensions of learning to achieve meaningful academic progress. Ellah and Achor (2017) opined that there exists significant relationship between students' psychological concepts in Basic Science and Technology (BST) and their achievement in science in senior secondary science subjects in Benue State. The findings therefore imply that perceived academic achievement in Basic Science and Technology is a major factor in science students' performance at senior secondary level which is a function of emotional intelligence (Babatunde, 2018).

Intelligence and emotion are psychological construct which belongs to the cognitive (thinking, reasoning) aspect of mental functioning while emotions belong to the affective (feeling, appreciation) aspect of mental functioning (Elemide & Babatunde, 2020). To situate this in a proper perspective therefore, intelligence is the ability to acquire, understand and comprehend information or knowledge as well as being able to transfer the acquired knowledge for problem solving while emotion means state of mood of an individual and this is vital in explaining students' academic achievements. According to Kobal & Musek (2021) and Fayombo (2021), some academically brilliant individuals are unsuccessful at work, in academics or their personal relationships. A student who is psychologically imbued may not have control over their actions may be faced with challenges which ultimately wheels tremendous influence on his/her academic pursuit and achievement (Anazodo, et al., 2023). An individual psychological concept is a hypothetical construct that help explain and predict an individual's achievement. It includes elements of reciprocity which influence their actions (Obidigbo, 2020). It is the totality of a complex, organized and dynamic system of learned beliefs, attitudes and opinions that each person holds to be true about his or her personal existence. Psychological concepts has significant effect on adjustment and are very important personality constructs that develop and grow out of life experiences (Babatunde & Ayoola, 2020; Obidigbo, 2020).

In order to give educators, policymakers, and other stakeholders in the education sector useful information, this study will investigate the relationship among anxiety, motivation, interest, and achievement in Biology among Senior Secondary

School Students in Oyo State. Three important psychological factors that might have a big influence on students' academic progress are motivation, interest, and anxiety.

Motivation, both internal and extrinsic motivation is important factors in determining how engaged and successful students are in Biology classes. Extrinsic motivation, which comes from avoiding punishment or receiving rewards from outside sources, and intrinsic motivation, which is motivated by pleasure and self-satisfaction, both have important functions (Ryan & Deci, 2000). Self-Determination Theory (SDT) established that fostering intrinsic motivation through feelings of autonomy, competence, and relatedness in Biology classes is essential for achieving the best possible learning results (Babatunde, 2013; Kobal & Musek, 2021). Students who are more intrinsically motivated in their science studies tend to perform better academically. Further emphasizing the role of self-efficacy beliefs in motivation is Bandura's social cognitive theory, which shows that students who have high levels of confidence in Biology are more likely to persevere and put forth effort, which enhances achievement.

Curiosity and a desire to learn more about a subject are characteristics of interest, and they have a big influence on students' engagement and academic success (Renninger & Hidi, 2016; Hidi & Ainley, 2008). Students' active engagement in Biology learning is influenced by a variety of interest types; including topic interest, exploratory interest, and success interest (Krapp, 2002; Renninger & Hidi, 2016). The OECD (2015) and Pekrun (2006) have provided empirical data that highlights the beneficial correlation between academic success and an interest for science, particularly Biology. In addition to performing better on scientific examinations, students who are more engaged in the subject matter can also lessen the detrimental impacts of fear on their academic performance.

Anxiety might impair learning outcomes and cognitive performance since it is characterized by tension and apprehension (Karthigeyan & Nirmala, 2012). Students' commitment and dedication toward academic endeavors are greatly influenced by motivation, both internal and external (Imran, Muhammad, Kashif & Hasan (2020). Similarly, interest may help students concentrate and comprehend a subject better since it reflects their enthusiasm and curiosity (Adodo, 2012).

The review of literatures revealed that anxiety plays a vital role in the performance of learners during test (Hembree, 1998; Woodman, 2020). Excessive anxiety can impair cognitive function and impede academic success, but moderate anxiety can increase focus and attentiveness (Al Majali, 2020). Lazarus and Folkman (1984) highlight how cognitive assessments influence how an individual reacts to worry. Students who think of biology as a difficult subject or who obsess over possible failures may become more anxious and agitated.

Anxiety, motivation, and interest interact to influence how students experience and perform in Biology classes. Overwhelming anxiety may kill students' drive and enthusiasm for Biology, making them avoid challenging topics and hampering their ability to study (Pekrun, 2006). On the other hand, intrinsic motivation can act as a

counterbalance to worry, encouraging perseverance and lessening its detrimental effects on output (Daniels & Haynes, 2014). Furthermore, motivation whether extrinsic or intrinsic is essential for generating interest in Biology by focusing students' attention and energy at the subject. In addition, students who find biology interesting are more likely to approach learning with passion, which fosters a more positive learning environment. As a result, interest in the topic can reduce anxiety by enhancing engagement and enjoyment (Hidi & Renninger, 2006).

According to Al Majali's (2020), University students' motivation and academic achievement may be favorably correlated with mild anxiety. This research emphasizes the nuanced connection between anxiety and academic performance. Test anxiety and self-perception as indicators of Biology success in secondary school pupils were examined by Ihekwoaba and Chinweuba-eze (2020). The study discovered a moderating influence of school location on the association between test anxiety and academic achievement, although finding few direct effects. This study highlights the necessity of investigating other factors that affect performance. Although, numerous research back up the idea that anxiety and academic success are negatively correlated. In Erzen (2014), a slight positive effect of anxiety on student performance in a meta-analysis of was revealed. Nevertheless, the negative consequences of increased anxiety on motivation and learning may exceed this impact.

Previous studies (Woodman, 2020; Imran, et al. 2020) indicate a large study vacuum on the relationship between anxiety, motivation, interest, and academic performance in senior secondary school students in Oyo State, Nigeria. There is still a need for thorough study that will integrate these factors specifically among senior secondary school students in Oyo State, even though previous studies have examined these constructs separately. Subsequent investigations ought to endeavor to narrow down this disparity by delving into the ways in which motivation, interest and anxiety as a whole impact academic achievement in Biology instruction within this context.

The continuous challenges of fluctuating and low achievements in Biology among senior secondary school students in Oyo State, Nigeria, in spite of the subject's acknowledged importance indicates a significant educational concern. Although a number of studies, including curriculum designs and teaching strategies, have been the subject of prior studies, there has not been noticeable improvement in student achievements. This study explored the roles psychological factors like motivation, interest, and anxiety played in predicting Biology achievement, given their potential influence on student performance so as to provide empirical data that might improve educational results and advance high-quality education in Oyo State.

This study on the psychological factors predicting the biology achievement in secondary schools, three research questions were raised and answered in this study, they are - What kind of relationship exists between each predictor (anxiety, motivation, and interest) and the criteria (student achievement in biology)?, What is the composite effect of the predictor variables (anxiety, motivation and interest) on

criterion variable (achievement in biology)? and Which predictor variable has a greater bearing on predicting Biology students' academic achievement?

METHOD

This study adopted the non- experimental research design of correlational approach. Multistage sampling techniques were used to sample respondents for this study. Simple random sampling was used to select five (5) Local Government Areas in Oyo Central Senatorial District. Proportionate to size technique was used to sample four (4) schools in each LGA. From each of the schools, systematic random sampling method was used to select twenty students from SS11 Biology classes that participated in the study. A total of four hundred (400) Senior Secondary Two (SS II) students both males and females were chosen to take part in the study.

Data for the study were collected using four instruments which include Biology Interest Scale (BIS) with reliability co-efficient of 0.906, Anxiety Traits Inventory (ATI) with $\alpha = 0.738$, Academic Motivation Scale (AMS) with $\alpha = 0.865$ using Cronbach alpha and Biology Achievement Test (BAT) with a reliability co-efficient of 0.80 derived from KR20.

The researcher administered the instruments with the help of five trained research assistants which lasted two weeks after receiving initial approval from the school administration and inform consent of the participates. The data was analyzed using the SPSS software, which provided descriptive statistics such as mean, standard deviation, and frequency count, and inferential statistics like multiple regression at 0.05 level of significance.

RESULTS AND DISCUSSION

RQ1: What kind of relationship exists between each predictor (anxiety, motivation, and interest) and the criteria (student academic success in biology)?

Table 1. Correlation Matrix of Students' Achievement

	Biology Achievement	Anxiety	Motivation	Interest
Biology Achievement	1.000			
Anxiety	-0.272	1.000		
Motivation	0.187	-0.256	1.000	
Interest	0.253	-0.236	0.531	1.000
Mean	59.083	44.730	46.060	58.430
Standard Deviation	13.452	8.034	7.801	11.445

Significant at $p < 0.05$

In Table 1, the four variables: anxiety, motivation, interest, and biology achievement score are presented along with descriptive statistics and relationships between them. In this case, there is a significant negative correlation between anxiety and Biology achievement score ($r = -0.272$, $p < 0.05$), indicating that higher anxiety levels are associated with lower scores. However, there is a positive

significant association between motivation ($r = 0.187$, $p < 0.05$) and achievement in Biology as there is an upward correlation between interest ($r = 0.253$, $p < 0.05$) and achievement in Biology indicating that higher levels of interest are associated with higher students achievement in Biology

This result is in line with Zeidner, (2007), Karthigeyan & Nirmala (2012) and Putwain & Daly (2013) that found significant negative relationship between anxiety and student scores in Biology. The negative impacts of anxiety on cognitive function and information processing, which might hinder students' capacity to effectively communicate with and absorb academic content are likely to be the cause of this unfavorable link. The idea that higher levels of motivation are linked to improved academic performance is supported by the beneficial correlation ($r = 0.187$, $p < 0.05$) found between student achievement scores in biology and motivation. This result is consistent with the self-determination theory, which holds that students who have an innate desire to learn are more likely to actively participate in class assignments and persevere in the face of difficulties, which eventually results in better achievement (Deci & Ryan, 2000). The significance of developing students' interest in Biology for their academic achievement is shown by the beneficial relationships found in the relationship between interest and achievement scores in this study. The result is also in agreement with Hidi & Renninger (2016) who have indicated that students with a strong interest in a subject matter are more likely to invest the time and energy necessary to study it, resulting in an increased comprehension and retention of the content.

RQ2: What is the composite effect of the predictor variables (anxiety, motivation and interest) on criterion variable (achievement in biology)?

Table 2. Model Summary and ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8129.018	3	2709.673	16.748	.000
	Residual	64068.204	396	161.788		
	Total	72197.222	399			
Significant at $p < 0.05$						
	R	.336 ^b				
	R Square	.113				
	Adj. R Square	.106				
	Std. Error of the Estimate	12.71961				

The Model Summary in Table 2 shows that the regression model ($R^2 = 0.113$, Adjusted $R^2 = 0.106$) can explain a substantial amount of the variance in the scores. This means that the predictors can account for about 11.3% of the variance in scores at a standard error estimation of 12.71961. The ANOVA table data indicates that the regression model is significant ($F_{(3, 396)} = 16.748$, $p < 0.001$), indicating that the model as a whole significantly predicts the Biology achievement scores. At least one of the three predictors; motivation, anxiety, and interest significantly affects the outcomes, according to the significant regression analysis. The results of the correlation and

regression analyses indicate that anxiety, motivation, and interest are important factors influencing students' achievement in Biology. Stronger scores are correlated with moderate motivation and stronger interest levels, while higher levels of anxiety are associated with lower scores.

According to the result, anxiety and biology scores significantly correlated negatively, which is in line with other studies (Smith, J., & Johnson, A., 2020; Putwain & Daly 2013). It was proven by regression analysis that the sum of these factors explained 11.3% of the variation in scores. Managing anxiety while fostering motivation and interest may improve Biology achievement.

RQ3. Which predictor variable has a greater bearing on predicting biology students' academic achievement?

Table 3. Relative Contribution of predictors on achievement in Biology

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	Constant	60.283	6.367		9.469	.000
	Anxiety	-.368	.083	-.220	-4.458	.000
	Motivation	.058	.098	.033	.589	.556
	Interest	.216	.066	.184	3.266	.001

Table 3 shows the coefficients (extent) of the independent variables on the dependent variable. The constant coefficient which represents the expected value of the dependent variable when all independent variables are set to zero in this analysis is 60.283, indicating that if anxiety, motivation, and interest are all zero; the expected score would be approximately 60.283. The coefficient for anxiety is -0.368, indicating that for every one-unit increase in anxiety, the score is expected to decrease by 0.368. The negative sign suggests that higher levels of anxiety are associated with lower scores. The coefficient for motivation is 0.058, suggesting a weak positive relationship between motivation and achievement. However, this coefficient is not statistically significant ($p = .556$), indicating that motivation may not have a substantial impact on scores in this model. The coefficient for interest is 0.216, indicating that for every one-unit increase in interest, the score is expected to increase by 0.216 units. This coefficient is statistically significant ($p=0.001$), suggesting that interest has a positive and strong significant impact on scores.

Comparison of the relative significance of each predictor is possible using the standardized coefficients (Beta). While motivation ($\beta = 0.033$, $t(396) = 0.589$, $p < .05$) is not statistically significant, anxiety ($\beta = -0.220$, $t(396) = -4.458$, $p < .05$) and interest ($\beta = 0.184$, $t(396) = 3.266$, $p < .05$) appeared to have the more effects on scores in this approach. According to the study's findings, motivation had no statistically significant impact on students' test scores while anxiety and interest were strong predictors of those scores. "These findings are supported by prior research: for example, Swann (1994) found a negative association between anxiety and secondary school biology test scores. Similarly, England et al. (2019) report that higher classroom anxiety in

introductory biology predicts poorer performance and lower major persistence. In terms of interest and motivation, Rowland et al. (2019) show that interest in biology predicts achievement both directly and via learning strategies, and Karakaya (2022) reports that motivational dimensions (such as participation, competence and enjoyment) in context-based biology are linked to better student engagement. Further evidence from Nigeria (Vivian, 2021; Brown, 2021) indicates that test anxiety significantly predicts biology achievement among senior secondary students.” These results highlight how critical it is to treat anxiety and encourage interest in educational interventions meant to enhance Biology students' academic achievement.

CONCLUSION AND RECOMMENDATION

This study examined four variables: anxiety, motivation, interest, and biology achievement score and relationships between them. The significance of developing students' interest in Biology for their academic achievement is shown by the beneficial relationships between them. It was established that the correlation and regression analyses indicates that anxiety, motivation, and interest are important factors influencing students' achievement in Biology. In this study, motivation had no statistically significant impact on students' test scores while anxiety and interest were strong predictors of those scores. The results of this study add to our understanding of the intricate interactions between psychological variables and Biology achievement. The predictive score of 11.3% indicates a low forecast of students' achievement in Biology. Two of the three independent variables are significant: anxiety (negative) and interest (positive). The last component, motivation, is not significant but shows a positive relationship. The non-significant motivation resulted in lower predictive value. This finding suggests that motivation has minimal impact on Biology achievement among Nigerian students while anxiety and interest affects the students in opposite direction of each other. Thus, highlight the need for a comprehensive education strategy that takes into account students' interest and intrinsic motivation in addition to subject matter knowledge.

In view of the findings of this study and in achieving SDG4, the following recommendations were made: Policymakers should design curriculum that will lower anxiety and raise interest in biology, integrates real-world applications of biology into the curriculum showcasing the subject's relevance to both everyday life and future careers. Moreover, a conducive learning environment that prioritizes learning and growth over competition and high-stakes testing, be created to advance high-quality education for all students. Teachers should foster a more supportive learning environment by implementing techniques to lower anxiety and encourage interest that enables students to actively engage in the educational process to investigate and discover biological concepts. Other education stakeholders should maximize learning results.

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