

MODERATED-MEDIATION PATH ANALYSIS ON THE INFLUENCE OF STUDENTS' VARIABLES ON ACADEMIC ACHIEVEMENT IN BIOLOGY IN ONITSHA EDUCATION ZONE OF ANAMBRA STATE

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Abstract

The aim of the study was to determine moderated-mediation path analysis on influence of student variables (for example, students' self-esteem and self-efficacy, attitude, anxiety and study habit) on academic achievement of students in Biology at Senior Secondary Schools (SSS) level in Onitsha Education Zone of Anambra State. Three research questions guided the study and three hypotheses were tested at a 0.05 level of significance. A correlational survey research design was adopted for the study. The sample comprised of 357 students who offered Biology at SSS level in Onitsha Education Zone of Anambra State. Five instruments were used for data collection, titled: Biology Attitude Questionnaire (BAQ), Rosenberg self-esteem scale (RSES), Biology self-efficacy Scale (BSEQ), Beck Anxiety Inventory (BAI) and Study Habit Inventory (SHI). Cronbach's alpha was used in calculating the internal consistency of the items in the instruments, which yielded coefficient values of .79 for BAQ, .89 for RSES, .82 for BSEQ, .89 for BAI and .88 for SHI. The annual results (2022/2023 session) of SSS 2 students who offered Biology from the sampled schools were used to obtain academic achievement of students in Biology at SSS level in Onitsha Education Zone of Anambra State. The SPSS version 27 and MPLUS version 7 software were used in analyzing the data collected from the respondents. Research questions analyzed using mean, standard deviation, correlation and regression statistics. Hypotheses were analyzed using Chi-square statistic. The findings revealed that all the assumptions of the hypothesized causal model were upheld. Also, the models were fit and statistically significant and meaningful. The variables directly and indirectly through mediation variables in the model predicted academic achievement of students in Biology at SSS level in Onitsha Education Zone of Anambra State. The findings also revealed that an increase in any of the variables in the equations result in an increase in academic achievement of students in Biology at SSS level in Onitsha Education Zone of Anambra State while holding constant influence of other variables. Students' gender also has significant moderation effect in all the variables.

Keywords: Academic Achievement of Students, Anxiety, Attitude, Biology, Moderated-Mediation Path Analysis, Self-Efficacy, Self-Esteem, Student Variables, Study Habit, Senior Secondary Schools.

Introduction

Science education equip students with the curiosity to observe and explore the environment to experience more about the world in order to think logically and globally. Nja, Idiege and Obi (2017) opined that Science education covers Biology, Chemistry, Physics and Mathematics, which include Basic and Computer Science. For the purpose of this study, the authors focuses on Biology. The term "Biology" refers to the study of living organisms. The knowledge gained in Biology may provide opportunity for students to understand the functions of cells, tissues and organs in the body. The knowledge of Biology may also provide opportunity for students to understand how to study and interact with their environment for survival. This

necessitated the reason most students opt to study Biology despite its electiveness. The academic achievement of students in Biology at the Senior Secondary school (SSS) level has been reported to be consistently poor, fluctuating, below or slightly above average by researchers, chief examiners and examination bodies. For instance, most recent studies (for example, Ogbogu, 2023; Ejelue, 2022; Nwuba, 2021) found that the academic achievement of students in Biology at the SSS level in Onitsha and Awka Education Zone of Anambra State from the year 2015 to 2019 have been quite unsatisfactory. This report showed that students seem not to be achieving well academically in Biology at the SSS level in Onitsha and Awka Education Zone of Anambra State. The chief examiner's report from the year 2016 to 2019 also revealed that the academic achievement of students in Biology at the SSS level was below expectation. The poor academic achievement of students in Biology at the SSS level seem to be attributed to many factors such as low self-esteem, low self-efficacy, poor attitude, high level of anxiety and poor study habit.

This notwithstanding, WAEC analysis of the academic achievement of students in Biology at the SSS level in Onitsha Education Zone of Anambra State in the year 2018 to 2022 from the Department of Planning Research and Statistics seem not to conform with the general findings given by most researchers that the academic achievement of students in Biology at the SSS level has not been impressive. Rather, the analysis showed that the academic achievement of students in Biology at the SSS level in Onitsha Education Zone recorded over the period of 2018 to 2022 consistently fall above average (see Table 1).

Table 1: Academic achievement of students in Biology at the SSS level in Onitsha Education Zone over the period of 2018 to 2022.

YEAR	NO OF STUDENTS THAT SAT FOR THE EXAM.	NO OF STUDENTS THAT PASSED (A1 –C6)	NO OF STUDENTS THAT FAILED (P -F)	PERCENTAGE (%) OF PASSED (A1-C6)	PERCENTAGE (%) OF FAILURE (P-F)	OVERALL TOTAL IN PERCENTAGE
2018	3,938	3,348	590	85	15	100
2019	3711	3338	373	90	10	100
2020	3947	3596	351	91	09	100
2021	4,379	3927	452	90	10	100
2022	4638	3493	1145	75	25	100

Therefore, there is a mixed result based on previous evidence or report revealed regarding the academic achievement of students in Biology at the SSS level. As a result, there is a need to examine if students' variables (for example, students' self-esteem and self-efficacy), moderator variable (for example, students' gender) and mediator variables (for example, students' attitude, anxiety and study habit) can play significant roles in influencing better academic achievement of students in Biology at the SSS level in Onitsha Education Zone. The present study, therefore, sought to investigate the extent to which students' variables (for example, students' self-esteem and self-efficacy), moderator variable (for example, students' gender) and mediator variables (for example, students' attitude, anxiety and study habit) could positively influence academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Purpose of the Study

The purpose of the study is to examine the influence of students' variables (for example, students' self-esteem and self-efficacy), moderator variable (for example, students' gender) and mediator variables (for example, students' attitude, anxiety and study habit) on academic achievement of students' in Biology at the SSS level in Onitsha Education Zone.

Research Questions

The following research questions guided the study.

Research Question 1: What is the extent of association between students' variables (for example, students' self-esteem and self-efficacy), mediator variables (for example, students' attitude, anxiety and study habit)

and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Research Question 2: What are the relative and composite influence of all the students' variables (for example, students' self-esteem and self-efficacy) and mediator variables (for example, students' attitude, anxiety and study habit) on the outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Research Question 3: What are the moderating influence of gender on the relationships between students' variables (for example, students' self-esteem and self-efficacy), mediator variables (for example, students' attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Research Hypotheses

The following null hypotheses were tested at a 0.05 level of significance.

Research Hypthesis 1: Students' variables (for example, students' self-esteem and self-efficacy) and mediator variables (for example, students' attitude, anxiety and study habit) do not significantly influence outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Research Hypothesis 2: Mediator variables (for example, students' attitude, anxiety and study habit) do not significantly influence relationships between students' variables (for example, students' self-esteem and self-efficacy) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Research Hypothesis 3: Moderator variable (for example, students' gender) do not significantly influence relationships between students' variables (for example, students' self-esteem and self-efficacy), mediator variables (for example, students' attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Conceptual Framework

The schematic model (Figure 1) showed that there are two independent variables (for example, students' self-esteem and self-efficacy), one moderator variable (for example, students' gender), three mediator variables (for example, students' attitude, anxiety and study habit), and one dependent variable (for example, academic achievement) of students. The model showed that when SSS students exert high self-esteem and self-efficacy, they will experience better academic achievement of students. The model also showed that when SSS students exert high self-esteem and self-efficacy, they will equally exhibit positive attitude, low anxiety, and good study habit. The model also showed that when SSS students exhibit positive attitude, low anxiety, and good study habit, it will influence the interplay between SSS students' self-esteem, self-efficacy and academic achievement. The model further showed that students' gender will moderate between students' self-esteem, self-efficacy, attitude, anxiety, study habit and academic achievement.

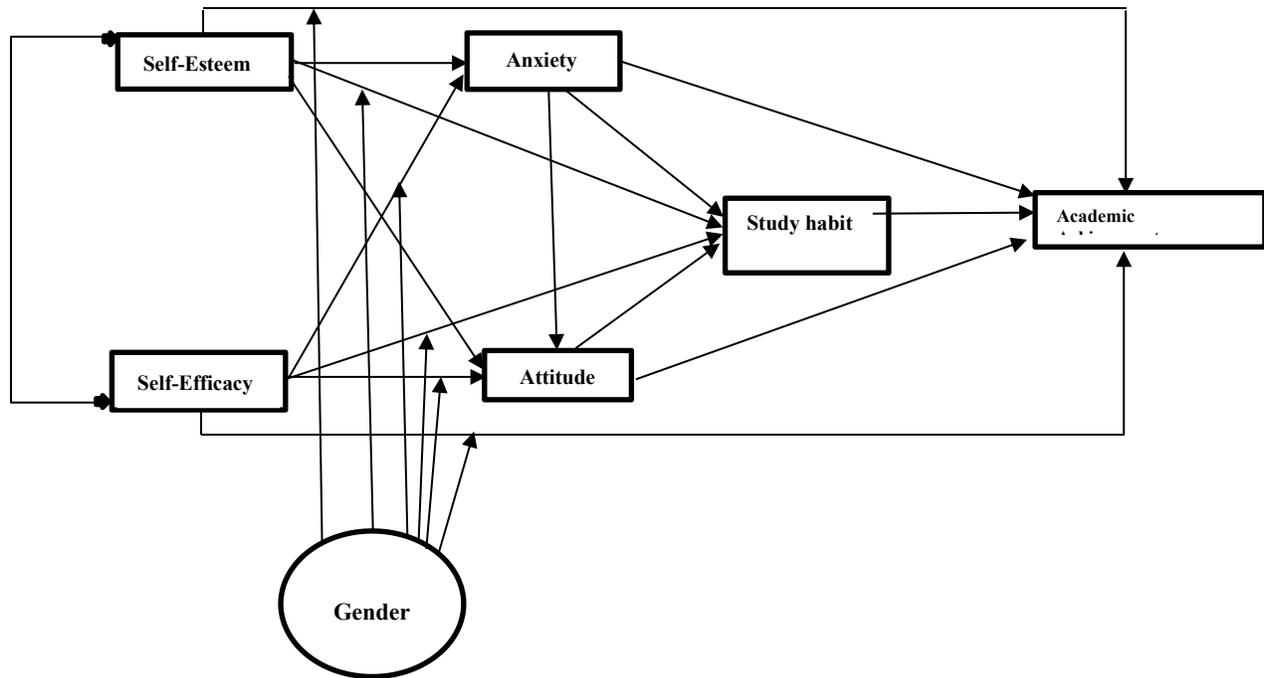


Figure 1: Path Causal Model Showing the Relationships with a Moderator and Mediators of the Study Variables.

Method

Research Design

A correlational survey research design was adopted for the study. According to Nworgu (2015), a correlational survey research design seeks to establish relationship(s) between two or more variables. This design is appropriate for this study because it seeks to establish relationship(s) between students' variables (for example, students' self-esteem and self-efficacy), moderator variable (for example, students' gender), mediator variables (for example, students' attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology.

Population and Sampling Procedure

The population of the study consisted of 5087 students of SSS2 who offer Biology in the 32 public SSS in Onitsha Education Zone of Anambra State. A multistage sampling method was employed to select 357 students of SSS2 from the three Local Government Areas in Onitsha Education Zone.

Data Collection Instrument

Five standardized instruments were used for data collection namely: Biology Attitude Questionnaire (BAQ) by Pavol, Gaye, and Julia (2007), Rosenberg Self-Esteem Scale (RSES) by Rosenberg (1965), Biology Self-Efficacy Questionnaire (BSEQ) Adapted from Schawarzar and Mathias (1979), Beck Anxiety Inventory (BAI) by Beck, Epstein, Brown and Steer (1986), Study Habit Inventory (SHI) by Jhoselle, Rayo, Lubo, and Cruz (2020). The academic achievement in Biology was obtained from Biology annual result (2022/2023) of the SSS2 students offering Biology from the sampled schools.

Validation and Reliability of Instrument

Four experts validated the instruments to ensure their suitability for local use in Nigeria. Cronbach's alpha was used to calculate the internal consistency of the items in the instruments, which yielded coefficient values of .79 for BAQ, .89 for RSES, .82 for BSEQ, .89 for BAI and .88 for SHI.

Data Analysis

Data collected from the respondents were analyzed using SPSS version 27 and MPLUS version 7 software. Research questions were answered with mean, standard deviation, correlation and regression statistics. Research hypotheses were tested using Chi-square statistic.

Result

Answering Research Questions

Research Question 1: What is the extent of association between students’ variables (for example, students’ self-esteem and self-efficacy), mediator variables (for example, students’ attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Table 2: Correlation, mean and standard deviation on the association between students’ self-esteem, self-efficacy, attitude, anxiety, study habit and academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Var.	Mean	SD	SE	SF	AN	AT	SH	AA
SE	.125	.604	1					
SF	.658	.340	.211**	1				
AN	51.64	10.34	.008	.263**	1			
AT	52.17	9.72	.039	.302**	-.619**	1		
SH	51.19	9.12	.022	.213**	-.692**	.621**	1	
AA	51.73	9.87	.345	.177**	-.688**	.559**	.648**	1

Note. SE = Self-esteem, SF = self-efficacy, AN= Test anxiety, AT= Attitude towards Biology, SH = Study habit, AA = Academic achievement.

Table 2 presented the correlation analysis between the study variables (that is, students’ variables and its relation constructs, mediator variables and its related constructs and outcome variable and its relation construct. The Table showed that there is no correlation between students’ self-esteem and students’ test anxiety ($r = .008$). The Table also showed that there is no correlation between students’ self-esteem and students’ attitude towards Biology ($r = .039$). The Table also showed that there is no correlation between students’ self-esteem and students’ study habit ($r = .022$). The Table also showed that there is a moderate correlation between students’ self-esteem and students’ academic performance in Biology ($r = .345$).

The Table also showed that there is a low correlation between students’ self-efficacy and students’ test anxiety ($r = .263$). The Table also showed that there is a moderate correlation between students’ self-efficacy and students’ attitude towards Biology ($r = .302$). The Table also showed that there is a low correlation between students’ self-efficacy and students’ study habit ($r = .213$). The Table also showed that there is a low correlation between students’ self-esteem and students’ academic performance in Biology ($r = .177$).

Research Question 2: What are the relative and composite influence of all the students’ variables (for example, students’ self-esteem and self-efficacy) and mediator variables (for example, students’ attitude, anxiety and study habit) on the outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Table 3: Regression on the relative and composite influence of all the students’ variables (self-esteem and self-efficacy) and mediator variables (attitude, anxiety and study habit) on the academic achievement of students in Biology in Onitsha Education Zone.

Relative contributions of each Variables to Achievement	R ²	Adjusted R ²	Rank	Remark
Self-esteem	.375	.369(36.9%)	3 rd	High
Self-efficacy	.477	.471 (47.1%)	1 st	High
Anxiety	.014	.012 (1.2%)	5 th	Low
Attitude	.326	.324 (32%)	4 th	High
Study habit	.430	.430 (43%)	2 nd	High
Composite contributions of all variables to achievement	.557	.551 (55.1%)		Very High
Relative contribution of the mediating variables to achievement				
Anxiety	.014	.012 (1.2%)	3 rd	Moderate
Attitude	.326	.324 (32%)	2 nd	High
Study habit	.430	.430 (43%)	1 st	Very High
Composite contribution of all mediating variables to achievement	.471	.468 (46.8%)		Very High

NB-- Adjusted R² below .1 is low, .11 to .30 is moderate, .31 to .50 high while .51 and above very high (Cohen, 1988).

Table 3 showed that all the variables yielded an adjusted R² of .551. This implied that all the variables in the causal model contributed 55.1% of variance of the academic achievement of students in Biology. The composite contribution of all the mediating variables (for example, students’ anxiety, attitude and study habit) to academic achievement of students in Biology is 46.8% variance. In line with Cohen (1988) guidelines for interpreting the contributions of variables to dependent variables in causal modeling, the independent and mediating variables have meaningful contributions to variance of academic achievement of students in Biology in the causal model. In terms of relative contributions of each variable to academic achievement of students in the causal model, students’ self-esteem has high contribution to variance in academic achievement of students in Biology (36.9%), students self-efficacy has high contribution to variance of academic achievement of students in Biology (47%), students’ anxiety has low contribution to variance in academic achievement of students in Biology (1.2%), students attitude has high contribution to variance in academic achievement of students in Biology (32%), while students’ study habit has high contribution to variance of academic achievement of students in Biology (43%). Table 3 also showed that, students’ self-efficacy contributes most to variance of academic achievement of students in Biology in the causal model, followed by students’ study habit, self-esteem, attitude and anxiety. In terms of contribution of the mediating variables, students study habit contributes most to variance of academic achievement of students in Biology in the causal model followed by students’ attitude and then students’ anxiety.

Research Question 3: What are the moderating influence of gender on the relationships between students’ variables (for example, students’ self-esteem and self-efficacy), mediator variables (for example, students’ attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone?

Table 4: Interaction effect of gender on the relationships between students’ variables, mediator variables and outcome variable of students in Biology in Onitsha Education Zone.

Variables	Path co-efficient	Direction	Strength
Moderator variable			
Gender	.147	Positive	Moderate
Moderator with Independent variables			
Gender * self-esteem	.346	Positive	High
Gender * self-efficacy	.226	Positive	Moderate
Moderator with mediating variables			
Gender * Anxiety	-.312	Negative	High
Gender * attitude	.241	Positive	Moderate
Gender * study habit	.329	Positive	High

Path co-efficient below .1 is low, .11 to .30 is moderate, .31 to .50 high while .51 and above very high (Cohen, 1988).

Table 4 showed that students’ gender has moderate positive effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. In terms of interaction effect of students’ gender with the independent variables, students’ gender with students’ self-esteem has high positive interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. Also, students’ gender with students’ self-efficacy has moderate positive interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. In terms of interaction effect of students’ gender with the mediating variables, students’ gender with anxiety has high negative interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. Students’ gender with students’ attitude has moderate positive interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone, while students’ gender with students’ study habit has high positive interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Testing Research Hypotheses

Research Hypthesis 1: Students’ variables (for example, students’ self-esteem and self-efficacy) and mediator variables (for example, students’ attitude, anxiety and study habit) do not significantly influence outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Hypothesis 1 was tested using confidence intervals of Root Mean Square Error of Approximation (RMSEA) of the causal model. A confidence interval that does not fall across zero, with a $p < .05$ indicates that the causal model is statistically significant and meaningful (Kline, 2015). The Chi-square of Goodness of fit and test of significance was presented in Table 5.

Table 5: Chi-square Goodnes of Fit on the influence of students’ variables (self-esteem and self-efficacy) and mediator variables (attitude, anxiety and study habit) on academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Measures	Estimate	P-value
Chi-square Goodnes of Fit	18.308	.845
RMSEA	.07 (.030 .244)	.001

Table 5 showed that the confidence interval of RMSEA of the causal model did not fall across zero at (CI, .030, .244) 95% probability level meaning that the hypothesized causal model for the study is statistically significant and meaningful. The results of the Chi-square Goodnes of Fit of non-statistical significance also attest to the fact that the hypothesized path causal model is meaningful.

Research Hypothesis 2: Mediator variables (for example, students’ attitude, anxiety and study habit) do not significantly influence relationships between students’ variables (for example, students’ self-esteem and self-efficacy) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Hypothesis 2 was tested using t-test of Adjusted R² of direct and indirect contribution of students’ variables to academic achievement in Biology at the SSS level in Onitsha Education Zone. A p < .05 indicates that the contribution is statistically significant and meaningful.

Table 6: Regression on the mediator variables (attitude, anxiety and study habit) between students’ variables (self-esteem and self-efficacy) and academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Relative contributions of each Variables to Achievement	Adjusted R ²	t-test	p-value
Self-esteem	.369	11.56	.003
Self-efficacy	.471	23.17	<.001
Anxiety	.012	2.88	.004
Attitude	.324	16.85	P<.001
Study habit	.430	21.06	P<.001
Composite contribution of all variables to achievement			
	.551	6.52	P<.001
Composite contribution of all Mediating variables to achievement	.468	7.12	P<.001

Table 6 showed that all the variables yielded an adjusted R² of .551. This implied that all the variables in the hypothesized causal model contributes 55.1% of variance of academic achievement of students in Biology at the SSS level in Onitsha Education Zone is statistically significant (t=6.52, p<.001), the composite contribution of all mediating variables (anxiety, attitude and study habit) to academic achievement of students in Biology at the SSS level in Onitsha Education Zone is also statistically significant (t=7.12, p<.001).

In terms of relative significant contributions of each variable to academic achievement of students in the hypothesized model; students’ self-esteem, self-efficacy, attitude, anxiety and study habit have significant contribution to variance in academic achievement of students in Biology at the SSS level in Onitsha Education Zone (p<.05).

Research Hypothesis 3: Moderator variables (for example, students’ gender) do not significantly influence relationships between students’ variables (for example, students’ self-esteem and self-efficacy), mediator variables (for example, students’ attitude, anxiety and study habit) and outcome variable (for example, academic achievement) of students in Biology at the SSS level in Onitsha Education Zone.

Hypothesis 3 was tested using t-test of standardized regression weights. A t-value > 1.96 indicates that the moderating path model is statistically significant and meaningful.

Table 7: Regression on the moderator variable (gender) between students’ variables (self-esteem and self-efficacy), mediator variables (attitude, anxiety and study habit) and academic achievement of students in Biology at the SSS level in Onitsha Education Zone.

Variables	Path co-efficient	SE	t-test	p-value
Moderator variable				
Gender	.147	.030	4.966	.000
Moderator with Independent variables				
Gender * self-esteem	.346	.042	8.23	.000

Gender * self-efficacy	.226	.030	7.53	.001
Moderator with mediating variables				
Gender * Anxiety	-.312	.030	10.40	.000
Gender * attitude	.241	.041	5.878	.003
Gender * study habit	.329	.031	10.61	.004

Table 7 showed that students' gender has significant effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 4.966 > 1.96$). In terms of significant interaction effect of students' gender with the independent variables, students' gender with students' self-esteem has significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 8.23 > 1.96$). Also, students' gender and students' self-efficacy have significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 7.53 > 1.96$). In terms of significant interaction effect of students' gender with the mediating variables, students' gender with students' test anxiety has significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 10.40 > 1.96$). Students' gender and students' attitude has significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 5.878 > 1.96$). Also, students' gender and students' study habit also have significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone ($t, 10.61 > 1.96$). The paths co-efficient for female and male students, and test of significant difference between male and female paths co-efficient in the hypothesized path causal model are presented in Table 7. A t -value > 1.96 indicates that the path co-efficient is statistically different for male and female students.

Discussion

The assumptions of the hypothesized causal model were checked and tested with different measures and the assumptions were met and non was violated. In terms of model fit, Chi-square goodness of fit, RMSEA and other indicators attested that the hypothesized causal model for the study is statistically significant and meaningful. The findings of the study also showed that all the variables jointly yielded an adjusted R^2 of .551. This implied that all the variables in the hypothesized causal model jointly contributed 55.1% of variance of academic achievement of students in Biology at the SSS level in Onitsha Education Zone, while the composite contribution of all mediating variables (for example, students' anxiety, attitude and study habit) to academic achievement of students' in Biology at the SSS level in Onitsha Education Zone is 46.8% variance. The contribution of all the variables in the hypothesized causal model to academic achievement of students in Biology at the SSS level in Onitsha Education Zone is statistically significant. The composite contribution of all mediating variables (for example, students' anxiety, attitude and study habit) to academic achievement of students in Biology at the SSS level in Onitsha Education Zone is also statistically significant. In terms of significant interaction effect of students' gender as moderator variables with the independent variables. Students gender with students' self-esteem and students' self-efficacy have significant interaction effect on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. The study also found that in terms of significant moderating interaction effect of students' gender with the mediating variables (moderated-mediation variables), students' gender with students' test anxiety, attitude and study habit have significant interaction effect on academic achievement of students in biology at the SSS level in Onitsha Education Zone.

The study also found that the variables mediated through one another to predict academic achievement of students in Biology at the SSS level in Onitsha Education Zone. The study in the aspect of moderated-mediation corresponded with the study of Waldeyer, et al. (2022) which showed that the effect of conscientiousness on academic performance of students is mediated by using effort regulation strategies and time management strategies. That is, for effort regulation strategies, the effect is moderated. It also corresponded to the study of Fosu, Arthur, Boateng and Adu-Obeng (2023) which revealed that mathematics interest mediated between self-concept and academic achievement in mathematics. In terms of significant effect of students' gender, this study contradicted the study of Umar, Yagna, Fajja and Ali (2015) which indicated that there were no significant differences exist between students' gender and academic performance in Colleges of Education in Borno State. It also contradicted the study of Ioannis and Mohammed (2022)

which recorded that female scored higher than male. In addition, the work aligns with the study of Okafor (2019), who found that there is significant difference between academic achievement of male and female which was in favour of male in Orlu Education Zone, Imo State.

Conclusion

The study concluded that all the variables; that is, students' self-esteem, self-efficacy, anxiety, attitude and study habit have significant contributions to academic achievement of students in Biology at the SSS level in Onitsha Education Zone. The variables mediated through one another to predict academic achievement of students in Biology at the SSS level in Onitsha Education Zone. Also, students' gender moderated the effect of independent and mediating variables on academic achievement of students in Biology at the SSS level in Onitsha Education Zone. This implied that the variables discussed in this study played major roles individually and collectively in improving academic achievement of students in Biology at the SSS level in Onitsha Education Zone. Also, the variables could be a contributing factors towards male and female academic achievement in Biology at the SSS level in Onitsha Education Zone.

Recommendation

Based on the findings of the study, the following recommendations are made:

1. Students' self-esteem, self-efficacy, positive attitude, good study habit, less anxiety should be encouraged among students offering Biology at the SSS level in Onitsha Education Zone, and other Zones of Anambra State for better academic achievement of students.
2. Equal opportunities and gender equity should not be neglected in order to improve academic achievement of students in Biology at the SSS level in Onitsha Education Zone.
3. There should be constant orientation on psychological variables at the SSS level in Onitsha Education Zone and other Zones of the State at onset of admission especially in SSS1 for personal development and better academic achievement of students in Biology.

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