



PREDICTIVE ANALYSIS: ACADEMIC RESILIENCE AS A DETERMINANT OF MATHEMATICS ACHIEVEMENT AMONG SENIOR SECONDARY SCHOOL STUDENTS IN NIGERIA

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Abstract

Mathematics is considered a key foundation for scientific knowledge required for the development of any nation. Poor mathematics achievement has been reported nationally. This paper was designed to investigate academic resilience as a determinant of mathematics achievement among senior secondary school students in Owerri municipal council of Imo State. A correlational design was used for the study. The study comprised a population of 32,068 students in public secondary schools in Owerri Municipal Council of Imo State. A sample of 180 SSII students was drawn from the population, using simple random sampling. Two instruments were used for data collection in this study. They are: the Academic Resilience Scale (ARS) for secondary school students was developed by Martin and Marsh with a Cronbach reliability coefficient of 0.74, and the Mathematics Achievement Proforma (MAP). Descriptive and inferential statistics including simple linear regressions were used for data analysis. The findings showed that academic resilience positively and significantly predicted mathematics achievement irrespective of gender. It was recommended to prepare and encourage students to be resilient, with the spirit of resilience inculcated at a young age, as this helps them in life and positively predicts mathematics achievement.

Keywords: Academic achievement, Academic resilience, Gender and mathematics.

Abstrak

Matematika dianggap sebagai landasan utama pengetahuan ilmiah yang diperlukan untuk pembangunan bangsa mana pun. Prestasi matematika yang buruk telah dilaporkan secara nasional. Makalah ini dirancang untuk menyelidiki ketahanan akademik sebagai penentu prestasi matematika di kalangan siswa sekolah menengah atas di dewan kota Owerri di Negara Bagian Imo. Desain korelasional digunakan untuk penelitian ini. Penelitian ini terdiri dari populasi 32,068 siswa di sekolah menengah negeri di Dewan Kota Owerri Negara Bagian Imo. Sampel diambil dari populasi sebanyak 180 mahasiswa SSII dengan menggunakan simple random sampling. Dua instrumen digunakan untuk pengumpulan data penelitian ini. Yaitu: Skala Ketahanan Akademik (ARS) untuk siswa sekolah menengah yang dikembangkan oleh Martin and Marsh dengan koefisien reliabilitas Cronbach sebesar 0,74, dan Mathematics Achievement Proforma (MAP). Statistik deskriptif dan inferensial termasuk regresi linier sederhana digunakan untuk analisis data. Temuan menunjukkan bahwa ketahanan akademik memprediksi prestasi matematika secara positif dan signifikan tanpa memandang gender. Direkomendasikan untuk mempersiapkan dan mendorong siswa untuk menjadi tangguh, dengan semangat ketahanan yang ditanamkan sejak usia muda, karena hal ini membantu mereka dalam hidup dan memprediksi secara positif prestasi matematika.

Kata kunci: Gender dan matematika, Ketahanan akademik, Prestasi akademik.

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INTRODUCTION

Mathematics is often described as a dynamic and elegant field of human activity, serving as a unifying force across various branches of science. Without mathematics, science and its understanding remain superficial. Dealing with numbers and figures, mathematics finds widespread application across numerous fields and serves as the foundation for most scientific disciplines. It holds a central position in secondary school curricula, aiming to equip students with the skills to apply mathematical knowledge effectively and responsibly in everyday problem-solving and decision-making. Integration of mathematics into national life is deemed essential for any nation's development, as it serves as a catalyst for technological advancement and overall national progress (Unodiaku, 2012). Aptly described as the language of science and technology (Olowojaiye, 2012), mathematics is a systematic, organized, and precise branch of science.

Mathematics is gainfully applied in the social, political, scientific, and technological development of countries worldwide. In essence, without mathematics, there would be no science, which includes technology, and without technology, all the facets of modern society would not exist (Odili, 2006; Ricketts, 2015). Due to the importance of mathematics and its contributions to national development, the Nigerian government made it compulsory for every child at all levels of the primary and secondary school system to study mathematics in the country, as indicated in the national policy of education (Federal Republic of Nigeria, 2012). Globally, a strong performance in Mathematics holds significant value for both students and a country's economic well-being. Consequently, achievement in mathematics garners substantial interest across all levels of education, playing a pivotal role in individuals' intellectual development and career choices. Despite its recognized importance, it is disheartening to observe consistently low performance among students in both internal and external examinations, with statistics indicating a persistent trend of mass failures in mathematics (Ogbeche et al., 2021; West African Examination Council, 2016), leading to diminished academic achievement.

According to Hanushek, Peterson, and Woessmann (2010), the imperative of having a larger number of students excel in mathematics remains unfulfilled. Research suggests that the quantity of high achievers in mathematics in most states falls below that of leading

industrialized nations such as Japan, China, and the United Kingdom (Hanushek et al. in Ricketts, 2015). This observation might have prompted former U.S. President Obama to remark that our future hinges on reaffirming America's role as the world's engine of scientific discovery and technological innovation. He emphasized that contemporary leadership relies on how we educate our students, particularly in mathematics, science, and technology (Ricketts, 2015).

Regrettably, available data highlights a concerning gap in the number of high-achieving students in mathematics compared to several leading developed nations (Hanushek et al., 2010), posing a challenge for Nigeria's educational landscape. In the country, mathematics is compulsory at both the primary and secondary school levels. Moreover, obtaining a commendable score in mathematics is often a prerequisite for admission to science-based courses in colleges and universities. This is in line with the notion that mathematics lays the foundation for scientific technical knowledge for individual and technological advancement (Tella, 2007).

In an endeavor to enhance students' achievement in mathematics, educational psychologists and mathematics educators have been actively involved in the search for variables, both personal and environmental, that could be manipulated to facilitate academic gains. Among the various personal and psychological variables that have garnered attention in the realm of mathematics achievement, resilience appears to be increasingly prominent, often surpassing other factors (Tella, 2007). The concept of resilience, particularly in the context of students' educational experiences and its impact on academic performance, is regarded as an important aspect of effective learning. However, it is the learner's response to education that ultimately determines the extent to which they will succeed in their educational endeavors.

Resilience, as defined by Masten (2014), refers to the process, capacity, or outcome of successful adaptation despite facing challenging or threatening circumstances. Similarly, Riley and Masten (2005) characterize resilience as the ability to exhibit positive adaptation patterns in the face of adversity. It is a psychological construct observed in certain individuals, allowing them to achieve success despite encountering difficult situations. Resilience embodies the capacity to bounce back and surpass obstacles, regarded as a valuable asset in human characteristics.

The significance of resilience as a determinant of a child's mathematics achievement

cannot be underestimated. It stems from an interest in identifying the distinguishing characteristics of individuals who thrive under challenging conditions compared to those who do not. Historically, economically disadvantaged children have faced a disproportionate risk of academic failure. However, despite the multiple mechanisms through which poverty impedes development and psychological adjustment in these children, a notable percentage manage to overcome adversity, demonstrating competence despite economic hardships. They subsequently lead successful, well-adjusted, and productive lives (Gizir & Aydin, 2009).

Students must overcome numerous hurdles on their academic journey, including challenging coursework, demanding schedules, technological setbacks, and disruptive living situations that hinder studying. Additionally, they must learn to overcome negative behaviors and cultivate positive habits conducive to achieving their academic goals. Resilience plays a vital role in addressing these obstacles and promoting academic success.

To confront their challenges and persevere through difficult times, students should focus on cultivating their academic resilience. While developing resilience won't eliminate their difficulties, it can empower them to tackle challenges with greater confidence. According to Harrington (2015), academic resilience entails the capacity to persist despite encountering negative academic experiences. It involves students' ability to effectively navigate the challenges they encounter while learning a specific subject. Academic resilience contextualizes the broader resilience construct and signifies an enhanced probability of educational success despite facing adversity.

Various studies have been conducted globally and locally to identify predictors of mathematics achievement (He, 2014; Harrington, 2015; Ogbeche et al., 2021). Despite these efforts, mathematics achievement levels remain consistently poor. In Imo State, mathematics achievement among students has persistently fallen below average, as evidenced by low performance in WAEC and NECO examinations over the years. Consequently, many students fail to qualify for science and mathematics courses in higher education institutions, hindering the country's technological advancements and the realization of Vision 2030 goals. Research has shown that resilience can significantly influence students' academic and life outcomes, including their achievement levels. It is against this backdrop that this study seeks to investigate whether academic resilience

serves as a determinant of mathematics achievement among secondary school students in Owerri Municipal Council of Imo State.

Research questions

The study provides answers to the following research questions: (RQ1) To what extent does academic resilience predicts student's achievements in mathematics?; (RQ2) To what extent does determinant of mathematics predicts male achievements in mathematics?; (RQ3) To what extent does determinant of mathematics predicts female achievements in mathematics?

Null hypotheses

The following hypotheses were tested in this study at 0.05 level of significance: (H01) Academic resilience does not significantly predict students' achievement in mathematics; (H02) Academic resilience does not significantly predict male students' achievement in mathematics; (H03) Academic resilience does not significantly predict female students' achievement in mathematics.

RESEARCH METHODS

The study employed a predictive correlational research design. This design was used due to its appropriateness in the measurement of two or more variables and the relationship between or among those variables (Stangor, 2011). Further, the design is suitable for the study because the researcher is interested in predicting the outcome of mathematics achievement using certain variable (academic resilience) as predictor.

The target population for the study consisted of all senior secondary school students in Owerri Municipal Council of Imo State, Nigeria. According to data from the Secondary Education Management Board (SEMB) in 2018/2019 academic session, the total population is 32,068. The sample comprised 180 SSII students from Imo State. Utilizing a simple random sampling technique, a total of four (4) public secondary schools were randomly selected from the ten (10) public secondary schools in Owerri Municipal Council. From each selected school, forty-five (45) SSII students were randomly chosen to participate in the study, resulting in a total sample size of 180 students. The selection process involved balloting without replacement to ensure an unbiased representation of students from the chosen schools.

The Academic Resilience Scale (ARS) for high school students, designed by Martin and Marsh (2006), consisted of nine items assessing students' levels of self-belief, persistence, composure, and commitment. These items were uniformly ranked on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The scale's total score ranged from a minimum of 9 to a maximum of 45, providing insights into students' academic resilience levels.

The Mathematics Achievement Proforma (MAP) served as a tool for gathering data on students' achievement scores in mathematics. This proforma documented students' standard entries of mathematics achievement scores across their first, second, and third terms, as well as their cumulative scores. The instrument ARS is a standard instrument, its validity had been guaranteed by Martin and Marsh (2006). This is because, they had been used in different studies. However, to cater for construct validity, the questionnaire was examined by experts who examined the items critically and give feedback in form of suggestions for modifications, insertions and deletions. Secondary school teachers were consulted for MAP. This was due to their knowledge of what is appropriate for students at the different levels of achievement. The reliability of the instrument (ARS) was previously established using the Cronbach Alpha reliability technique in secondary school contexts. Martin and Marsh (2006) reported a Cronbach reliability coefficient of 0.74 for the ARS, indicating satisfactory internal consistency.

The data collected were analyzed using coefficient of determination and regression techniques. Single regression statistical technique was used to test the null hypotheses at 0.05 alpha level. Regression took into account the effect of independent variable on a dependent variable and determines the quantitative relationships between them. When p -value is less 0.05, the null hypothesis was rejected otherwise the null hypothesis was accepted. Among the 180 students who filled out the questionnaires, 167 students completed them accurately.

RESULTS AND DISCUSSION

The results are presented in the order of the research questions and hypotheses raised. To answer RQ1, the results of research data analysis are presented in Table 1.

Table 1 presents the prediction of academic resilience to the variance observed in students' achievement in mathematics. The result shows that academic resilience

predicted only 0.04% to the variance observed in students' achievement in mathematics.

Table 1. Prediction of academic resilience to students' achievement in mathematics

Variables	N	R	R-square	% Prediction
Academic Resilience	167	.020	.0004	0.04
Mathematics Achievement	167			

Furthermore, the summary of the data analysis results to answer RQ2 is presented in Table 2.

Table 2. Prediction of academic resilience to male students' achievement

Variables	N	R	R-square	% Prediction
Academic Resilience	65	.104	.011	1.1
Mathematics Achievement	65			

Table 2 presents the prediction of academic resilience to the variance observed in male students' achievement in mathematics. The result shows that academic resilience predicted only 1.1% to the variance observed in male students' achievement in mathematics.

Furthermore, the summary of the data analysis results to answer RQ3 is presented in Table 3.

Table 3. Prediction of academic resilience to female students' achievement

Variables	N	R	R-square	% Prediction
Academic Resilience	107	.013	.0000169	0.0169
Mathematics Achievement	107			

Table 3 presents the prediction of academic resilience to the variance observed in female students' achievement in mathematics. The result shows that academic resilience predicted only 0.02% to the variance observed in female students' achievement in mathematics.

Table 4. Summary of regression analysis for H01

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	6.773	1	6.773	.069	.793
Residual	16159.634	165	97.937		
Total	16166.407	166			

From the regression analysis in Table 4, the statement of hypothesis (H01) is accepted; implying that academic resilience does not significantly predict students'

achievement in mathematics. This is because, the p -value (Sig.= 0.793) is greater than 0.05 alpha level.

Table 5. Summary of regression analysis for H02

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	62.367	1	62.367	.688	.410
Residual	5713.879	63	90.696		
Total	5776.246	64			

From the regression analysis in Table 5, the statement of hypothesis (H02) is accepted; implying that academic resilience does not significantly predict male students' achievement in mathematics. This is because, the p -value (Sig.= 0.410) is greater than 0.05 alpha level.

Table 6. Summary of regression analysis for H03

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.679	1	1.679	.017	.897
Residual	10026.527	100	100.265		
Total	10028.206	101			

From the regression analysis in Table 6, the statement of hypothesis (H03) is accepted; implying that academic resilience does not significantly predict female students' achievement in mathematics. This is because, the p -value (Sig.= 0.897) is greater than 0.05 alpha level.

Findings of the study

From the findings of the study, it revealed that academic resilience related positively with students' achievement in mathematics irrespective of gender. This means that increase in academic resilience would increase students' achievement in mathematics. Academic resilience predicted only 0.04% to the variance observed in students' achievement in mathematics. Academic resilience predicted only 1.1% to the variance observed in male students' achievement in mathematics. Academic resilience predicted only 0.01% to the variance observed in female students' achievement in mathematics. Academic resilience does not significantly predict students' achievement in mathematics. The results that academic resilience positively and insignificantly predicts mathematics achievement are consistent with previous findings that show that resilience factors such as persistence and confidence are essential for continuous improvement in mathematics. For example,

Chatman (2011) examined institutional factors that affect mathematical achievement of female high school students.

The results indicated that once the resilience factors are put in place, students show continuous improvement in mathematics. Rojas (2015) reported similar findings in his study on the impact of resilience on the academic achievement of at-risk rural and urban high school students. The results of Ricketts (2015) revealed that the at-risk students were highly resilient which positively related to their GPAs. Academic resilience does not significantly predict male students' achievement in mathematics. Academic resilience does not significantly predict female students' achievement in mathematics. These results similar to that of He (2014) who reported that the resilient students are found to be much more motivated and satisfied with their mathematics classes as compared to their non-resilient counterparts. The positive relationships corroborated the findings of Fallon (2010), Ricketts (2015), and Rojas (2015) that those variables have influence on students' mathematics achievements. The results of this study revealed that academic resilience predicted only 1.1% to the variance observed in male students' achievement in mathematics. In confirmation with the hypothesis using regression analysis to analyze the significance, it showed that academic resilience does not significantly predicts male student's achievement in mathematics. The hypothesis in table 6 show that the null hypothesis is accepted this implies that the academic resilience does not significantly predicts female students' achievement in mathematics. Abolmaali and Mahmudi (2013) carried out study among female high school students, which revealed that resilience and the level of perceived challenges significantly predicted students' academic achievement.

CONCLUSION

Taking into consideration of the findings obtained by testing the hypothesis, the researcher hereby concludes that the study level that academic resilience does not predict students' achievement, hence there is little no effect on students' achievement and academic resilience. Academic resilience related negatively with students' achievement in mathematics irrespective of gender. It does not significantly predict student's achievement in mathematics, it also does not significantly predict male student's achievement in mathematics. It can also be seen that academic resilience does not significantly predict female student's achievement in mathematics.

Considering the above findings, the following recommendations are made: (1) Parents and other educational stakeholders work together to enhance the students' academic resilience since the findings indicated that it was a positive predictor of mathematics achievement, (2) Teachers should be made more aware of use of different technique to arouse the interest of learners and bring out resilience in them, (3) Mathematics teachers should be exposed to regular training workshop, conference, seminars and symposia to constantly update their knowledge of these psychological variables that could influence student's achievement, (4) Government and curriculum planners should be able to design curriculum content to look as a rewarding package once each step is completed and hence look more interactive to bring out resilience and drive to study to the students, (5) Preparing and encouraging students to be resilient helps them in life as spirit of resilience is inculcated into them at a young age which is important as a young growing adult.

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