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Predicting Students' Academic Achievement in Biology by Their Academic Resilience and its Dimensions

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Abstract
The quest to identify factors that could be influenced to drive academic excellence in a 21st century classroom fueled the study on predictive influence of academic resilience on secondary school students' academic achievement in Biology, applying a predictive correlational research design. 1,198 High School Students, obtained using multistage sampling procedure, were the respondents. Academic Resilience Scale (ARS) and Students academic records were employed for data collection. The adapted instrument (ARS), when pilot tested for internal consistency using Cronbach Alpha, yielded a reliability coefficient value of 0.81. Regression analyses were utilized to analyze data. The results revealed among others that academic resilience caused 51.5% variance in students' achievement in Biology, indicating that academic resilience significantly and positively contributed to secondary school students' achievement in Biology, with all the dimensions of academic resilience, individually and jointly, contributing to students' achievement in biology, significantly. Considering the findings, it was recommended among others that education stakeholders should organize orientation programs and seminars in schools to educate students on strategies that can be employed to strengthen resilience in academic settings.

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Introduction

Biology, in today's modern society, has been established as a resource for sustainable development and growth, due to its invaluable relevance to bioengineering, agriculture, disease control and most importantly, living a healthy life. As a subject and an intellectual enterprise, whose importance to man cannot be overemphasized, Anyigor et al. (2025) posited that biology is a continuous endeavor in which man seeks to solve his complex challenges in life, rather than merely a collection of scientific findings pertaining to living things. Similarly, Nwuba et al. (2024) affirmed that it is an integrative discipline that connects other branches of science such as chemistry, physics, geography, agriculture and mathematics, making it an indispensable for the advancement of knowledge and technology.

Considering these benefits of biology, many developing countries like Nigeria, has enshrined the subject into its curriculum, mandating schools to enroll both their science and art inclined students to offer the subject at the senior secondary school level with the foresight to produce a self-sustaining individual who can create jobs after schools. Despite these expectations, studies have shown that students, while in school, are not always eager to enroll in the subject or some that do, find it difficult to cope with its intrinsic demands, ranging from the complexity of its subject matter, bulkiness of its curriculum, to the abstractness of its contents. In efforts to help students mitigate the intricacies associated with learning Biology, researchers in the 21st has argued that there is a need to reposition efforts from environmental variables to student-related variables, as secondary school students, even without studying Biology, are constantly exposed to challenges and demands of academic life, that hamper their mental health and in return influences their learning outcomes in schools. In this light, the current study identified academic resilience as a variable that may help students overcome challenges associated with school demands and sought to ascertain its predictive influence on their academic achievement in Biology.

Resilience simply entails the ability of an individual to overcome adversity and even flourish in trying circumstances. Academically, Mwangi et al. (2015) defined it as a learner's ability to manage stress, overcome educational challenges and demands, to learn. In recent times, academic resilience also used interchangeably as educational resilience, has become a vital construct studied in education, due to its influence on students' academic life (learning outcomes) and overall development. Nuha, et al. (2024) argued that academic resilience is a multifaceted construct, that supports the growth and development of an individual, as it encompasses the skills of control, mental state, control of impulses, motive assessment, compassion, autonomy, rational optimism, and connecting with others. Cassidy (2016) classified academic resilience into three core dimensions namely; Perseverance (ability to demonstrate diligence and persist when confronted with challenges), reflective and adaptive help-seeking (ability to assess ones strengths, inadequacies and proactively look for support from others), and negative affect and emotional response (including negativity and the recognition of unfavorable situations that people encounter in their lives), that drive students to achieve academic success despite difficulties.

Considering these attributes of academic resilience, one can posit that the construct is a vital tool associated with advances in academic performance, psychological health, and functioning ability under difficult conditions. Supporting the premise, Habib (2019) opined that students who are scholastically resilient often maintain elevated levels of educational drive and performance, despite the difficult circumstances that makes them vulnerable to underperforming.

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Accordingly, Victor-Aigboidion et al. (2018) reiterated that resilient students are autonomous learners who are able to approach issues from multiple perspectives and perceive failure as something that can be conquered rather than an impassable barrier, because they often possess the ability to interact socially in order to ask peers and others for assistance. Summarizing, Geetha and Sunil (2024) opined that learners who show strong levels of academic resilience are more capable of overcoming barriers, navigating difficulties in the classroom, and possibly succeeding in their academic endeavors.

Academic achievement is the end result of all academic efforts. Ouma and Munyua (2018) described it as the degree to which a student has met the learning objectives, typically as determined by an examination or ongoing assessment test, using a grading system. In education, Nwuba et al. (2022) asserted that academic achievement has assumed more importance because it enables education stakeholders, at all levels of education, ascertain the extent to which educational objectives have been achieved, since they inform them on what students' have learnt, their level of comprehension of what is learnt and what is yet to be learnt. Supporting the premise, Chapagai (2024) posited that academic achievement is very important as it is strongly linked to positive outcomes and values, as students who are academically successful have better future prospect. Acknowledging academic achievement as the key to assessing the degree to which academic goals has been achieved, the rationale behind the research was conceived to determine how academic resilience and its dimensions predict Biology students' academic achievement in schools in Anambra State.

Research Questions

The following specific research questions guided the study;

1. What is the predictive value of social academic resilience on secondary school students' academic achievement in biology?
2. What are the relative contributions of the individual dimensions of academic resilience (perseverance (P), reflective and adaptive help-seeking (RAHS), and negative affect and emotional response (NEER)) to secondary school students' academic achievement in biology?

Hypotheses

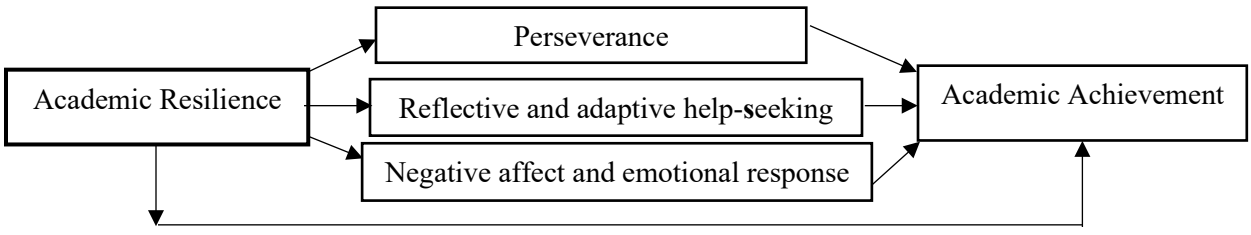
The null hypotheses were tested at 0.05 level of significance

1. Secondary school students' academic resilience is not a significant predictor of their academic achievement in biology.
2. Individual dimensions of academic resilience (P, RAHS and NEER) are not significant predictors of secondary school students' academic achievement in biology.

Literature Review

Conceptual Framework

The schema for the study is represented as thus;



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The schema shows explicitly the predictive influence of academic resilience and its dimensions (P, RAHS and NEER) on students' academic achievement (dependent variable) in biology.

Theoretical Framework

The study is anchored on Self-Efficacy theory (SET) put forward by Albert Bandura in 1977. The theory states that individuals are likely to succeed by developing and creating self-perceptions of capability (resilience) that become instrumental to the goals they pursue, and to the control they manifest over their own behavior and environment. According to SET, self-efficacy affects behavior by dictating the objectives and challenges people set for themselves, the amount of effort they decide to put into achieving their objectives and conquering obstacles, as well as the degree to which they persevere in the face of challenges and difficulties, all of which explain the tenets of resilience.

In his view, Bandura (1977) stated that there are four sources of self-efficacy from which people judge their strength and capability namely; Emotional and psychological arousal, mastery experience, vicarious experience, and verbal persuasion. Emotional and psychological arousal of individuals simply relate to the behavioral and emotional feedback people receive when completing activities that have been assigned to them. According to Bandura, individuals are aware of their bodily reactions (tiredness, pain etc) and uncomfortable feelings (stress, anxiety) that might have a negative impact on performance and competence, but individuals who overcome their negative emotions, become resilient in adversity. Mastery of experience provides information on one's successes and failures, with similar tasks. Bandura explained that with information provided, one can estimate one's confidence because the experience of conquering obstacles and ultimately completing a challenging endeavor is a potent testament to one's perseverance.

Vicarious experience, on the other hand, refers to gaining knowledge from seeing other people's achievements and shortcomings**.** Bandura explained that individuals through vicarious learning can determine their chances of success by looking at both their own and other people's prior performance on the same activity and thus, through reflective and adaptive-help-seeking thrive. Finally, the source of verbal persuasion by significant others is related to positive and negative appraisal from others. Bandura noted that verbal and non-verbal messages from families, educators and classmates, which can be helpful or harmful, inform students about the likelihood that they will succeed or fail in a particular task or area. Bandura reiterated that supportive verbal persuasion can encourage one to put in the effort to master certain activities, and sustain it when problems arise and vice versa.

Bandura (1977) self-efficacy theory was adopted for the study because through the sources of self-efficacy, the theory explains the dimensions of academic resilience (P, RAHS and NEER) that encourages students to see challenges as tasks to be mastered and controlled. SET by implication intimates that teachers, parents and other education stakeholders all have major roles to play in fostering and sustaining the academic resilience of a child in school and at home, because as the needs of a child and his environment interplay, the consequences may result in a child becoming either engaged, curious, connected, and whole, or demotivated, ineffective, and detached.

Academic Resilience and Its Dimensions

Academic resilience, in recent years, has become one of the most important dimensions of resilience studied in education as it explains students achieving good educational outcomes despite

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adversity. In his study, Cassidy (2016) argued that despite hardship, academic resilience indicates a higher chance of academic success, through its three major components (dimensions):

Perseverance (Persistence) (P)

Perseverance reflects an individual's capacity to persevere, despite obstacles. In academic context, it refers to staying motivated and passionate despite setbacks in pursuing one's academic goals. Academic perseverance is the degree to which a student can carry on with their academic pursuits despite challenges or barriers (Gauri and Surajita, 2021). Academic perseverance includes traits like putting in effort while refusing to give up, adhering to one's targets, accepting and acting on suggestions, inventive problem solving, and seeing hardships as opportunities to surmount hurdles, push past barriers and grow (Cassidy, 2015).

Reflective and adaptive help-seeking (RAHS)

Reflective and adaptive help-seeking refers to a self-initiated procedure that involves asking peers and adults for help in order to accomplish an assigned task. In academics, RAHS is a student behavioral tactic that entails social interaction and behavior management in order to get assistance from others, with the goal of learning and mastering course material later on their own (Dueñas et al., 2021). Parker et al (2019) stressed that reflective and adaptive help-seeking, when utilized by students, can offer both immediate stress relief and a lasting growth of healthy self-sustaining resources (such as a sense of control, confidence, and independence), which are crucial for handling future scholastic challenges.

Negative affect and emotional response (NEER)

NEER explains students' coping strategies for stress and negative feelings. Almulla (2024) described the term as the process by which we influence which emotions we have, when we have them and how we experience and express these emotions. Cassidy (2016) summarized that negative affect and emotional response are linked to cognitive skills of decision-making and problem-solving since it features elements like confidence, hopelessness, worry, despairing, avoiding negative feelings, and accepting bad effects, which are indispensable tools for development and growth.

Empirical Studies

Academic resilience, in education today, embraces the development of mental and behavioral characteristics that support a student's total academic success and well-being, going beyond simple academic achievement. Recognizing the premise, several studies have been conducted to determine how academic resilience affects students learning outcomes.

Oyoo et al. (2018) determined if academic resilience can predict high school students' academic burnout in Homa-Bay County, Kenya and concluded that a substantial negative association existed between academic resilience and academic burnout. In another research, Habib (2019) ascertained the relationship among school students' academic resilience, academic motivation and academic confidence in Kashmir, India, revealing that a positive statistically significant correlation exists between school students' academic resilience and academic motivation as well as between their academic resilience and academic confidence. Karabıyık (2020) explored the interaction between academic resilience and academic achievement in university students in Ankara, Turkey, revealing that positive correlations existed between GPA and perseverance as well as with reflecting and adaptive help-seeking, while a negative correlation was revealed between students' GPA and negative affect and emotional response. The multiple regression analyses affirmed that only reflecting and adaptive help-seeking is a significant predictor of GPA. In a similar review, Duru et al. (2024) investigated if students' mathematics

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achievement can be determined by their academic resilience in Owerri municipal council of Imo State and revealed that academic resilience positively and significantly predicted mathematics achievement, irrespective of gender. A read through the available empirical reviews affirms that academic resilience is a contributor to students learning outcomes. However, based on available literature, no similar study known to the researcher has been conducted, specifically on students' academic achievement in Biology, to ascertain if the same results are obtainable in Anambra State, Nigeria. The gap the current study intends to fill.

Research Method

A predictive design was adopted. Cresswell (2012) described predictive correlational research design as a type of correlation design that seeks to not only ascertain the relationship, that exists between concepts, but also attempts to predict or understand future behavior to identify the independent variable(s) that predict the dependent variable(s). The researchers deemed the design suitable for the study because the study sought to not only indicate the direction and degree of the relationship between the variables under investigation but also to determine the variance in the dependent variables that is caused by the predictor variables.

Research Context and Participants

A sample of 1,198 students, were drawn from the 24,102 Senior Secondary Year Two (SS2) students offering Biology in the 265-government owned secondary schools in Anambra state using multi-stage sampling procedure. Multi-stage sampling procedure was employed due to the large and dispersed nature of the population. The procedure was employed as follows; Firstly, the population was already in strata based on the six education zones (Aguata, Awka, Nnewi, Ogidi, Onitsha and Otuocha) in the state, hence the researchers employed simple random sampling technique to draw out three (Awka, Nnewi and Onitsha) out of the six education zones. The choice of three education zones for the study, was to have a widespread sample size to enable the researcher generalize the findings of the study. After the sampling of zones, the researchers secondly used the proportionate stratified random sampling technique mathematical formula, to estimate the number of SS2 students expected from each of the drawn zones (Awka = 458; Nnewi =301 and; Onitsha = 446). This was employed to ensure that each zone (stratum), represented in the sample, is in the same proportion as it is in the population. At the third stage, purposive sampling technique was employed to select five schools each from the three sampled zones. The choice of purposive sampling technique was for two reasons; One was to ensure that each selected school has enough biology students to meet the sample size allocated to each zone, when summed together and secondly, to ensure that at least one school was selected from each of the local government areas in the zone. Finally, simple random sampling technique was employed to randomly pick SS2 students, from the selected schools, to make up the sample size of 1,198 used in the study.

Data collection Instruments

Two instruments were employed to collect data from respondents: An adapted 30-item Academic Resilience Scale (ARS) and Biology score Proforma (BSP). The Academic Resilience Scale (ARS) was adapted from Academic Resilience Scale (ARS-30) developed by Cassidy in 2016. The original ARS is a 30-item scale, with five response options of Strongly Agree (SA), Agree (A), Undecided (UN), Disagree (D) and Strongly Degree (SD), organized under the 3 core dimensions (P, RAHS and NEER) of academic resilience. In adapting the scale, the statements and

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response options were retained, however, some sentences were reconstructed to suit the level of the respondents. Since ARS was modified, it was revalidated by three experts and yielded a reliability coefficient score of 0.81 for internal consistency, when estimated using Cronbach Alpha formula. The biology score proforma (BSP), on the other hand, is a spreadsheet containing the sampled students' examination scores in Biology from 1st, 2nd and 3rd term of 2024/2025 academic session. The examination scores of the three terms were summed and the average of each student calculated and used as the academic achievement scores.

Data collection

Research assistants assisted in the direct administration (face-to-face delivery) of the instrument. Prior to the administration of the instrument, an official letter of ethical approval was written to the principals and students of the sampled schools for their consent. Once approved, the research assistants were briefed on the objectives of the study, instrument administration method and then how to collect students' achievement scores (recorded in the biology score proforma) from the form (class) teachers, of the sampled schools. During the collation and summation of responses, seven (7) retrieved questionnaires were not properly filled and thus, were discarded, reducing the sample to 1,198 instead of the initial estimated sample size of 1,205.

Data Analyses

In analyzing the collected data, regression analyses (simple and multiple regression) were employed. R-value (r) was used to ascertain the magnitude and direction of the relationship while R-squared (r^2)/coefficient of determination was used to indicate the variance in students' academic achievement in Biology that is as a result of academic resilience. The individual predictions of the various dimensions of academic resilience on students' academic achievement in biology were ascertained using unstandardized beta-coefficients. From the unstandardized coefficients B values of the individual predictor variable, the equations or models for the prediction of students' academic achievement in biology were derived.

Findings and Discussion

This section provides analyzed results, from the data collected. The results were presented in tables in line with the research questions and hypotheses that guided the study.

Table 1: Prediction of Students' Academic Achievement in Biology by their Academic Resilience

Model	R	r^2	Adjusted r^2	Unstandardized coefficients (B)	Std. Error
Constant	0.718[a]	0.515	0.515	48.754	
Academic Resilience				0.532	5.665

a. Predictors: (Constant), Academic Resilience (AR)
b. Dependent: Academic Achievement (AA)

In Table 1, an R-value of 0.718 (indicating a moderate positive relationship between AR and AA) and an R^2 (coefficient of determination) value of 0.515 were obtained. The coefficient of determination (r^2) value obtained reveals that academic resilience contributed 51.5% of the variance in students' achievement scores in biology. Also, the unstandardized coefficient *B* of 0.532 shows that a unit rise in academic resilience, increases students' academic achievement in biology by 53.2%.

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Table 2: Significance of Prediction of Students' Academic Achievement in Biology by their Academic Resilience

	Model	Sum of Squares	Df	Mean Square	F	P-value	Decision
1	Regression	40832.815	1	40832.815	1272.276	0.000[b]	Sig.
	Residual	38384.796	1196	32.094			
	Total	79217.610	1197				

a. Dependent Variable: Achievement Scores in Biology
b. Predictors: (Constant), Academic Resilience

Table 2 data reveals that at an F-value (1 and 1196) of 1272.276, P-value is 0.000. since the p-value is less than 0.05 alpha levels, the null hypothesis is rejected. This confirms that academic resilience is a significant predictor of secondary school students' academic achievement in Biology. Since academic resilience is a significant predictor of students' achievement in Biology, the regression model (Y = a + bx) for the prediction as obtained from Table 1, where constant is 48.754 and b value is 0.274 is:

AA = 48.754 + 0.532 (AR)

Where, **AA**= Achievement Score in Biology and **AR** = Academic Resilience Score

Table 3: Contributions of the Individual Dimensions of Academic Resilience to the Prediction of Secondary School Students' Academic Achievement in biology

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	SD. Err.	Beta	T	Sig.
1 (Constant)	49.672	.919		54.037	.000
Perseverance	.469	.042	.272	11.114	.000
Reflective & Adaptive Help Seeking	.616	.049	.348	12.628	.000
Negative Effect & Emotional Response	.466	.051	.233	9.098	.000

a. Dependent Variable: Academic Achievement in Biology

The unstandardized B coefficients values, in table 3, reveals that a unit rise in perseverance increases students' achievement score in Biology by 46.9%, a unit rise in reflective and adaptive help-seeking increases achievement score by 61.6% and finally, a unit rise in negative effect and emotional response increases achievement score of students in biology by 46.6%. Based on the table, the order of contributions of each dimension of academic resilience to students' achievement score in biology from highest to lowest is; Reflective and adaptive help-seeking (61.6%), followed by perseverance (46.9%) and lastly, by negative effect and emotional response (46.6%)

Table 4: Significance of Prediction of students Achievement in Biology by the Individual Dimensions of Academic Resilience

	Model	Sum of Squares	Df	Mean Square	F	Sig.	Decision
1	Regression	39105.305	3	13035.102	388.008	.000[b]	Sig.
	Residual	40112.305	1194	33.595			
	Total	79217.610	1197				

a. Dependent Variable: Academic Achievement
b. Predictors: (Constant), NEER, P, RAHS

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Analysis of data in Table 4 reveals that all the individual dimensions of academic resilience jointly are significant predictors of students' academic achievement in biology, since the p-value (0.000) obtained is less than 0.05 alpha levels, at an F-value (3 and 1194) of 388.008. Further analysis of data contained in table 3 reveals that perseverance, reflective and adaptive help-seeking and negative effect and emotional response, individually, are significant predictors of students' achievement scores in Biology, since their obtained p-values at t-values (3,1194) of 11.114 for perseverance (0.000), 12.628 for reflective and adaptive help-seeking (0.000) and 9.098 for negative effect and emotional response (0.000), are less than 0.05 alpha levels. Since the result confirms that the three dimensions of academic resilience, individually and jointly, substantially contributed to students' achievement scores in biology, the regression model equation ($Y = a + bx_1 + cx_2 + dx_3$) derived from table 3 can be written as:

$$AA = 49.672 + 0.469\ (P) + 0.616\ (RAHS) + 0.466\ (NEER)$$

Where, AA = Academic Achievement in Biology, P = Perseverance, RAHS = Reflective and Adaptive Help Seeking, and NEER = Negative Effect and Emotional Response.

Academic Resilience and Academic Achievement

The research establishes that academic resilience positively and substantially contributed to students' academic achievement in biology. This significant positive prediction could be explained by the skills of higher self-confidence, self-esteem, and perseverance associated with resilience, empowering learners to overcome barriers, negotiate difficulties in the classroom, and eventually succeed in their academic endeavors**.** Academic resilience inculcates in students the ability to demonstrate determination and drive in the face of challenges and struggles (rather than ignoring or exaggerating them), retain a positive outlook, be assured to endure and most importantly, adapt and thrive in academic struggles, as in the phase of these obstacles, students display abilities in formal thinking, creative thinking, and application, all of which positively influence their achievement and overall quality of life. The study's findings accede with that of Karabiyik (2020), Abubakar et al. (2021), and Ojeleye et al. (2023) who revealed in their studies that academic resilience is a positive and substantial contributor to students' academic achievement. Similarly, Duru, et al. (2024) and Almulla (2024) findings, also conforms to the findings of this study.

On individual contributions of academic resilience dimensions to students' academic achievement in Biology, the study revealed that the three dimensions of academic resilience positively and substantially contributed to students' achievement in biology, individually and jointly, with P having the highest prediction, followed by RAHS and lastly, NEER. This significant positive individual and joint prediction of students' academic achievement by the three dimensions of academic resilience could be credited to academic resilience ability of cultivating in students' the attributes of pushing forward despite difficulties, interacting and seeking for assistance when challenged as well as managing ones' stress and emotions, that ultimately culminate to positive learning outcomes (academic achievement). The findings of Abubakar et al. (2021), and Almulla (2024) accede to the present study's findings. Furthermore, the study, to an extent, agrees with Karabiyik (2020) findings that positive prediction existed between RAHS, P and students GPA, but however disagrees with Karabiyik, that a negative correlation existed between NEER and GPA and that, RAHS was the only significant predictor of students' GPA, not P and NEER.

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Conclusion and Recommendations

The study sought to ascertain if secondary school students' academic resilience predicted their academic achievement in Biology, applying a predictive design. The study which utilized secondary school students revealed that academic resilience and its dimensions, individual and jointly, are substantial contributors to academic achievement of students in Biology. The study also established that academic resilience when fostered through sensitization and counselling sessions, significantly enhances students' academic achievement in Biology. Considering the outcomes, it was suggested that:

1. Orientation programs and seminars should be organized by education stakeholders in secondary schools to educate students on strategies that can be employed to strengthen their resilience in academic settings or during examinations.
2. Schools should organize workshops for parents, led by experienced psychologists and counsellors, to counsel them on how to help foster their children's resilience levels at home, as a positive and calming home environment during early childhood can enhance resilience among children in their later lives.

Conflict of Interest

None.

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