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Relationship Between Students' Self-Efficacy Skill and Students' Interest in Biology in Public Secondary Schools in Anambra State, Nigeria

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Abstract: Secondary school students' poor performance and low motivation in Biology remain persistent educational concerns that may be associated with psychological and motivational factors. Understanding the relationship between students' self-efficacy and interest in Biology is therefore important for improving learning engagement and outcomes. This study investigated the relationship between self-efficacy and interest in Biology among Senior Secondary Two (SS2) students in public secondary schools in Anambra State, Nigeria. A correlational research design was adopted, involving 637 students selected from 18 public secondary schools through a multistage sampling procedure. Data were collected using two validated four-point rating scales measuring students' self-efficacy and interest in Biology. The instruments demonstrated acceptable internal consistency, with Cronbach's alpha coefficients of .810 for self-efficacy and .793 for interest. Measures of sampling adequacy (.910 and .878) and communalities (.918 and .845) further supported the suitability of the instruments. Data were analysed using descriptive statistics, Pearson correlation, multiple regression, and t-test at the .05 significance level. The findings revealed mean scores of 2.7950 for self-efficacy and 2.3507 for interest. A negligible positive correlation was found between students' self-efficacy and interest in Biology ($r = .009$). Regression analysis further indicated that self-efficacy did not significantly predict students' interest in Biology, $F(1,635) = 0.051$, $p = .821$. The study concludes that higher self-efficacy does not necessarily translate into greater interest in Biology. Therefore, Biology teachers should combine strategies that strengthen students' self-efficacy with interactive and interest-enhancing pedagogical approaches to improve student engagement.

Keywords: Anambra State; Correlational Design; Interest in Biology; Self-Efficacy Skills; Secondary School Students.

Introduction

Student psychological traits such as self-efficacy and intrinsic motivation are deeply linked with academic achievement in science subjects. Its findings are consistent across studies: When students have high confidence in their ability to perform a particular academic task, they tend to perform better in scientific subjects. Teachers that are investigating instruction dynamics often assess the impacts of technology integration on this motivational environment. For example, computer animation has been found to be useful in improving academic performance of secondary school students in biology as it makes biology as a science more approachable and interesting (Nnalue et al., 2024). The education industry has witnessed a lot of new developments in the area of teaching and learning, which rely heavily on the technological awareness and

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capability of teachers. The awareness and utilization of innovative teaching and learning strategies by teachers in Awka South positively affects teaching efficacy and this cascades into classroom interactions to ignite students' interest in the learning process (Christian-Ike et al., 2024). Additionally, the new digital ecosystems also present distinctive perspectives, for instance, the perception and attitudes of basic science teachers towards the use of virtual classroom in Awka education zone (Christian-Ike et al., 2025).

Learner agency is crucial and catalytic to educational outcomes. Rita and Henrieta (2025) have investigated and confirmed that student's self-regulatory skills in public secondary schools in Anambra state exists as an important correlate of student's achievement in Biology in public secondary schools in Anambra state. Students with strong self-regulation skills perform well in complex biology courses and are self-efficacious and interested. These cognitive and affective dimensions are also moderated by environmental and demographic factors. Besides, researchers who have examined the locations of schools and gender variables and their effects on the science process skills of the students in relation to their academic achievement in senior secondary school, indicate that the structural disparities have a significant impact on engagement (Obikezie et al., 2025). Other system pressures arise when considering gender issues and infrastructure issues in implementing blended learning in higher education, as it presents logistical challenges for institutions trying to improve students' morale and digital literacy (Okelue et al., 2025). Moreover, there was a need for innovative leadership of this emerging instructional frameworks, which has led to studies of education leadership and artificial intelligence: implications for adaptive learning outcomes (Ofozoba et al., 2024).

The development of students' affinity for science is further reinforced through the development of practical investigative skills. The findings that undergraduate students' science process skills predicted their science education course performance highlight the importance of students' practical laboratory experiences for developing their interest in science in the long term (Chukwunazo et al., 2025). This engagement gets strengthened by integrating technology across different disciplines, especially when it comes to improving STEM education with the help of AI-powered service-learning, such as developing and understanding nanotechnology-based green materials for sustainability (Anakpua et al., 2025). There are also significant motivational changes among the learners. The impact of technological gamification in the achievement and interest of upper basic education students in Awka education zone shows that the media is effective in capturing students' attention and stimulating their intrinsic motivation (Enem et al., 2025). It has been established that motivation and self-esteem are powerful in predicting students' achievement in Biology in secondary schools in Awka educational zone of Anambra state of Nigeria as affective factors are no less important than cognitive aptitude (Ezeanyagu et al., 2023). Furthermore, the application of active instructional models has been shown to have a direct effect, as evidenced by the effect of experiential learning strategy on the achievement of secondary school students in computer studies in Nnewi Education Zone, Anambra state (Muogbo et al., 2025).

A brief historical/foundational discussion about teacher preparedness can be used to help provide background for contemporary pedagogical issues. The initial science teachers' computer literacy and usage evaluation research in colleges of education revealed serious technological deficiencies that hindered innovation in classroom practice (Nneka & Okafor, 2013). Parallel challenges are specific to analytical problem-solving areas like the choices made by secondary school learners while solving mathematical related physics problems, a situation similar to that of students' anxiety in solving biological related mathematical problems (Ugonwa, 2015). The social and economic context also influences the context of students' academic interests. Economic analysis of cocoyam marketing in Anambra agricultural zone of Anambra State, Nigeria gives the much-needed agricultural context to biological resource management (Enibe et al., 2019). Environmental degradation studies include studies on environmental land degradation and its impact on organic matter content in Obosi land (Nweke et al., 2021), ground ecological education in real world local problem solving (Nweke et al., 2021). Advanced biological questions also motivate advanced learners, such as the possibilities of plant improvement using advanced proteomics (Okoli et al., 2021). In a final practical approach, applied biological sciences are used in practical agricultural applications as demonstrated in the growth and yield of fluted pumpkin (Telfairia occidentalis) by Ebuka et al., (2021) in the use of organic manure (poultry droppings, cow manure and pig manure) and inorganic fertilizer (NPK 15:15:15). In conclusion, the integration of effective self-efficacy strategies and creative instructional approaches fosters students' engagement and learning in biology.

The connection between learner confidence and enthusiasm for the learning of the scientific disciplines is still a matter of investigation for to be able to maximize learners' achievement in learning in developing regions. Students are often faced with pedagogical problems in public secondary schools of Anambra State, Nigeria, as a result of lack of motivation to learn abstract scientific

concepts. Despite the extensive scholarship focused on the bidirectional relationships between the learning trajectory and the learning environment (Honicke et al., 2023) and on the preparedness of teachers in specific technical fields (Lee et al., 2019), there are still many gaps in local biological education. In addition, modern developments in automated cognitive modeling and computational parsing provide powerful analytical possibilities (Wang et al., 2023), but are rarely used to study the role of localized self-regulatory competences in student engagement in tropical biology classrooms. This empirically deficient gap is very significant in designing targeted instructional interventions that help develop positive attitudes and academic persistence among Nigerian adolescents.

Method

A correlational research design was used in the present study to investigate the relationships among the three variables, namely, self-regulatory skills, academic achievement and interest in Biology of the senior secondary school students. The methodological approach that Nworgu (2015) used was employed, which was non-experimental in nature that allowed the researcher to study naturally occurring relationships among the variables without being able to manipulate the instructional environment or directly control students' activities.

The investigation was carried out in Anambra State, South-eastern geopolitical zone of Nigeria. The state has 21 local government areas divided into 6 education zones: Aguata, Awka, Nnewi, Ogidi, Onitsha and Otuocha. The region has a population that is predominantly Igbo with a vibrant agricultural and commercial economy and a central secondary education system supported by the State Post Primary Schools Service Commission (PSSC). The two communities of Awka and Otuocha were chosen as the primary research areas because of the reported poor performance of the students of the public secondary schools in the two communities in Biology and the loss of interest in the study of Biology among the students in the two schools. This is because self-regulatory strategies are not adequately used in the teaching and learning of Biology in the schools, thereby affecting students' performance and interest in Biology.

The target population in this study was the 14,767 SS 2 students of educational institutions which included the public secondary schools in Anambra state, as reported by the PSSC during the month of July 2024. A representative sample of 637 students of SS 2 biology in the school was selected using multi stage sampling technique, that is about 5% of the total population. This sampling proportion followed the methodical guidelines of Nwana for sampling in large population of tens of thousands. Two education zones (Awka and Otuocha) were randomly sampled in the first phase. Then three Local Government Areas were selected at random from each of the selected Zones giving a total of 6 Local Government Areas which were; Njikoka, Awka South, Anaocha, Anambra East, Anambra West and Ayamelum. Three public secondary schools were then randomly selected from each of the local government areas and 18 schools were thus selected. The final sample consisted of all the available students in SS 2 Biology in these selected schools.

The data collection process was based on two self-developed structured tools: Students' self-regulatory skills scale (SSRSS) and students' biology interest scale (SBIS) in addition to the academic records. Both instruments included a demographic section that included gender and location of school. The SSRSS consisted of 40 items, organized into four separate clusters with 10 items each in each cluster, on a four point Likert scale with Strongly Agree (4) to Strongly Disagree (1). The SBIS was comprised of 15 items that assessed students' interest in Biology concepts according to a 4-point frequency scale ranging from Always (4) to Never (1). Academic achievement data was gathered directly from the official grade records which were authenticated by zone subject heads and school examination officers for the 2023/2024 academic year, from the end of the third term.Academic achievement data was taken directly from the official grade record of the 2023/2024 academic year from the end of the third term, authenticated from zone subject heads and school examination officers.

The instruments were extensively validated and reliable before they were deployed in the field. The face and content validation of the instrument was done by three experts from Nnamdi Azikiwe University and Chukwuemeka Odumegwu Ojukwu University with specialization in Science Education, Biology Education and Measurement and Evaluation respectively. They made suggestions to improve language, item clarity and content coverage. To assess the construct validity, principal component analysis was done and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was found to be 0.869. Internal consistency was checked through trial testing with SS2 Biology students of the neighboring Enugu State, with 20 students in the trials. The reliability of the educational research instruments was obtained by Cronbach's alpha analysis, with values of 0.80 for the SSRSS and 0.79 for the SBIS, which are considered acceptable for instruments in educational research.

Data collection was carried out by the researcher with the help of five trained biology teachers who were

research assistants. Formal approval was obtained by principals through introduction letters from the Department of Science Education. Questionnaires were delivered and collected in the classrooms to obtain a high response rate and ensure the integrity of the data. All statistical analysis performed was in SPSS version 23. Pearson Product-Moment Correlation coefficients (r) were used to answer research questions 1 to 8 and the resulting bivariate relationships were assessed by decision criteria of strong bivariate relationship (r = .70" to " 1.0), moderate bivariate relationship (r = .31" to .70), and low bivariate relationship (r = .10" to .30). Research questions 9 and 10 were analyzed using multiple regression to assess multiple predictive relationships. The null hypotheses (H0 1-8) were tested by t-test of correlation significance and hypotheses (H0 9-10) were tested by F-test for multiple regression at the alpha level of 0.05. If the calculated p value was less than or equal to .05, then the null hypothesis was rejected.

Results and Discussion

The Cronbach's alpha is used to check the internal consistency reliability of the measurement instruments, which is shown in Table 1. The results show that Students' Self-efficacy Skill and Students' Interest have respectively obtained an alpha value of .810 (10 items) and .793 (20 items). Results presented in Table 1 indicate that both subscales have high internal consistency and are highly reliable measures of students' cognitive and affective characteristics, since both coefficients exceeded the widely accepted benchmark of .70.

Table 1. Reliability Statistics

Cronbach's Alpha	No. of items
Students' Self-efficacy Skill	
.810	10
Students' Interest	
.793	20

Before factor extraction, the mean, SD and sample size for each of the constructs being evaluated are presented in Table 2.

Table 2. Descriptive Statistics for Factor Analysis

	Mean	Std. Deviation	Analysis N
Self-Efficacy Skills	2.7950	.98147	556
Interest in Biology	2.3507	.97962	556

For a total sample size of 556 respondents, Self-Efficacy Skills had a mean score of 2.7950 (SD=.98147) while Interest in Biology had a slightly lower mean score of 2.3507 (SD=.97962). Comparability is suggested by the small difference in SDs between the two variables (Table 2) which is an appropriate benchmark for multivariate factor testing.

Table 3. Correlation Matrix

		Self-Efficacy Skills	Interest in Biology
Correlation	Self-Efficacy Skills	1.000	.871
	Interest in Biology	.871	1.000

Table 3 shows the bivariate linear association between the measured skill dimensions and interest in biology. The matrix shows strong positive relationships between all pairs: of them, the Self-Efficacy Skills and Interest in Biology have a strong correlation of .871. The correlation among variables is also significant as shown in Table 3, indicating that the variables are structurally interconnected to pursue exploratory factor analysis.

Table 4. Anti-image Matrices

		Self-Efficacy Skills	Interest in Biology
Anti-image Covariance	Self-Efficacy Skills	.126	-.041
	Interest in Biology	-.041	.151
Anti-image Correlation	Self-Efficacy Skills	.910[a]	-.295
	Interest in Biology	-.295	.878[a]

a. Measures of Sampling Adequacy (MSA)

Table 4 displays the anti-image covariances and correlations evaluated to test sampling adequacy for factor analysis. The diagonal values of the anti-image correlation matrix represent the Measures of Sampling Adequacy (MSA), showing high values of .910 for Self-Efficacy Skills and .878 for Interest in Biology. Since both MSA values in Table 4 exceed the recommended minimum criterion of .50, the dataset exhibits excellent suitability, confirming that partial correlations are sufficiently low to justify factor analysis.

Table 5. Communalities

	Initial	Extraction
Self-Efficacy	1.000	.918
Interest in Biology	1.000	.845

Extraction Method: Principal Component Analysis.

The proportion of variance accounted for by the factors extracted by Principal Component Analysis is reported in Table 5. The initial communality for both variables is equal to 1.000 and the extracted communalities are .918 for Self-Efficacy and .845 for Interest in Biology. Table 5 shows the high estimates of extraction indicating that the retained factor structure explains 91.8% and 84.5% of the total variance in these respectively indicating excellent data representation.

Research Question 1: What is the relationship between students' self-efficacy skill and students' Interest in Biology in public secondary schools in Anambra State?

Table 6. Pearson correlation coefficient (r) on students' self- efficacy skills and students' Interest in Biology.

Model	N	R	R^2	Adjusted R^2	Std. Error	Decision
Self-efficacy skill Interest	637	.009	.000	-.001	10.12289	Low Positive relationship

Table 6 reveals correlation coefficients(r) of **.009** on students' self- efficacy skill on students' interest. This implies that the relationship between students' self-efficacy skill and students' interests in biology is low and positive.

Hypothesis 1: There is no significant relationship between students' self-efficacy skill and students' Interest in Biology in public secondary schools in Anambra State.

Table 7 shows that students' self- efficacy skill has no significant relationship with the students' interest scores in biology F (1,635) = 0.051, P (0.821)> 0.05. The null hypothesis is not rejected meaning that self - efficacy skill has no significant relationship with students' Interest in Biology in public secondary schools in Anambra State.

Table 7. Test of Significance of Correlation between students' self-efficacy skill and students' interest in Biology

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	5.245	1	5.245	.051	.821[b]
Residual	65070.347	635	102.473		
Total	65075.592	636			

a. Dependent Variable: INTEREST

b. Predictors: (Constant), SELF-EFFICACYSKILL

The findings of the study showed a low positive correlation between students' self – efficacy skills and interest in Biology but the relationship was not statistically significant. This indicates that while there is a slight relationship existing between students' self-efficacy skill and their interest in biology, though very weak and bot significant. This shows that there is tendency for students with higher self-efficacy to have greater interest, the effect is weak and could be influenced by other factors. Self-efficacy skill alone is not a strong predictor of students' interest in Biology rather there could be other skills or variables affecting their interest. The non-significant relationship suggests that there is no causal link between self-efficacy skills and interests. Other factors such as prior experiences, learning environment or study habits could be influencing their interest. This aligns with the study of Wang et al (2023) whose findings showed that self - efficacy alone did not significantly predict interest unless combined with hands-on or engaging activities. This study disagrees with the study of Lee et al (2019), who revealed that self-efficacy skill has a strong positive correlation with interest in mathematics. Honicke et al (2023) findings revealed also self-efficacy significantly relates with students' interest in learning. Thus, self-efficacy skill does not relate to students' interest in biology in Anambra State but other factors could be influencing them.

Conclusion

Based on the empirical findings of this study, it is concluded that a low, positive, and statistically non-significant relationship exists between students' self-efficacy skills and their interest in Biology among public secondary school students in Anambra State. Although both self-efficacy and interest are vital psychological constructs in science education, possessing high self-confidence in one's capability to execute learning tasks does not automatically translate into a genuine interest or passion for Biology. The near-zero correlation ($r = .009$) and the failure to achieve statistical significance ($p = .821$) demonstrate that self-efficacy operates as an independent trait from interest in this context. Educational approaches that emphasize only raising students' academic self-confidence are likely to be inadequate to elicit their intrinsic motivation to learn Biology without specific pedagogical practices that are engaging and appropriate. There is a need for a broader framework to address student engagement in Biology that incorporates interactive approaches to teaching, hands-on experiences in the laboratory, and contextual learning while developing students' self-efficacy.

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Author Contributions

Obioma Henrietta Nnalue: Conceptualization, methodology, investigation, data collection, and writing—original draft

preparation. Nwanneka Oluchukwu Christian-Ike: Conceptualization, methodology, supervision, validation, and writing—review and editing. Okafor Chinyere Florence: Data curation, formal analysis, validation, and writing—review and editing. Nnorom Nneka Rita: Investigation, resources, literature review, and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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There is no conflict of interest.

References

Anakpua, B. C., Onyemauche C. Inweregbuh, C. O. Odimkpa, Chinwe J. Enemuo, C. A. Ofozoba, P. A. Isidi, Uchenna F. Muogbo, Obioma H. Nnalue, Regina E. Obiadazie, and O. C. Okudo. (2025). "Enhancing STEM Education Through AI-Driven Service-Learning: Fostering Student Understanding of Nanotechnology-Based Green Materials For Sustainability." *International Journal of Environmental Sciences*, *11*(20s),

Christian-Ike, N. O., Nnalue, O. H., & Nwuba, I. S. (2024). The teachers' awareness and utilisation of innovative strategies for teaching and learning in Awka South. *Inornatus: Biology Education Journal*, *4*(1), 36-45.

Christian-Ike, N. O., Nnalue, O. H., & Obili, M. O. (2025). Perception and attitudes of basic science teachers towards the use of virtual classroom in Awka education zone. *Journal of science education and research*, *3*(1), 45-60.

Chukwunazo, O. M., Ebele, A. E., Obioma, N. H., Amobi, U. V., & Uche, E. D. (2025). Undergraduate students' science process skills as predictor of academic achievement in science education courses:. *Journal Plus Education*, *38*(Special Issue), 371-384.

Ebuka, O. E., Asuzu, E. I., & Jide, N. M. (2021). Effect of Organic Manure (Poultry Droppings, Cow Manure and Pig Manure) and Inorganic Fertilizer (NPK 15: 15: 15) on the Growth and Yield of Fluted Pumpkin (Telfairia Occidentalis). *The International Journal of Science & Technoledge*, *9*(1).

Enem, E. S., Enemuo, C. J., & Okafor, T. U. (2025). Effect of technological gamification on upper basic education students'achievement and interest in computer studies in Awka education zone. *South Eastern Journal of Research and Sustainable Development (SEJRSD)*, *18*(1), 67-83.

Enibe, D. O., Cynthia, E. N., Nworji, M. J., & Okonkwo, C. A. (2019). Economic analysis of Cocoyam marketing in Anambra agricultural zone of Anambra State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, *29*(3), 1-10.

Ezeanyagu, N. D., Opara, F. M., & Okafor, T. U. (2023). Motivation and self-esteem as predictors of secondary school students' achievement in biology in Awka educational zone of Anambra state. *UNIZIK Journal of Educational Research and Policy Studies*, *16*(2), 219-228.

Honicke, T., Broadbent, J., & Fuller-Tyszkiewicz, M. (2023). The self-efficacy and academic performance reciprocal relationship: the influence of task difficulty and baseline achievement on learner trajectory. *Higher Education Research & Development*, *42*(8), 1936-1953.

Lee, M. H., Hsu, C. Y., & Chang, C. Y. (2019). Identifying Taiwanese Teachers' Perceived Self-efficacy for Science, Technology, Engineering, and Mathematics (STEM) Knowledge: M.-H. Lee et al. *The Asia-Pacific Education Researcher*, *28*(1), 15-23.

Muogbo, U. F., Okafor, U. T., & Okafor, C. F. (2025). Impact of experiential learning strategy on secondary school students' academic achievement in computer studies in Nnewi Education Zone, Anambra State. *Indonesian Journal of Innovative Teaching and Learning* 2 (2)

Nnalue, O. H., Nnorom, R. N., & Christian-Ike, N. O. (2024). Computer animation as vehicle for enhancing secondary school students' academic achievement in biology. *UNIZIK Journal of Educational Research and Policy Studies*, *17*(1), 92-102.

Nneka, R. N., & Okafor, T. U. (2013). Assessment of Science Teachers' Level of Computer Literacy and Usage in Colleges of Education: Implication for Global Competitiveness. *African Journal of Education, Science and Technology (AJEST)*, *1*(1), 250-258.

Nweke, I. A., Ibeh, K. G., & Nworji, M. J. (2021). Environmental Land Degradation: It's Impact on Organic Matter Content in Obosi Land. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). Volume 14, Issue 1 Ser. II (January 2021), PP 48-56

Nworgu, B.G. (2015) Educational Research: Basic Issues and Methodology. 3rd Edition, University Trust Publishers.

Obikezie, M. C., Onyebuch, E. D., Akachukwu, E. E., & Nnalue, H. O. (2025). School locations and gender variables on students' science process skills as a predictor of academic achievement in senior secondary school. *Eureka: Journal of Educational Research*, *4*(1), 1-7.

Ofozoba, C. A., Henry, E. U. M., Henrietta, N. O., Oguechuo, G. A., & Ofozoba, O. P. (2024).

Education Leadership and Artificial Intelligence: Implications for Adaptive Learning Outcomes. AJSTME, Volume. 10, Issue 6. 1086-1094,

Okelue, C., Henrietta, N. O., & Alado, M. I. (2025). Gender Dynamics and Infrastructural Challenges on the Implementation of Blended Learning in Higher Education. International journal of research and innovation in social science. IX (III). 2276- 2284

Okoli, E. E., Nworji, M. J., & Okoronkwo, C. M. (2021). Potentials of proteomics in plant improvement. *Int. J. Sci. Adv*, *2*(10).

Rita, N. N., & Henrieta, N. O. (2025). Student's self-regulatory skills as correlate of their academic achievement in biology in public secondary schools in Anambra state. *UNIZIK Journal of STM Education*, *8*(2), 180-191.

Ugonwa O, T. (2015). Difficulties Encountered by Secondary School Physics Students in Answering Mathematical Related Physics Questions. *American Academic & Scholarly Research Journal*, *7*(6).

Wang, C., Lai, H., Nissim, M., & Bos, J. (2023, July). Pre-trained language-meaning models for multilingual parsing and generation. In *Findings of the Association for Computational Linguistics: ACL 2023* (pp. 5586-5600).