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PREDICTIVE POTENCY OF TEACHERS' ASSESSMENT PRACTICES ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN MATHEMATICS IN NSUKKA EDUCATION ZONE, ENUGU STATE, NIGERIA

POTENCIAL PREDITIVO DAS PRÁTICAS DE AVALIAÇÃO DOS PROFESSORES SOBRE O DESEMPENHO DOS ALUNOS DO ENSINO MÉDIO EM MATEMÁTICA NA ZONA EDUCACIONAL DE NSUKKA, ESTADO DE ENUGU, NIGÉRIA

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Abstract

This study investigated the predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics in the Nsukka Education Zone, Enugu State, Nigeria. A correlational survey research design was adopted. A sample size of 342 Senor Secondary Two (SS II) Mathematics students in Nsukka education zone was used for the study. Teachers' Assessment Practice Questionnaire (TAPQ) and Mathematics Achievement Test (MAT) were used for data collection. Reliability coefficients of 0.93 and 0.91 were obtained for TAPQ and MAT respectively. Linear regression analysis was used to answer research questions 1-5 while research questions 6-7 was answered using multiple regression analysis. Regression t-test was used to test hypotheses 1-5, while hypotheses 6 was tested using regression ANOVA. All hypotheses were tested at 0.05 level of significance. The findings revealed that formative assessment predicted 38.4%, diagnostic assessment predicted 37.1%, peer-assessment predicted 32%, and self-assessment predicted 26.4% of the variation in students' academic achievement. Summative assessment accounted for 5.2% of the variance. Importantly, the combined effect of all assessment practices jointly predicted 65.7% of students' achievement, indicating a significant and substantial influence of teachers' assessment practices on Mathematics achievement. The study concludes that assessment practices, particularly when used in combination, play a critical role in enhancing students' understanding, engagement, and learning outcomes in Mathematics. The study recommends that teachers adopt an integrated approach to assessment by combining formative, summative, diagnostic, self-, and peer-assessment strategies, and that educational authority provide professional development and policy support to strengthen the effective implementation of these practices. The findings highlight the importance of diverse and continuous assessment strategies as tools for improving academic achievement in secondary school Mathematics.

Keywords: Teachers' Assessment Practices. Formative Assessment. Summative Assessment. Diagnostic Assessment. Self-assessment. Peer-Assessment. Mathematics Achievement.

Resumo

Este estudo investigou o poder preditivo das práticas de avaliação dos professores sobre o desempenho acadêmico dos alunos do ensino médio em Matemática na Zona Educacional de Nsukka, no estado de Enugu, na Nigéria. Foi adotado um desenho de pesquisa correlacional. A amostra do estudo foi composta por 342 alunos do segundo ano do ensino médio (SS II) do curso de Matemática na zona educacional de Nsukka. O Questionário de Práticas de Avaliação dos Professores (TAPQ) e o Teste de Desempenho em Matemática (MAT) foram utilizados para a coleta de dados. Coeficientes de confiabilidade de 0,93 e 0,91 foram obtidos para o TAPQ e o MAT, respectivamente. A análise de regressão linear foi utilizada para responder às questões de pesquisa 1 a 5, enquanto as questões de pesquisa 6 e 7 foram respondidas utilizando análise de regressão múltipla. O teste t de regressão foi utilizado para testar as hipóteses 1 a 5, enquanto a hipótese 6 foi testada por meio de ANOVA de regressão. Todas as hipóteses foram testadas com um nível de significância de 0,05. Os resultados revelaram que a avaliação formativa predizia 38,4%, a avaliação diagnóstica predizia 37,1%, a avaliação entre pares predizia 32% e a autoavaliação predizia 26,4% da variação no desempenho acadêmico dos alunos. A avaliação sumativa foi responsável por 5,2% da variação. É importante ressaltar que o efeito combinado de todas as práticas de avaliação, em conjunto, previu 65,7% do desempenho dos alunos, indicando uma influência significativa e substancial das práticas de avaliação dos professores no desempenho em Matemática. O estudo conclui que as práticas de avaliação, particularmente quando utilizadas em combinação, desempenham um papel crítico no aprimoramento da compreensão, do envolvimento e dos resultados de aprendizagem dos alunos em Matemática. O estudo recomenda que os professores adotem uma abordagem integrada à avaliação, combinando estratégias de avaliação formativa, sumativa, diagnóstica, autoavaliação e avaliação por pares, e que as autoridades educacionais ofereçam desenvolvimento profissional e apoio político para fortalecer a implementação eficaz dessas práticas. Os resultados destacam a importância de estratégias de avaliação diversificadas e contínuas como ferramentas para melhorar o desempenho acadêmico em matemática no ensino médio.

Palavras-chave: *Práticas de Avaliação dos Professores. Avaliação Formativa. Avaliação Sumativa. Avaliação Diagnóstica. Autoavaliação. Avaliação entre Pares. Desempenho em Matemática.*

1 INTRODUCTION

Mathematics is widely regarded as one of the most important subjects in the school curriculum because of its relevance to scientific development, technological advancement, and everyday life activities. The subject plays a fundamental role in developing logical reasoning, analytical thinking, and problem-solving skills required for effective participation in modern society. Mathematics also serves as a foundational discipline for many fields such as engineering, economics, medicine, and computer science. Consequently, the academic achievement of students in mathematics is often considered a critical indicator of educational quality and national development (Aremu & Sokan, 2003; Oribhabor, 2020). In Nigeria, mathematics is a compulsory subject at both the primary and secondary school levels because of its strategic importance in building human capital and promoting socio-economic growth. In view of this importance, the level of students' achievement in mathematics has continued to attract the attention of educators, researchers, and policy makers.

Academic achievement in mathematics refers to the extent to which students have attained the instructional objectives of mathematics learning as measured through tests, assignments, classroom exercises, and external examinations (Nitko & Brookhart, 2014; Oribhabor, 2020). It reflects students' mastery of mathematical concepts, principles, and procedures, as well as their ability to apply these concepts to solve real-life problems (Akinsola & Olowojaiye, 2008; Ugwuanyi, 2019). However, despite the importance of mathematics in education and national development, students' achievement in the subject has remained a major concern in many countries, including Nigeria (Aremu & Sokan, 2003; Ajaja, 2010). Several reports from public examinations such as the West African Senior School Certificate Examination (WASSCE) have indicated persistent challenges in students' achievement in mathematics at the secondary school level (WAEC, 2022). These challenges have raised concerns among educators, policymakers, and researchers

regarding the factors responsible for students' poor achievement in mathematics (Musa & Othman, 2012; Govender, 2019).

Research evidence suggests that students' academic achievement in mathematics is influenced by several factors, including instructional strategies, students' attitudes toward mathematics, learning environment, availability of instructional materials, and teachers' classroom practices (Akinsola & Olowojaiye, 2008; Musa & Othman, 2012; Govender, 2019; Ugwanyi, 2019). Among these factors, teachers' classroom practices, particularly assessment practices, have attracted increasing attention in educational research because they play a crucial role in shaping students' learning experiences and academic outcomes (Black & Wiliam, 1998; Nitko & Brookhart, 2014). Assessment practices provide teachers with information about students' learning progress and enable them to make informed decisions about instruction (Bennett, 2011; Brookhart, 2017). Educational assessment refers to the systematic process of collecting, analyzing, and interpreting information about students' learning in order to improve teaching and learning processes (Nitko & Brookhart, 2014). Assessment is an essential component of the teaching–learning process because it enables teachers to evaluate students' understanding of subject content, identify learning difficulties, and provide feedback that supports academic improvement. According to Black and Wiliam (1998), effective assessment practices can significantly enhance students' learning outcomes because they provide opportunities for feedback, reflection, and instructional adjustment.

In mathematics education, assessment plays a particularly important role because mathematical knowledge is cumulative and hierarchical in nature. Learning advanced mathematical concepts often depends on students' mastery of prerequisite knowledge and skills. If students develop misconceptions or gaps in their understanding of foundational concepts, these difficulties may hinder their ability to learn more complex topics. Effective assessment practices therefore help teachers identify students' strengths and weaknesses in mathematics and provide appropriate interventions that improve learning outcomes (Heritage, 2010). Teachers employ various assessment practices in the classroom to monitor and evaluate students' learning. These practices include formative assessment, summative assessment, diagnostic assessment, self-assessment, and peer assessment (Black & Wiliam, 1998; Nitko & Brookhart, 2014; Ross, 2006; Topping, 2009; Andrade & Valtcheva, 2009; Double, McGrane, & Hopfenbeck, 2020). Each of

these assessment approaches serves a unique purpose in the teaching–learning process and contributes to students' academic achievement in different ways.

Formative assessment refers to ongoing evaluation conducted during the instructional process to monitor students' learning progress and provide feedback that supports improvement. Examples of formative assessment include quizzes, classroom questioning, homework assignments, and group discussions. The primary objective of formative assessment is to identify students' learning difficulties while instruction is still in progress so that teachers can adjust their teaching strategies accordingly. Studies have shown that formative assessment can significantly improve students' academic achievement in mathematics because it provides timely feedback that helps students understand their mistakes and improve their achievement (Black & Wiliam, 1998; Bennett, 2011). Rakoczy *et al*. (2019) also reported that formative feedback enhances students' motivation and self-efficacy in mathematics learning. While formative assessment focuses on supporting learning during instruction, summative assessment complements this by evaluating students' overall achievement at the end of a learning period.

Summative assessment, on the other hand, is conducted at the end of an instructional period to evaluate students' overall academic achievement. Examples include end-of-term examinations, standardized tests, and final assessments. Summative assessment provides evidence of whether students have achieved the intended learning objectives of a course or instructional unit. In mathematics education, summative assessment often involves written examinations that measure students' ability to solve quantitative problems and apply mathematical procedures. Although summative assessment primarily focuses on evaluating learning outcomes, it also provides important information that can guide curriculum improvement and instructional planning (Brookhart, 2017).

Diagnostic assessment is another important form of classroom assessment that helps teachers identify students' prior knowledge and learning difficulties before instruction begins. Diagnostic assessment typically involves pre-tests, concept inventories, and skill assessments designed to determine students' readiness for new learning tasks. In mathematics classrooms, diagnostic assessment enables teachers to plan instruction that addresses specific learning gaps and ensures that students are adequately

prepared for upcoming lessons (Nitko & Brookhart, 2014; Heritage, 2010). In mathematics classrooms, diagnostic assessment is particularly valuable because understanding advanced concepts often depends on mastery of foundational knowledge. By identifying gaps in students' understanding early, teachers can provide targeted interventions that improve overall academic achievement (Guskey, 2003).

In addition to teacher-led assessment practices, modern educational approaches emphasize student-centered assessment strategies such as self-assessment and peer assessment (Boud, 2000; Panadero, 2017). Self-assessment involves students evaluating their own learning progress by reflecting on their strengths, weaknesses, and areas that require improvement (Ross, 2006; Andrade & Valtcheva, 2009). This process encourages students to take responsibility for their learning and develop metacognitive skills that enable them to regulate their learning processes (Panadero, 2017). Research indicates that self-assessment can improve students' academic achievement by promoting deeper understanding, critical thinking, and independent learning (Ross, 2006; Andrade & Valtcheva, 2009; Falchikov & Boud, 2007).

Peer-assessment, on the other hand, engages students in evaluating the work of their classmates and providing constructive feedback. Through peer assessment, students engage in collaborative learning and develop critical thinking skills by analyzing and evaluating different approaches to problem solving. This collaborative approach fosters critical thinking, reflection, and deeper understanding of mathematical concepts, as students must analyze, justify, and discuss problem-solving strategies (Topping, 2009; Double, McGrane, & Hopfenbeck, 2020). Studies have shown that peer assessment can improve students' academic achievement in mathematics because it promotes interaction, reflection, and collaborative problem solving (Topping, 2009; Double *et al*., 2020).

In recent years, educational researchers have increasingly focused on the predictive role of teachers' assessment practices in determining students' academic achievement. Predictive studies examine the extent to which certain variables can forecast variations in academic outcomes. In the mathematics education, teachers' assessment practices can serve as predictor variables because they influence students' engagement with learning tasks, feedback processes, and conceptual understanding. Evidence from previous studies suggests that when teachers effectively implement diverse assessment strategies such as formative feedback, diagnostic evaluation, and peer learning, students

are more likely to develop positive attitudes toward mathematics and achieve higher academic achievement (Andersson & Palm, 2017).

In Nigeria, concerns about students' academic achievement in mathematics have prompted researchers to examine various factors that influence learning outcomes. Studies conducted in Nigerian secondary schools have identified several factors associated with students' achievement in mathematics, including teaching methods, classroom environment, and assessment practices (Akinsola & Olowojaiye, 2008; Ugwuanyi, 2019). However, many of these studies have focused primarily on instructional strategies while giving limited attention to the predictive potency of teachers' assessment practices. Given the persistent concerns about students' achievement in mathematics and the growing recognition of the importance of assessment in the teaching–learning process, it becomes necessary to examine how teachers' assessment practices predict students' academic achievement. Therefore, this study seeks to investigate the predictive potency of teachers' assessment practices on senior secondary school students' academic achievement in mathematics in the Nsukka Education Zone of Enugu State, Nigeria.

2 METHODS

The study adopted a correlational survey research design. According to Nworgu (2025), a correlational research design is a quantitative non-experimental method used to establish the relationship between two or more variables as they naturally occur without manipulation. Correlational designs reveals both the strength and direction of associations and are particularly useful where the goal is to determine whether one or more variables can predict an outcome rather than explain cause-and-effect relationships. In predictive correlational studies, the focus is on using one or more predictor variables (such as teachers' assessment practices) to forecast variation in a criterion variable (such as students' academic achievement) based on observed statistical relationships.

The study was conducted in Nsukka education zone, Enugu State. The population of the study comprised 4,345 Senior Secondary Two Mathematics students in the Nsukka Education Zone of Enugu State, Nigeria. A sample size of 342 SS II Mathematics students drawn through multistage sampling approach was used for the study. Data was collected

using Teachers' Assessment Practice Questionnaire (TAPQ) and Mathematics Achievement Test (MAT). The instruments were designed by the researchers. The instruments underwent face validation, which was ensured through the use of two experts in Mathematics Education and one expert in Measurement and Evaluation. Meanwhile, the content validity of MAT was established with the use of table of specifications or test blueprint. Reliability coefficient of .93 was obtained for TAPQ using Cronbach Alpha. Cronbach Alpha was used because the instrument (TAPQ) was polytomously scored. However, reliability coefficient of .91 was obtained for MAT with the use of KR-20. KR-20 was used because the instrument (MAT) was dichotomously scored.

To conduct the study, permission to conduct the study was obtained from school authorities, and informed consent was secured from participants. The two instruments were administered to the respondents in the sample schools by the researchers and were collected immediately upon completion. Data analysis was conducted using regression analysis to determine the predictive power of individual and combined assessment practices on students' academic achievement. Specifically, linear regression analysis was used to answer research questions 1-5 while research questions 6-7 was answered using multiple regression analysis. Regression t-test was used to test hypotheses 1-5, while hypotheses 6 was tested using regression ANOVA. All hypotheses were tested at 0.05 level of significance.

3 RESULTS

3.1 Research question one

What is the predictive potency of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics?

Table 1

Linear regression analysis of the predictive power of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.620[a]	.384	.382	4.02816

(R^2) = Coefficient of Determination

The result in Table 1 shows that the correlation coefficient between teachers' formative assessment practices and secondary school students' academic achievement in Mathematics was 0.620. This means that, there exist a high positive relationship between teachers' formative assessment practices and secondary school students' academic achievement in Mathematics. Table 1 also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.620 was 0.384. This coefficient of determination (R^2) indicates that 38.4% of variation in students' academic achievement in Mathematics is attributed to teachers' formative assessment practices. This is an indication that 61.6% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' formative assessment practices.

3.2 Hypothesis one

There is no significant predictive potency of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics.

Table 2

Regression t-test analysis of significant predictive power of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	16.977	1.454		11.672	.000
	FormativeAssessement	.533	.037	.620	14.565	.000

The result in Table 2 shows that t-value of 14.565 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis of no significant predictive power of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant predictive power of teachers'

formative assessment practices on secondary school students' academic achievement in Mathematics.

3.3 Research question two

What is the predictive potency of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics?

Table 3

Linear regression analysis of the predictive power of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.229[a]	.052	.050	4.99711

(R^2) = Coefficient of Determination

The result in Table 3 shows that the correlation coefficient between teachers' summative assessment practices and secondary school students' academic achievement in Mathematics was 0.229. This means that, there exist a low positive relationship between teachers' summative assessment practices and secondary school students' academic achievement in Mathematics. The Table also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.229 was 0.052. This coefficient of determination (R^2) indicates that 5.2% of variation in students' academic achievement in Mathematics is attributed to teachers' summative assessment practices. This is an indication that 94.8% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' summative assessment practices.

3.4 Hypothesis two

There is no significant predictive potency of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics.

Table 4

Regression t-test analysis of significant predictive power of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	29.980	1.853		16.182	.000
	SummativeAssessement	.208	.048	.229	4.332	.000

The result in Table 4 shows that t-value of 4.332 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis of no significant predictive power of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant predictive power of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics.

3.5 Research question three

What is the predictive potency of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics?

Table 5

Linear regression analysis of the predictive power of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.609[a]	.371	.369	4.07093

(R^2) = Coefficient of Determination

The result in Table 5 shows that the correlation coefficient between teachers' diagnostic assessment practices and secondary school students' academic achievement in Mathematics was 0.609. This means that, there exist a high positive relationship between

teachers' diagnostic assessment practices and secondary school students' academic achievement in Mathematics. The Table also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.609 was 0.371. This coefficient of determination (R^2) indicates that 37.1% of variation in students' academic achievement in Mathematics is attributed to teachers' diagnostic assessment practices. This is an indication that 62.1% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' diagnostic assessment practices.

3.6 Hypothesis three

There is no significant predictive potency of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics.

Table 6

Regression t-test analysis of significant predictive power of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	15.881	1.572		10.104	.000
	DiagnosticAssessment	.564	.040	.609	14.163	.000

The result in Table 6 shows that t-value of 14.163 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis of no significant predictive power of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant predictive power of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics.

3.7 Research question four

What is the predictive potency of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics?

Table 7

Linear regression analysis of the predictive power of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.514[a]	.264	.262	4.40323

(R^2) = Coefficient of Determination

The result in Table 7 shows that the correlation coefficient between teachers' self-assessment practices and secondary school students' academic achievement in Mathematics was 0.514. This means that, there exist a moderate positive relationship between teachers' self-assessment practices and secondary school students' academic achievement in Mathematics. The Table also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.514 was 0.264. This coefficient of determination (R^2) indicates that 26.4% of variation in students' academic achievement in Mathematics is attributed to teachers' self-assessment practices. This is an indication that 73.6% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' self-assessment practices.

3.8 Hypothesis four

There is no significant predictive potency of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics.

Table 8

Regression t-test analysis of significant predictive power of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	12.706	2.295		5.537	.000
	SelfAssessment	.641	.058	.514	11.049	.000

The result in Table 8 shows that t-value of 11.049 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis of no significant predictive power of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant predictive power of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics.

3.9 Research question five

What is the predictive potency of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics?

Table 9

Linear regression analysis of the predictive power of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.566[a]	.320	.318	4.23304

(R^2) = Coefficient of Determination

The result in Table 9 shows that the correlation coefficient between teachers' peer assessment practices and secondary school students' academic achievement in Mathematics was 0.566. This means that, there exist a moderate positive relationship between teachers' peer assessment practices and secondary school students' academic

achievement in Mathematics. The Table also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.566 was 0.320. This coefficient of determination (R^2) indicates that 32% of variation in students' academic achievement in Mathematics is attributed to teachers' peer assessment practices. This is an indication that 68% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' peer assessment practices.

3.10 Hypothesis five

There is no significant predictive potency of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics.

Table 10

Regression t-test analysis of significant predictive power of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	17.296	1.647		10.504	.000
	PeerAssessment	.523	.041	.566	12.648	.000

The result in Table 10 shows that t-value of 12.648 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis of no significant predictive power of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant predictive power of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics.

3.11 Research question six

What is the joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics?

Table 11

Multiple regression analysis of the joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.811[a]	.657	.652	3.02350

(R^2) = Coefficient of Determination

The result in Table 11 shows that the correlation coefficient between teachers' peer assessment practices and secondary school students' academic achievement in Mathematics was 0.811. This means that, there exist a very high positive joint relationship between teachers' assessment practices and secondary school students' academic achievement in Mathematics. The Table also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.811 was 0.657. This coefficient of determination (R^2) indicates that 65.7% of variation in students' academic achievement in Mathematics is jointly attributed to teachers' assessment practices. This is an indication that 34.3% of the variation in students' academic achievement in Mathematics is attributed to other factors other than teachers' assessment practices.

3.12 Hypothesis six

There is no significant joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics.

Table 12

Regression ANOVA of significant joint predictive power of personality traits on students' social adjustment in public secondary schools in Cross River State

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5887.317	5	1177.463	128.804	.000[b]
	Residual	3071.552	336	9.142		
	Total	8958.868	341			

The result in Table 12 shows that F-ratio of 128.804 with associated exact probability value of .000 was obtained. This probability value of 0.00 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis no significant joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics was rejected. The researcher therefore, concludes that there is a significant joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics.

3.13 Research question seven

What is the regression model for predicting the relationship among teachers' assessment practices on secondary school students' academic achievement in Mathematics?

Table 13

Multiple regression analysis showing the regression model for predicting the relationship among teachers' assessment practices on secondary school students' academic achievement in Mathematics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.377	1.892		-2.313	.021
	FormativeAssessement	.237	.035	.276	6.799	.000
	SummativeAssement	.038	.031	.042	1.235	.218
	DiagnosticAssessment	.382	.033	.412	11.704	.000
	SelfAssessment	.163	.048	.131	3.394	.001
	PeerAssessment	.259	.036	.280	7.164	.000

The result in Table 13 shows that the linear regression "β" associated with the predictor variables gives varying difference in the dependent variable (academic achievement) "Y" when comparing groups that differ by one unit. In other word, "β" is expected to change the outcome of the dependent variable "Y". With the information in Table 13, the regression model can be shown as $Y = \beta_1 (X_1) + \beta_2 (X_2) + \beta_3 (X_3) + \beta_4 (X_4) + \beta_5 (X_5) + C$. Where "$\beta_1$" represents coefficient of teachers assessment practices, X_1 represents teachers assessment practices, Y represents academic achievement and C represents the constant value. Therefore, by inputting the corresponding values in Table 13, the model equation becomes: $Y = 0.237X_1 + 0.038X_2 + 0.382X_3 + 0.163X_4 + 0.259X_5 + 4.377$.

4. DISCUSSION OF FINDINGS

4.1 Predictive potency of teachers' formative assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that teachers' formative assessment practices predicted 38.4% of secondary school students' academic achievement in Mathematics. This indicates that formative assessment practices account for a substantial proportion of the variance in students' achievement in Mathematics. In other words, the way teachers continuously assess students during instruction significantly contributes to how well students perform academically in the subject. The finding further revealed that teachers' formative assessment practices have a statistically significant predictive power on students' academic achievement in Mathematics. This suggests that formative assessment is not only associated with students' achievement but also serves as a reliable indicator of future academic achievement. The predictive strength of formative assessment practices observed in this study suggests that when teachers regularly employ formative assessment strategies, they create opportunities for continuous monitoring of students' learning progress. This continuous monitoring enables teachers to modify instructional approaches, provide remediation where necessary, and reinforce difficult mathematical concepts. Such instructional adjustments ensure that students develop a deeper

understanding of mathematical concepts, which translates into improved academic achievement.

The significant predictive power of formative assessment practices can be attributed to the nature and purpose of formative assessment itself. Formative assessment provides continuous feedback to both teachers and students during the teaching and learning process. Through activities such as quizzes, classroom questioning, assignments, and short tests, teachers are able to monitor students' understanding of mathematical concepts and identify areas of difficulty early enough for corrective instruction. When students receive timely feedback, they are better able to recognize their mistakes, adjust their learning strategies, and improve their understanding of mathematical procedures and concepts. This process ultimately leads to improved academic achievement (Black & Wiliam, 2018; Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006). The finding also supports the argument that formative assessment encourages active participation and engagement among learners. When students are aware that their progress is continuously monitored through classroom activities, they tend to participate more actively in lessons, complete assignments diligently, and pay closer attention to feedback provided by the teacher. This increased engagement contributes positively to their overall academic achievement in Mathematics (Black & Wiliam, 2018; Ozan, 2018; Hattie, 2009).

The finding of this study is consistent with the position of Black and Wiliam (2018), who asserted that formative assessment plays a crucial role in enhancing students' learning outcomes because it provides immediate feedback that helps learners improve their achievement before final evaluations are conducted. Similarly, Ozan (2018) reported that formative assessment significantly improves students' engagement and understanding of subject content, thereby contributing to higher academic achievement. The current finding also aligns with the results of Olagunju (2020), who found that consistent formative assessment practices positively influenced students' achievement in Mathematics in Nigerian secondary schools.

4.2 Predictive potency of teachers' summative assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that teachers' summative assessment practices predicted 5.2% of the variation in secondary school students' academic achievement in Mathematics. Although the proportion of variance explained is relatively small compared to some other instructional factors, the result still indicates that summative assessment practices contribute meaningfully to students' academic achievement in Mathematics. The further finding of a statistically significant predictive power suggests that summative assessment practices remain an important component of the overall assessment process that influences students' learning outcomes. The significant predictive power observed in this study may also be attributed to the structured and comprehensive nature of summative assessments. These assessments are typically designed to measure students' cumulative understanding of mathematical concepts taught over a specific period. As such, students who consistently perform well in summative assessments are likely to demonstrate a solid grasp of mathematical procedures and concepts, which translates into improved overall academic achievement. Previous research has similarly indicated that summative assessments provide reliable indicators of students' learning outcomes because they evaluate the extent to which learners have mastered the instructional content (Nitko & Brookhart, 2014).

However, the relatively low percentage of variance explained (5.2%) in this study suggests that while summative assessment practices have a statistically significant predictive influence on students' achievement, they may not be as influential as other forms of assessment that provide ongoing feedback during instruction. This observation supports the view of many educational scholars that summative assessment alone may not be sufficient to significantly enhance learning outcomes because it typically occurs after instruction has been completed, thereby limiting opportunities for immediate instructional adjustment (Black & Wiliam, 2018). Unlike formative assessment, which provides continuous feedback to guide learning, summative assessment primarily focuses on measuring learning outcomes rather than improving the learning process itself.

This finding is consistent with the findings of Anwar *et al*. (2025) and Zahid and AlManiam (2025) whose study found that well-structured evaluation practices improve

students' engagement and encourage better preparation for learning tasks, thereby enhancing academic achievement. Similarly, Gatotoh, Origa, and Kipkurui (2024) reported that assessment practices, particularly those that provide feedback on students' learning progress, contribute positively to students' mathematics achievement. These studies support the present finding that effective summative assessment practices can serve as an important predictor of students' academic achievement, even though other instructional and learner-related factors may also contribute to achievement. The finding of this study also aligns with earlier studies which suggest that summative assessments serves as useful indicators of students' academic achievement, particularly when the assessments are properly aligned with instructional objectives and curriculum standards (Harlen, 2012). When summative assessments are well designed, they provide valuable information about students' mastery of mathematical knowledge and skills. This information can guide teachers in evaluating the effectiveness of their instruction and identifying areas where further instructional improvement may be required.

4.3 Predictive potency of teachers' diagnostic assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that teachers' diagnostic assessment practices predicted 37.1% of the variation in secondary school students' academic achievement in Mathematics. The analysis further indicated that teachers' diagnostic assessment practices had a statistically significant predictive power on students' academic achievement. This implies that diagnostic assessment plays a substantial role in determining students' achievement in Mathematics. Diagnostic assessment enables teachers to identify students' prior knowledge, learning difficulties, and misconceptions before or during instruction, thereby allowing teachers to adjust their teaching strategies to meet students' learning needs. One possible reason is that diagnostic assessment helps teachers identify students' prior knowledge, strengths, and learning difficulties before or during instruction. When teachers understand what students already know and where they experience challenges, they can adjust their teaching methods, learning materials, and classroom activities to address those gaps. This targeted instructional approach makes

learning more effective and helps students develop a clearer understanding of mathematical concepts, which can lead to improved academic achievement.

This finding is in agreement with the findings of Guskey (2018) who reported that diagnostic assessment helps teachers identify students' strengths and weaknesses, enabling them to provide appropriate instructional support that improves learning outcomes. Similarly, Brookhart (2017) found that when teachers regularly use diagnostic assessment to determine students' understanding before instruction, they are better able to design effective lessons that enhance students' academic achievement. In the same vein, Black and Wiliam (2009) emphasized that assessment practices that identify students' learning gaps and provide timely instructional adjustments significantly improve students' achievement. These studies support the present finding that effective use of diagnostic assessment practices can strongly predict and enhance students' academic achievement in Mathematics.

4.4 Predictive potency of teachers' self-assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that self-assessment practices predicted 26.4% of the variation in secondary school students' academic achievement in Mathematics, and further analysis indicated that self-assessment practices had a statistically significant predictive power. This suggests that self-assessment is an important contributor to students' achievement in Mathematics. The finding is not surprising because self-assessment practices encourage students to actively evaluate their own learning, reflect on their understanding of concepts, identify areas of weakness, and take responsibility for their learning progress. By engaging in these reflective practices, students become more aware of their strengths and weaknesses, adopt appropriate strategies to improve their understanding, and monitor their learning progress, which enhances their academic achievement.

This finding aligns with previous research demonstrating the positive impact of self-assessment on student learning outcomes. Brookhart (2017) emphasized that self-assessment promotes metacognition, allowing students to regulate their learning, set personal goals, and make adjustments that improve academic achievement. Similarly,

Andrade and Valtcheva (2009) found that students who regularly engage in self-assessment activities demonstrate higher achievement because they develop better learning strategies and a clearer understanding of evaluation criteria. Additionally, Black and Wiliam (2018) highlighted that self-assessment fosters student autonomy and engagement, which are critical for improved learning outcomes. The significant predictive power observed in this study indicates that students who consistently practice self-assessment are more likely to perform better in Mathematics, as they are actively involved in monitoring and improving their own learning.

4.5 Predictive potency of teachers' peer assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that teachers' peer-assessment practices predicted 32% of the variation in secondary school students' academic achievement in Mathematics, and further analysis indicated that peer-assessment had a statistically significant predictive power. This suggests that peer-assessment is an important instructional strategy that positively influences students' learning outcomes. Peer-assessment involves students evaluating the work or achievement of their classmates, providing constructive feedback, and reflecting on both their peers' and their own learning. This practice promotes collaboration, critical thinking, and deeper engagement with the subject matter, enabling students to identify and correct errors, clarify misunderstandings, and reinforce their knowledge of mathematical concepts.

The significant predictive power of peer-assessment observed in this study underscores its role not only as a formative tool but also as a strategy that can forecast students' academic outcomes. By engaging students in structured peer-evaluation, teachers provide opportunities for collaborative learning, immediate feedback, and self-reflection, all of which enhance student motivation and achievement in Mathematics. This suggests that integrating peer-assessment into routine classroom practice can be an effective approach to improving students' learning achievement.

The finding is in agreement with the findings of Topping (2009) whose study recorded that peer-assessment encourages active learning, accountability, and social interaction, all of which contribute to better student achievement. Similarly, Falchikov

and Goldfinch (2000) reported that students involved in peer-assessment activities tend to develop stronger analytical and evaluative skills, leading to improved understanding and retention of subject content. Furthermore, Panadero and Alonso-Tapia (2013) emphasized that peer-assessment fosters metacognitive development by requiring students to reflect critically on achievement criteria and apply them to evaluate both their own and their peers' work. In the context of Mathematics education, these processes can enhance problem-solving abilities, reinforce conceptual understanding, and improve overall achievement.

4.6 Joint predictive potency of teachers' assessment practices on secondary school students' academic achievement in Mathematics

The findings of the study revealed that 65.7% of the variation in students' academic achievement in Mathematics is jointly predicted by teachers' assessment practices, and further analysis indicated that the joint predictive power is statistically significant. This implies that collectively, formative, summative, diagnostic, self-, and peer-assessment practices have a substantial influence on students' academic achievement. The high percentage of variance explained demonstrates that assessment practices are central to the learning process and can serve as strong predictors of academic outcomes. When teachers employ a combination of these assessment strategies, they provide continuous feedback, identify learning gaps, promote reflective and collaborative learning, and reinforce students' understanding of mathematical concepts, all of which contribute to improved achievement.

The significant joint predictive power recorded in this study suggests that no single assessment practice is sufficient on its own to fully explain students' academic achievement in Mathematics. Instead, the synergistic use of multiple assessment methods ensures that students receive comprehensive feedback, opportunities for reflection, collaborative learning experiences, and reinforcement of knowledge. This integrated approach promotes a more complete understanding of mathematical concepts, encourages active participation, and ultimately leads to higher academic achievement. Therefore, teachers are encouraged to adopt a combination of assessment practices in their

classrooms to maximize students' learning outcomes and achieve meaningful improvements in Mathematics achievement.

The finding is consistent with previous research emphasizing that integrating multiple assessment practices provides comprehensive feedback, identifies learning gaps, and informs instructional adjustments, all of which enhance academic achievement (Black & Wiliam, 2018; Brookhart, 2017; Heritage, 2010). For instance, Andrade and Valtcheva (2009) reported that combining self- and peer-assessment with teacher-led assessments fosters metacognition, self-regulation, and motivation, leading to improved achievement. Similarly, Panadero and Alonso-Tapia (2013) observed that students exposed to multiple assessment strategies develop stronger problem-solving and reflective skills, which translate into higher academic achievement. Guskey (2018) also noted that diverse assessment practices enable teachers to monitor students' learning continuously and implement timely interventions, reinforcing the predictive power of combined assessment practices. Black and Wiliam (2018) also argued that combining different assessment strategies allows teachers to monitor learning effectively, provide timely feedback, and make instructional adjustments that significantly improve student achievement. Similarly, Brookhart (2017) highlighted that integrating multiple assessment practices enables teachers to address diverse learning needs, foster student engagement, and encourage self-regulation. Studies by Andrade and Valtcheva (2009) and Panadero and Alonso-Tapia (2013) also support the idea that combining self-assessment and peer-assessment with traditional formative and summative evaluations enhances students' metacognitive skills, learning motivation, and achievement outcomes.

5 CONCLUSIONS

The study investigated the predictive potency of teachers' assessment practices (formative, summative, diagnostic, self-, and peer-assessment) on secondary school students' academic achievement in Mathematics in the Nsukka Education Zone, Enugu State, Nigeria. The findings revealed that each type of assessment practice significantly predicted students' achievement, with formative and diagnostic assessments showing the highest individual predictive power. Summative, self-, and peer-assessment practices also demonstrated significant contributions, although their predictive strength varied.

Importantly, the combined effect of all assessment practices jointly predicted 65.7% of the variation in students' academic achievement, highlighting the substantial influence of a comprehensive assessment approach on learning outcomes.

The study therefore concludes that assessment practices are not merely evaluative tools but are instrumental in enhancing student learning, providing feedback, identifying learning gaps, and fostering self-regulation, collaboration, and reflective thinking. Teachers' consistent use of diverse assessment strategies supports instructional decision-making and improves students' engagement, understanding, and achievement in Mathematics. Therefore, adopting an integrated and balanced approach to classroom assessment is critical for maximizing students' academic achievement. The study therefore, advocates for professional development programs that equip teachers with the knowledge and skills to effectively implement formative, summative, diagnostic, self-, and peer-assessment strategies, thereby improving the quality of Mathematics instruction and learning outcomes in Nigerian secondary schools.

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

1. Integration of Multiple Assessment Practices: Teachers should adopt a balanced and integrated approach to assessment by combining formative, summative, diagnostic, self-, and peer-assessment strategies in Mathematics instruction. This approach ensures continuous feedback, identification of learning gaps, and reinforcement of students' understanding, which can significantly enhance academic achievement;
2. Professional Development for Teachers: Educational authorities and school administrators should organize regular professional development programs to train teachers in effective assessment strategies. Emphasis should be placed on the practical application of formative, diagnostic, self-, and peer-assessment practices alongside summative assessment to improve instructional quality and student learning outcomes;
3. Encouraging Student Self-Assessment and Peer Assessment: Teachers should encourage students to actively engage in self-assessment and peer-assessment activities. These practices promote metacognition, self-regulation, collaboration, and critical thinking, enabling students to take responsibility for their learning and improve their academic achievement in Mathematics;

4. Use of Diagnostic Assessment to Identify Learning Needs: Teachers should routinely employ diagnostic assessments to identify students' prior knowledge, misconceptions, and areas of difficulty. Early detection of learning gaps allows teachers to implement targeted interventions and remedial strategies, which can improve students' conceptual understanding and achievement;
5. Policy Support for Effective Assessment Practices: Policymakers should develop guidelines and provide resources that support the effective implementation of diverse assessment practices in secondary schools. Encouraging a culture of continuous assessment and feedback can enhance the overall quality of Mathematics education in the Nsukka Education Zone and similar educational system;
6. Further Research: Future studies should explore the predictive power of assessment practices across other subjects, different educational zones, and varied student populations to generalize the findings and provide additional insights into effective assessment strategies.

AUTHORS' CONTRIBUTIONS

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Francis Elochukwu Ikeh, Innocent O. Odo, Emmanel Nzeakor and Emmanuel Sunday Odo developed the research framework, designed the questionnaires, and coordinated data collection from the participating schools.

Francis Elochukwu Ikeh, Owolawi Olaniyi and Emmanuel Nzeakor conducted the statistical analysis, interpreted the results, and drafted the initial discussion section.

Innocent O Odo, Emmanuel Nzeakor, Ifeoma Clementina Metu and Chinyere Nwamaka Emefo reviewed relevant literature, synthesized previous studies, and contributed to the development of the introduction and background sections.

Emmanuel Sunday Odo, Mercy Ifunanya Ani, Blessing C Anapua, Ifeoma Clementina Metu and Benson Chukwunonso Ezeanyi ensured the accuracy of references, edited the manuscript for clarity and coherence, and contributed to the formulation of conclusions and recommendations.

Benson Chukwunonso Ezeanyi, Emmanuel Sunday Odo and Ogbanufe Uchenna Obiageli provided critical oversight of the methodology, reviewed the analytical approach, and ensured compliance with ethical standards.

Francis Elochukwu Ikeh provided overall supervision of the research project, offered guidance on methodological rigor.

All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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