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PREDICTIVE INFLUENCE OF ATTITUDE, ACADEMIC SELF-EFFICACY AND TEST-TAKING SKILL ON ACADEMIC ACHIEVEMENT OF STUDENTS IN MATHEMATICS IN UPPER BASIC EDUCATION IN ABIA STATE OF NIGERIA

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ABSTRACT
Mathematical ability is very important for the economic success of a society. This study focuses on predictive influence of attitude, academic self-efficacy and test-taking skill on academic achievement of students in mathematics in upper basic education in Abia state of Nigeria. The study was guided by three research questions. Predictive correlation research design was adopted for the study. The study was conducted in Abia State. The population of the study consisted 31,809 upper basic education level two students for 2023/2024 academic session. A sample of 1080 (458 males and 622 females) upper basic two students was selected for this study using multi-stage sampling techniques. Data were collected using the following three standardized instruments; Student Attitude toward Mathematics Inventory (MAI) for junior secondary school students, Academic Self-efficacy Scale (ASS), and Test-Taking Skill Inventory (TSI). Academic achievement scores in mathematics were collected from the students' cumulative examination folder in their respective schools using Proforma. The instruments were revalidated for suitability. Cronbach Alpha was used to determine the internal consistency of the instruments which yielded coefficient values of .93, .94, and .81 for MAI, ASS and TSI respectively. Academic achievement scores in mathematics were collected from the students' cumulative examination folder in their respective schools using a Proforma. All relevant assumptions of the regression equation model were tested and met; the researchers then proceeded with the Regression analysis using Mplus software version 7.4. The study showed that attitude towards mathematics, academic self-efficacy and test-taking skill were significant predictors of academic achievement of students in mathematics. The result showed that the three variables yielded an adjusted R squared of 51.6%. The exogenous variables had meaningful contributions to variance of students' academic achievement in mathematics in the regression equation model. The researchers recommended among others that mathematics teachers should integrate teaching of appropriate test-taking skills as they teach the subject content to enable students, especially weak ones, effectively express their knowledge in classroom during mathematics lesson.

Keywords: Mathematics, academic achievement, attitude, self-efficacy and test-taking skill.

Introduction

Mathematics plays a very vital role in the modernization of human civilization. Although it is abstract, it emerges from the real world (Sherman, Richardson, and Yard, 2014). Mathematics is said to be the bedrock of all the sciences and the physical world in general. For instance, in our day-to-day activities like buying and selling, we apply some mathematics concepts like addition, subtraction, multiplication, division, ratio and proportion, among others (Esomonu and Anekwe, 2021). Mathematical ability is very important for the economic success of a society. Mathematics skills are essential because of its application in other disciplines which includes engineering, sciences, social sciences, technology and even arts. Abe and Gbenro (2014) pointed out that mathematics plays a multidimensional role in science and technology of which its application spread to all areas of science, technology as well as business enterprises.

Mathematics is one of the core subjects in both basic and senior secondary schools; and also, it is needed for admission into tertiary institutions in Nigeria. According to Federal Republic of Nigeria (FRN, 2014) in the National Policy on Education;the main objective of teaching mathematics in basic education level is to enable students acquire basic scientific knowledge and skills that will enable them meet societal needs of creating employment and wealth. The contribution of mathematics to the national development has been seen in all facets of human life in various degrees (Anekwe, 2021). Possession of minimum of credits/passes in five subjects including English Language and mathematics qualifies a graduate of 9-year basic education who sat for the Basic Education Certificate Examination (BECE) for admission into the 3-year Senior Secondary School programme.

In spite of the relevance of mathematics to the development of science and technology in the 21st century, the achievement of students in the subject has been persistently poor in Abia state. It was recorded that from 2018-2022 the percentage pass with credit and above in mathematics in BECE in Abia State were 52.0%, 54.0%, 53.94%, 40% and 47.29% respectively (Abia State Ministry of Education, Examination Development Centre, 2024). The poor achievement in mathematics have great consequences and implication on students and nation at large. This showed that much is required from the Abia students to reach the desired expected level of achievement in the examination, notwithstanding the importance of mathematics in the life of the students and entire society. This unsatisfactory achievement in mathematics may be attributed to influence of some student-related variables such as; students' attitude towards mathematics, academic self-efficacy and test-taking skill among others. Hence, there is an urgent need to investigate the predictive influence of these student-related variables in students' academic achievement in mathematics using path analysis.

Academic achievement is the sum total of a student's performance after the content of a curriculum has been taught or delivered by the teacher. Internal and external examinations by students are usually used to measure the extent of academic achievement of students. As stated in words of Ricarda (2017), academic achievement denotes

performance outcome that indicate the degree to which a person has proficient specific goals that were the focus of activities in instructional environment, especially in schools, colleges, and universities. Hence, mathematics achievement of students is the total performance of the students in mathematics after the content of a mathematics curriculum has been taught or delivered by the teacher. Studies by Pipere and Mieriņa (2017) suggested that academic achievement in mathematics is influenced by attitude of students toward learning the subject.

Attitude is a predisposition of an individual to react favourably or unfavourably towards a designed class of stimuli such as objects, places and persons. According to Gbore (2013), attitude as an element could be regarded as the sum of an individual's predisposition towards an object, institution or idea. In other words, attitude is a predisposition of a person towards social objects which may be positive or negative. It is regarded as the factor that determines how a person will react to any object, person, phenomenon or situations. Baidoo, Assan and Baidoo (2022) stated that attitude towards learning mathematics is influenced by self-efficacy

Self -efficacy is people's beliefs about their capabilities to produce the designated level of performance that exercises influence over events that affect their lives. Regarding school mathematics, self-efficacy is found to be one of the most critical variables for explaining difference in mathematics performance of students that explains some variations while predicting students' mathematics achievement (Pajares, 2016). An essential characteristic of self-efficacy is that it has a significant relationship with cognitive and non-cognitive constructs, including academic achievement (Schunk and Mullen, 2012). Schnell et al (2015) found that high self-efficacy was positively associated with higher performance goals, greater effort investment and task persistence, especially in high test-anxious individuals. In other words, academic self-efficacy affects test-taking skill positively.

Test-taking skill is a cognitive skill that allow students to undertake any test-taking situation in an appropriate manner, and to know what to do before, during, and after the test (Dodeen, 2009). These skills help students to translate their knowledge from classroom learning to answering and responding to questions when taking tests. Test-taking skill positively affects students' test-taking competency and hence impact upon their academic achievement. Test-taking skill is transferable skills (Sefcik, Bice and Prerost, 2013), where once acquired, students may be enabled to use these skills across a variety of subjects and within different settings and conditions. Test-taking skill is related to the motivation to learn and to the attitudes students may hold with regards to specific subjects. Additionally, test-taking skill can be effectively used to help examinees eliminate any feelings of tension and anxiety that may interfere with their ability to communicate what they know in a test situation. Therefore, improving students' testing skills is likely to indirectly improve students' academic achievement in mathematics.

Purpose of the Study

The purpose of the study was to predict the influence of attitude towards mathematics, academic self-efficacy and test-taking skill on academic achievement of students in mathematics in upper basic education in Abia state.

Research Questions

1. What is the predictive influence of attitude towards mathematics, academic self-efficacy, and test-taking skill on academic achievement in mathematics?
2. What is the regression equation model of the influence of the exogenous variables on the achievement of students in mathematics?
3. What proportion is the composite influence of the exogenous variable on the achievement of students in the mathematics in the model?

Methods

Predictive correlation research design was adopted for the study. The study was conducted in Abia State. The population of the study consisted 31,809 upper basic education level two students for 2023/2024 academic session (Source: Abia State Universal Basic Education Board, 2024). A sample of 1080 (458 males and 622 females) upper basic two students was selected for the study using multi-stage sampling techniques. Data were collected using the following standardised instruments; student attitude towards mathematics inventory for junior secondary school students by Esomonu and Anekwe (2021), academic self-efficacy scale by Abdul and Ashraf (2009), and Test-Taking Skill Inventory developed by Dooden (2008). Academic achievement scores in mathematics were collected from the students' cumulative examination folder in their respective schools using Proforma. The instruments were adopted because they were developed and standardised by measurement experts with well-established psychometrics properties. The data were first screened for missing values, 51 respondents had missing values representing 4.7% approximately. Hence, listwise deletion approach was adopted. After deleting the 51 incomplete scores, the sample size was reduced to 1029. Thereafter, test of assumptions of regression analysis were conducted. Univariate outliers of the data were checked by examination of the boxplot value of each variable in the mathematical model. An examination of the boxplot of the scores suggests four potential outliers in the scores of study habit. The four potential outliers' scores were replaced with the mean score of the variable in lines with the recommendation of Kline (2016). The data for the variable were rerun with boxplot and no outliers was found. Other variables have no outliers. The assumption of univariate and multivariate normality was also examined. Univariate normality was tested by calculating the skewness and kurtosis value of each variable. A skewness and kurtosis value that is less than 2.00 indicates that the assumption of normality has been met (Garson, 2012; Jamshidian and Jalal, 2011). The skewness statistics of the variables in this study are within the range of −.196 to .504 and kurtosis are within the range of -.244 to -1.207, all within the range of an absolute value below 2.0 suggesting evidence of normality. Multivariate normality was examined using Mardia test

for Standardized Kurtosis. A Standardized Multivariate Kurtosis (Std-MK) -1.5179 was found. The value was below 5 recommended (Bryne, 2016). Therefore, the univariate and multivariate normality were met. To test if the assumption of absence of multicollinearity among the variables was violated, Variance Inflated Factor (VIF) and Tolerance (T) statistics were used; Variance Inflated Factor (VIF) and Tolerance (T) of the exogenous variable were examined. Self-efficacy Tolerance=.859, VIF=1.165; Attitude towards mathematics, Tolerance=.761, VIF=1.314 and test-taking skill, VIF =1.355, Tolerance=.738 values were less than 10 for VIF and greater than .20 for T respectively as recommended (Schumacker, 2015). Hence, there is no presence of multicollinearity among the variables in the path model. Durbin Watson statistics was used to test if the assumption of independent errors was violated; the results showed that the value of Durbin Watson statistics is 1.948 less than 4 butgreater than zero as recommended (Denis, 2020). Hence, the assumption of independent error of observation was met. The assumption of normal distribution error was checked using histogram and normal P-P plot of standardized residuals. Histogram of standardized residuals shows that the assumption of normal distribution of error was met. Furthermore, the Normal P-P plot of standardized residuals data points were not completely off the line, but close. Hence, the errors were normally distributed. The scatter plot of standardised predicted values shows that the data met the assumptions of homogeneity of variance and linearity as the data were distributed above zero in both dimensions and do not show any pattern. The data also met the assumption of non-zero variances ((Self-efficacy, variance=9.74; Test-taking skill, Variance=182.35; Attitude towards mathematics, Variance=57.87; Achievement= 89.93) as there is no zero variance for any of the variable in the study. Having assessed the suitability of the data and all relevant assumptions of the regression equation model met, the researchers then proceeded with the Regression analysis using Mplus software version 7.4

Results

Research Question 1: What is the predictive influence of attitude towards mathematics, academic self-efficacy, and test-taking skill on academic achievement in mathematics?

Table 1 Path Co-efficient in the Regression Path Model for the Study

			Stand. Estimate	Unstand. Estimate	S.E.	t	P	Remark
Intercept				2.234	2.42	9.233	***	Significant
ACH	<---	SH	.143	.190	.036	5.268	***	Significant
ACH	<---	AT	.187	.233	.035	6.664	***	Significant
ACH	<---	PP	.104	.270	.069	3.911	***	Significant
ACH	<---	TTS	.354	.248	.020	12.396	***	Significant
ACH	<---	SE	.113	.344	.080	4.288	***	Significant

Multiple R-squared: 0.841, Adjusted R-squared: 0.74.7; F-statistic: 8239 on 5 and 97 DF, p-value: < .012; ACH= Academic Achievement, TTS= Test Taking Skill, SE= Self efficacy, ATT= attitude towards mathematics, SH=Study habit, PP= Peer Pressure.

Table 1 showed a multiple regression analysis that examined the impact of three predictors - attitude, self-efficacy and test-taking skill on students' academic achievement in mathematics. That attitude towards mathematics and self-efficacy have medium positive direct effect size on students' academic achievement in mathematics at Upper Basic Education in Abia State respectively, while test-taking skill has large positive direct effect size on students' academic achievement in mathematics. The model demonstrated a strong overall fit (multiple R^2=0.841), indicating that these predictors explained approximately 84.1% of the variance in mathematics achievement. It also showed that the variables were all significant predictors, highlighting their importance in influencing academic achievement of the students in mathematics in the upper basic education in Abia State. The corresponding hypothesis, shows that attitude towards mathematics, academic self-efficacy and test-taking skill) have significant direct effect size on the academic achievement of students in mathematics.

Research Question 2: What is the regression equation model of the influence of the exogenous variables on the achievement of students in mathematics?
The unstandardized (slope) estimates and intercepts in Table 1 was used to build the regression equation model for the study. Regression Equation Model for this Study: Academic Achievement =2.234+.233*Attitude towards mathematics +.248* Test Taking Skill + .344 *Self efficacy

Research Question 3: what proportion is the composite influence of the exogenous variable on the achievement of students in the mathematics in the model. The result in Table 1 shows that all the variables yielded an adjusted R squared of 74.7%. In line with Cohen (1988) guidelines for interpreting the contributions of variables to dependent variables in regression model, the exogenous variables have meaningful contributions to variance of students' academic achievement in the regression equation model.

Discussion of the Findings

The researchers found out that attitude towards mathematics and self-efficacy have medium positive direct effect size on students' academic achievement in mathematics at Upper Basic Education in Abia State respectively, while test-taking skill has large positive direct effect size on students' academic achievement in mathematics. The corresponding hypothesis, shows that attitude towards mathematics, academic self-efficacy and test taking skill have significant direct effect size on the academic achievement of students in mathematics.

The above finding on the significant relationship between self-efficacy and students' performance in mathematics is consistent with studies of Abubakar et al. (2016); Ali and Sepideh (2016); Naz et al. (2016) who found a significant relationship between self-efficacy and academic performance. Kanmani (2018) in a divergent report found no significant relationship between self-efficacy and academic performance which contradicts the present finding. Self-efficacy significantly predicts students' performance in mathematics, this finding agrees with studies of Odiri (2020); Negara et al. (2020); Brashi (2022) who found self-efficacy as predictor of performance in mathematics. The findings revealed that all the variables jointly predicted academic achievement in mathematics. The finding is in line with Nwanze and Okoli that the ten variables the authors worked on jointly predicted academic achievement in Chemistry.

Conclusion

Based on the findings, it was concluded that attitude towards mathematics, academic self-efficacy, and test-taking skill are significant predictors of academic achievement of students in mathematics in upper basic education in Abia State of Nigeria. And that all the variables jointly predicted academic achievement in mathematics.

Recommendations

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

1. Schools should implement programmes that enhance students' academic self-efficacy and eliminate negative attitude among the students towards the subject through mentorship, goal-setting workshops, and positive reinforcement strategies.
2. The use of test-taking skill should be incorporated into mathematics class in secondary schools because it improves students' academic performance and boost students' confidence in writing tests and examinations in mathematics. This should be achieved through various activities like practicing with different question types, familiarizing students with test formats among others.

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