TEST TAKING SKILLS AND MATHEMATICAL COMPETENCIES AS PREDICTORS OF SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN MATHEMATICS

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Abstract
The study investigated test taking skills and mathematical competencies as predictors of students' academic achievement in mathematics. A correlational research design was adopted for the study. Three research questions and three hypotheses guided the study. The population of the study comprised 2691 SS II students from 59 public schools in Nsukka Education Zone, Enugu State, Nigeria. The study used a sample size of 350 students drawn using simple random sampling. For data collection, the researchers adapted Mathematics Test Taking Skills Scale (MTTSS), and developed the Mathematics Competency Scale (MCS) and Mathematics Achievement Test (MAT) for the study. The instruments for the study were face validated by three specialists. While MAT was developed using a test blueprint, MTTSS and MCS were further exposed to factor analysis for construct validation. Using Cronbach alpha approach, the reliability estimates of MTTSS and MCS were established to be 0.82 and 0.90, respectively, while the reliability estimate of MAT was established to be 0.86 using the KR-20 formula. Regression analysis was used to answer the research questions, while ANOVA was used to test the hypotheses at the 0.05 level of significance. The result revealed that the proportion of variation in students' achievement in mathematics that may be attributable to their test taking skills and mathematical competencies is jointly and independently significant ($p<0.05$). Based on this result, it was recommended that relevant education stakeholders should ensure that workshops and seminars are organized for students in order to improve their test taking skills and mathematics competencies.

Key word: Mathematics, Academic Achievement, Test Taking Skills, Mathematical Competencies

Introduction

Mathematics education plays a crucial role in shaping the intellectual and practical development of individuals. This is because mathematics education enables individuals to develop problem solving skills, logical reasoning skills, promote analytical and quantitative skills, as well as enhances their critical thinking (Malangtupthong, et al., 2022). These skills are important in enhancing effective communication, supporting technological literacy, fostering creativity and innovation (Osedumma, et al.,2022). Individuals acquire these skills in mathematics especially at the secondary school level of education. This provides a firm foundation for the higher education and career of students, and equips them to be future professionals in diverse fields like engineering, software

development and economics (Gocheva-Ilieva, et al.,2021).

Therefore, mathematical principles and concepts have become part of almost every area of work in science and technology. This emphasizes the role of mathematics as the foundation for nation-building, daily living, and an agent for the development of critical and disciplined mindsets in individuals as well as support the understanding of other quantitative and logic embedded disciplines (Roohi, 2014, Uwaezuoke & Ideozu, 2014). Due to the enormous importance of mathematics, it occupies a central place in the educational curriculum. Mathematics is made compulsory at the primary and secondary levels of education and each candidate requires at least a 'credit pass' in external examinations for admission into tertiary institutions (NPE, 2013). Also, Abe and Gbenro (2014) opined that the development and survival of any nation depends on the improvement of the teaching and learning of mathematics. Despite the importance of mathematics, the academic achievement of students in mathematics has been unsatisfactory especially in external examinations (Owan, 2020). As Okeke, et al. (2022) defined, academic achievement refers to the attainment of academic goal by a learner. When this academic achievement is poor, it could mean that educational objectives are not been met and could affect the educational system of a country. This has been of great concern to educational stakeholders, parents and students.

In an increasingly technology and information-based society, student's mathematical development and proficiency has become an important factor. Therefore, the concern about student's mathematics achievement is abundant and growing. This concern has led to various researches on the factors that influence the academic achievement of students in mathematics. Okolo (2015) and Okeke, et al. (2015) reported that anxiety affects students' academic achievement. Also, Odogwu and Benedicta (2015) reported that students' attitude affects their performance in mathematics. Other factors like parental attitude (Kiwanuka, et al., 2015), teacher's attitude (Kele, 2018), teaching methods (Sardauna, 2018) amongst others have been reported to have an influence on students' achievement. Despite a number of investigations on the factors that affect students' academic achievement in mathematics and efforts targeted at alleviating the scourge, reports have shown that students' achievement have continued to be unsatisfactory. Therefore, there is need for further investigation and interventions which considers students' test taking skills (Dixon & Erinosho, 2020) and mathematical competencies (Nguyen, et al., 2016; Gocheva-Ilieva, et al., 2021), especially with respect to reports that claim they may have an influence on secondary school students' academic achievement in mathematics.

Academic achievement may be enhanced when students acquire the appropriate competencies and utilize them in studying and learning of mathematics. Alpers (2013) formulated eight key mathematical competencies namely; thinking mathematically, reasoning mathematically, posing and solving mathematical problems, modeling mathematically, representing mathematical entities, handling mathematical symbols and formalism, communicating in, with, and about mathematics, making use of aids and tools. Based on these competencies, specific teaching and learning methods for mathematics have to be designed in order to improve students' achievement in mathematics. Despite the need for students to be competent in Mathematic, reports with respect to the relationship

between mathematics competencies and achievement in Mathematics have not been in agreement. While Omeodu (2019) reported that students' academic competencies have a positive influence on their academic achievement. On the contrary, Abin, et. al., (2020) posited that competence may not be sufficient to explain achievement in mathematics. Due to the differing reports by researchers, further investigation on mathematical competencies is necessary. Nevertheless, Nuraida, et al. (2019) asserted that irrespective of the role students' competencies may play in relation to students' academic achievement, students who are competent in the knowledge of mathematics may still have unsatisfactory mathematics achievement due to a myriad of factors which may include poor or lack of test taking skills.

The ability to utilize appropriate strategies to demonstrate competence and perform at optimal level on a test is referred to as test-taking skills. Such skills enable students to recognize what to do before-test, during test and after-test to achieve success (Dodeen, et al., 2014). Students must be proficient in test-taking for the test to adequately serve as a measure of their mastery of a learning content. Due to the advantages of test taking skills, previous researches have been carried out in order to determine the relationship between students' test taking skills and their academic achievement. However, these reports have not been in agreement. Okolo and Kolawole (2021) reported that enhancing students' test taking skills improved their achievement. On the contrary, Lewandowski, et al., (2016) reported that a deficit in test taking skill may have a negative effect on students 'academic achievement, especially in mathematics. Therefore, further investigation is required since there is yet to be a conclusion about students' test taking skills and mathematics achievement.

Research Questions

1. What proportion of students` achievement in mathematics is predicted by test taking skills?
2. What proportion of students` achievement in mathematics is predicted by mathematics competencies?
3. What proportion of students` achievement in mathematics can be jointly predicted by test taking skills and mathematics competencies?

Hypotheses

HO_1: Students` achievement in mathematics is not significantly predicted by test taking skills.

HO_2: Students` achievement in mathematics is not significantly predicted by mathematics competencies.

HO_3: Students` achievement in mathematics not significantly predicted by the joint relationship of test taking skills and mathematics competencies.

Research Design

Correlational research design was adopted in the study. This research design was adopted because the study established the relationship between test taking skills, mathematical competencies and academic achievement of secondary school students in mathematics. The population of this study comprised 2691 senior secondary school II (SSS II) mathematics students in 59 public secondary schools in Nsukka Education Zone of Enugu

State, Nigeria. The sample size consisted of 350 participants drawn using simple random sampling (balloting with replacement). Three instruments were used in the study, they are: Mathematics Test Taking Skills Scale (MTTSS) adapted from Biçak (2013) and Doden (2008), Mathematics Competency Scale (MCS) and Mathematics Achievement Test (MAT) developed by the researchers. The three instruments were face validated by three experts. MAT was developed using a table of specification. The MTTSS and MCS instruments were construct validated using factor analysis with principal axis factoring based on varimax rotation. Items that were factorially pure with factor loading value of 0.32 as recommended by Tabachnick and Fidell (2001) were selected and used for the study. The MAT instrument was subjected to content validation using table of specifications. A total of 20 items each were arrived at for MTTSS, MCS and MAT instruments. The instruments were trial tested on 40 students and reliability indices of 0.82 and 0.90 were obtained for MTTSS and MCS instruments respectively using Cronbach alpha method of internal consistency, while an index of 0.86 was obtained for MAT using KR-20 formula. Face-to-face method of data collection was used to gather data for the study. Simple linear regression was used to answer research questions 1 and 2, while multiple regression was used for research question 3. The hypotheses were tested using ANOVA at a significance level of 0.05.

Results

Table 1: Test Taking Skills and Mathematical Competencies Predicting Achievement in Mathematics

Model	N	R	R^2
Test Taking Skills	350	0.662	0.438
Mathematical Competencies	350	0.594	0.353
Test Taking Skills × Mathematical Competencies	350	0.723	0.523

a. Predictors (Constant), Test Taking Skills, Mathematical Competencies, S= Significant

The regression analysis for the proportion of students' achievement in mathematics that is predicted by test taking skills is shown in Table 1. The obtained correlation coefficient (R) is 0.66. This suggests that test taking skills and academic achievement in mathematics have a moderate relationship. Test taking skills accounted for 44% of the variation in students' achievement in mathematics. The result in Table 1 indicates the regression analysis for the prediction of mathematics competencies on students' achievement in mathematics. The result shows a correlation coefficient (R) of 0.59 which implies a moderate relationship between the two variables. Mathematics competencies accounted for 35% of the variation in students' achievement in mathematics. Table 1 further shows the regression analysis for the proportion of students` achievement in mathematics that is jointly predicted by test taking skills and mathematics competencies. The result revealed a correlation coefficient of 0.72. This shows a strong relationship between the variables. Test taking skills and mathematics competencies jointly accounted for 52% of the variation in students' achievement in mathematics.

Hypothesis One: Students` achievement in mathematics is not significantly predicted by

test taking skills.

Table 2: ANOVA result of test taking skills predicting achievement in mathematics

Model		Sum of Squares	df	Mean Squares	F	Sig.
1	Regression	2692.936	1	2692.936	27.322	.000[b]
	Residual	32387.694	348	93.323		
	Total	35080.630	349			

Note: p<0.05

The analysis of data in Table 2 shows the significant prediction of test taking skills on academic achievement in mathematics. Table 2 shows that F= 27.322, p =0.000. Since 0.000 is less than the level of significance of 0.05, HO_1 is rejected. Hence, test taking skills significantly predicts students' achievement in mathematics.

Hypothesis Two: Students` achievement in mathematics is not significantly predicted by mathematics competencies.

Table 3: ANOVA result of mathematical competencies predicting achievement in mathematics

Model		**Sum of Squares**	**df**	**Mean Squares**	**F**
1	Regression	2759.221	1	2115.879	22.412
	Residual	32321.409	348	96.324	
	Total	35080.630	349		

Note: p<0.05

The analysis of data in Table 3 shows the significant prediction of mathematical competencies on students' academic achievement in mathematics. Table 3 shows that F= 22.412, p =0.000. Since 0.000 is less than the level of significance of 0.05, HO_2 is rejected. Hence, mathematical competencies significantly predict students' achievement in mathematics.

Hypothesis Three: Students` achievement in mathematics not significantly predicted by the joint relationship of test taking skills and mathematics competencies.

4: ANOVA result of test taking skills and mathematical competencies predicting achievement in mathematics

Model		**Sum of Squares**	**df**	**Mean Squares**	**F**	**Sig.**
1	Regression	2358.668	2	2552.417	26.433	.000[b]
	Residual	32721.962	347	96.693		
	Total	35080.630	349			

Note: p<0.05

The analysis of data in Table 4 shows the joint significant prediction of test taking skills and mathematical competencies on students' academic achievement in mathematics.

Table 4 shows that F= 26.433, p =0.000. Since 0.000 is less than the level of significance of 0.05, HO_3 is rejected. Hence, test taking skills and mathematical competencies jointly and significantly predicts students' achievement in mathematics.

Discussion

The result of the study shows that test taking skills predicts 44% of the achievement of students in mathematics. This result implies that the level of students' test taking skills have a significant influence on their academic achievement. Further analysis indicates that test taking skills significantly predicts students` academic achievement in mathematics. This result strengthens the fact that students' test taking skills enable them to prepare well and perform well during tests, which could have predicted their academic achievement. This result is similar with that of Dixon and Erinosho (2020); and Okolo and Kolawole (2021) who reported that test taking skills have a significant influence on students' achievement.

The result of the analysis revealed that mathematics competencies predict35% of students` achievement in mathematics. Further analysis shows that mathematics competencies significantly predict the achievement of students` in mathematics. This shows that students' competencies in mathematics have an influence on their academic achievement in mathematics. This result is possible because students who have low levels of mathematics competencies may not be able to perform well in mathematics tests which thereby predicted their academic achievement in mathematics. This result is similar with that of Nguyen, et. al., (2016); and Gocheva-Ilieva, et al., (2021) who reported that test taking skills has a significant influence on students' achievement.

The result further showed that the proportion of students` achievement in mathematics that can be jointly predicted by test taking skills and mathematics competencies is 52%. Further analysis revealed a significant joint prediction. This result means that the level of test taking skills and mathematics competencies experienced by students` influences their academic achievement in mathematics.

Conclusion

In line with the result obtained from this investigation, it is concluded that test taking skills and mathematical competencies independently and jointly predict students' academic achievement in mathematics. Thus, when students have low levels of test taking skills and mathematics competencies, their academic achievement can be affected.

Recommendations

The recommendations highlighted below are based on the findings of this study.

1. Relevant education stakeholders should ensure that workshops and seminars are organized for students in order to improve their test taking skills and mathematics competencies.
2. Teachers should give extra attention to students who have low levels of competency in solving mathematics questions.
3. Parents should encourage students to improve their test taking skills and competency in mathematics to enhance their academic achievement.

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