



# Relationship Between Teacher Pedagogical Competence and Students' Achievement in Mathematics at Kenya Certificate of Secondary Education: Implications on Teacher Professional Development

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## ABSTRACT

Students' achievement scores in Mathematics at the Kenya Certificate of Secondary Education (KCSE) has remained unsatisfactory over years. This has been linked to low teacher competence. The study sought to examine the relationship between teacher pedagogical competence and students' achievement in Mathematics at KCSE. The specific objectives of the study were to; (i) determine the pedagogical competence of secondary school teachers in Kenya, (ii) establish the relationship between teacher pedagogical competence and students' achievement in mathematics at KCSE and (iii) examine the effect of teacher pedagogical competence on students' achievement at KCSE. The study adopted a descriptive survey design. The study involved 238 teachers drawn from 35 secondary schools in Kenya. simple random sampling was used to select schools and teachers. Self-administered questionnaire, observation checklists and FDG schedule were used to collect data. Quantitative data was analyzed using descriptive and inferential statistics with the help of Statistical Package for Social Sciences (SPSS 26). Qualitative data from interviews and FDGs was analyzed thematically. Findings were presented in tables and figures. The study revealed that teacher competence in involving learners to design teaching and learning aid, use of participatory teaching and learning strategies, constructing tests and examination and creating portfolio for teaching had statistically significant positive correlation with students' achievement in mathematics. The study also revealed that teacher competence in giving assessment feedback was a strong predictor of students' achievement in mathematics. Based on the findings of the study, it was recommended that teacher professional development programmes should focus on enhancing teacher competence in providing assessment feedback.

**Keywords:** Teacher competence, mathematics, achievement, professional development

## INTRODUCTION

Teachers play a key role in delivery of quality education (Coolahan, 2003; Liston, Borko & Whitcomb, 2008; Shodh Sari (2023). That is why global and regional education policies have placed teachers at the center of education reform (Looney, 2019; Hanushek & Welch, 2006; Lauwerier & Akkari, 2015). Over the past couple of years, governments across Sub Saharan Africa (SSA) have invested colossal amounts to train teachers. Yet students' achievement in mathematics remains low. Meanwhile, research has shown that the quality of education is largely defined by teachers' pedagogical competence (Nbina, 2012; Passo, 2009; Irungu and Mugambi, 2013)

In line with the global practice, teacher pedagogical competence is conceptualized differently. In most cases teacher competence is interpreted not as a trained behavior but as developmentally acquired skills and capabilities. Ennis (2008) maintains that competence is the ability to apply or use knowledge, skills and abilities

to perform a critical task. Others attribute teacher competences to professional qualifications, experience, mastery of subject content and ability to collaborate with colleagues (Darling-Hammond, 2000; Lanier, 2014).

Academic qualification can be described in terms of level of certification earned by a teacher. Research has demonstrated that teacher qualifications have desirable effects on learning outcomes. As a result, teacher qualifications have become the target of educational reforms in many countries (Berry & Thorenson, 2001; Abe, 2014; Santiago, 2002; Dovrat Report, 2005). That notwithstanding, the findings on the relationship between teachers' academic qualifications and students learning outcomes are inconclusive and in some cases contradictory. For instance, while some studies have shown that the teacher's academic qualification had statistically significant effect yet others have indicated insignificant effect. (Koedel, 2007; Ferguson & Ladd, 1996). Richardson found that teacher preparation and certification are so far the strongest correlates of students' achievement in mathematics and reading. This has been confirmed by studies such as Unanma et.al, (2013) and Adeyemi (2013).

Teaching experience expressed in terms of number of years in service has also been found to be among key indicators of teacher quality (Ochieng, et.al. 2017; Clotfelter et al., 2014; Ogbonnaya, 2009). Rice (2010) observed that experience gained by teachers over time enhances their knowledge, skills, effectiveness and productivity in curriculum instruction. Tahir (2003) alluded that inexperienced teachers exhibited poor teaching strategies which resulted into low quality of education. Many other studies have found a positive effect of experience on teacher effectiveness (Dunkin, 1997; Rice, 2004; Bauer, 2005).

The relationship between the teacher's knowledge of subject matter and students' academic achievement is also equally not in doubt (Anupama & Minaketan, 2011; Siraiti, 2016; Omondi, Onyango & Odhiambo, 2021). However, other studies some have reported that teacher knowledge competence did not have a significant relationship with students' academic performance (Arif, et.al. 2015)

Whereas remarkable efforts have been made to invest in pre service teacher training in SSA some studies have shown a disconnect between teacher qualification and classroom practice (Sakambuta, et.al..2019).

In Kenya, the Education Sector Analysis Report (2018) said that some teachers had limited subject knowledge and pedagogical skills. The Early Grade Mathematics Assessment (EGMA), Eastern African Consortium for Monitoring Educational Quality (SACMEQ) and National Assessment System for Monitoring Achievement (NASMLA) also found that some teachers had limited mastery of the content in the subjects they handled (KNEC, 2020).

## 1.1 Statement of the Problem

Despite ongoing reforms in Kenya's education system, performance in mathematics at the Kenya Certificate of Secondary Education (KCSE) remains consistently low compared to other subjects. This raises concerns about the effectiveness of teaching practices in secondary schools. Teacher pedagogical competence is generally recognized as a critical at influencing student achievement. However, there is limited empirical evidence in the Kenyan context that directly links teachers' pedagogical competence to students' mathematics achievement at KCSE. Furthermore, while professional development programs for teachers are regularly implemented, questions remain about whether these initiatives adequately address the specific pedagogical gaps that hinder mathematics achievement. The lack of clear alignment between teacher training and classroom outcomes creates uncertainty about the role of professional development in improving mathematics performance. This study seeks to generate knowledge on how teacher pedagogical competence influences students' achievement in mathematics at KCSE, and how these findings can inform the design of more effective teacher professional development programs in Kenya.

## 1.2 Objectives of the Study

The specific objectives of the study were to;

- i. Determine the level of mathematics teachers' pedagogical competence in Kenya
- ii. Establish the relationship between teacher pedagogical competence and students' achievement in mathematics at KCSE
- iii. Examine the effect of teacher pedagogical competence on students' achievement at KCSE

## RESEARCH METHODOLOGY

The study adopted a descriptive research design. The study targeted all secondary schools in western Kenya and all teachers of mathematics in those schools. A sample of 238 teachers drawn from 35 secondary schools was used. Simple random sampling was used to select schools and teachers. Self-administered questionnaire, interview schedules and Focus Group Discussion (FDG) schedule were used to collect data. Quantitative data was analyzed using descriptive and inferential statistics with the help of Statistical Package for Social Sciences (SPSS 26). Qualitative data was summarized according to recurring themes.

## RESULTS

The findings of the study were presented under different sections namely; teachers demographic characteristics, experience, competence levels and relationship between teacher competence levels and students' academic achievement.

### 3.1 Teachers demographic characteristics

The study revealed preponderance of male teachers teaching mathematics in secondary schools, (69.1% males). This was interpreted to mean that participation in mathematics had masculinity attribution. This agreed with previous studies that observed disparity in women access and participation in science and mathematics at both national and institutional levels (Mbirianjau, Chege, & Oanda, 2019).

With respect to age, the study found that majority of the teachers (44%) were aged between 21 and 29 years, followed by those aged between 30 and 39 years (36%). Further, 15% of the teachers were aged between 40 and 49 years and those aged between 50 and 59 years were 4%. The study noted that a large proportion of secondary school teachers were middle aged. These findings agree with the OECD teaching and learning International Survey (2013) which indicated that the average age of secondary school teachers was 43 years. Thus the teaching force in Kenya was predominantly younger.

### 3.2 Teacher experience and qualifications

Regarding teachers' academic qualifications, the study found that teachers had relevant qualifications. A considerable proportion (87.8%) of the mathematics teachers had a B.Ed. degree while only 6.3 % held a diploma certificate.

### 3.3 The competence levels of mathematics teachers

The study sought to assess the competence of mathematics teachers in selected aspects. These aspects are described in Table 1.

Table 1. Description of teacher competence variables

Variable Label	Variable description
q1	planning a lesson



q2	analyzing syllabus
q3	subject content
q4	designing teaching and learning aid using local resources
q5	involving learners in preparation of teaching aid
q6	engaging learners in participatory learning methods
q7	constructing tests and examination
q8	using tests and examination items
q9	giving assessment feedback to students
q10	creating portfolio
q11	adjusting teaching based on context
q12	searching varied material
q13	using variety of teaching and learning material
q14	team teaching
q15	communication with students
q16	problem solving skills
q17	use of practical examples to facilitate teaching and learning
q18	addressing students personal needs

Data on teachers' self-perceptions on the surveyed variables was analyzed and findings are presented in Figure 1.

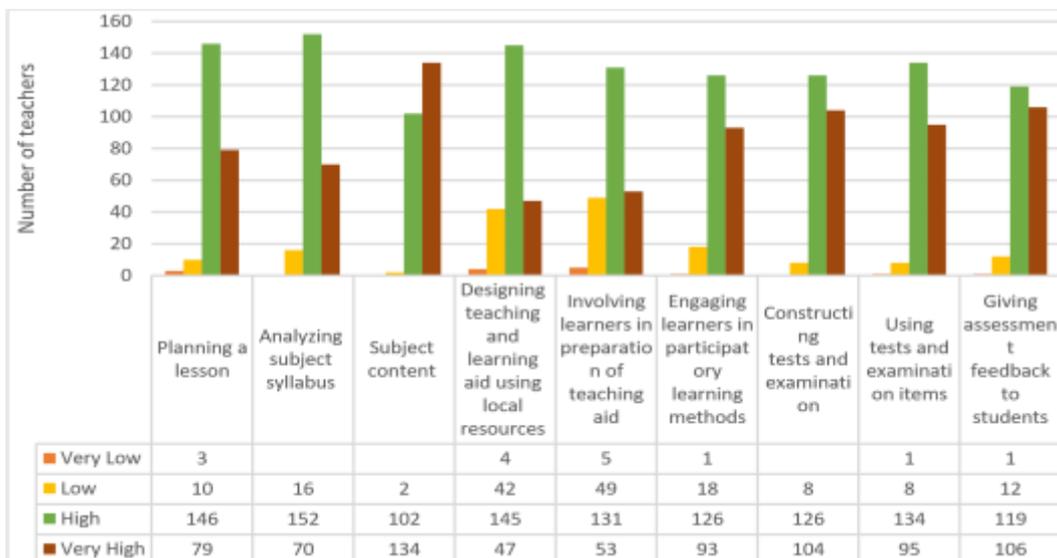


Figure 1. Teachers competence simulated data collected in September 2021.

The results displayed in Figure 1 show that majority of teachers had very high competence in mastery of subject content, constructing tests and examination, and giving assessment feedback to students (134, 56.3%), (104, 43.7%) and (106, 44.5%) respectively. Majority of the teachers also reported high competence in planning a lesson (146, 61.3%), analyzing subject syllabus (152, 63.9%) and designing teaching and learning resources using local resources (145, 60.9%). The findings were supported by teachers who participated in the FDG. For instance, one teacher reported that;

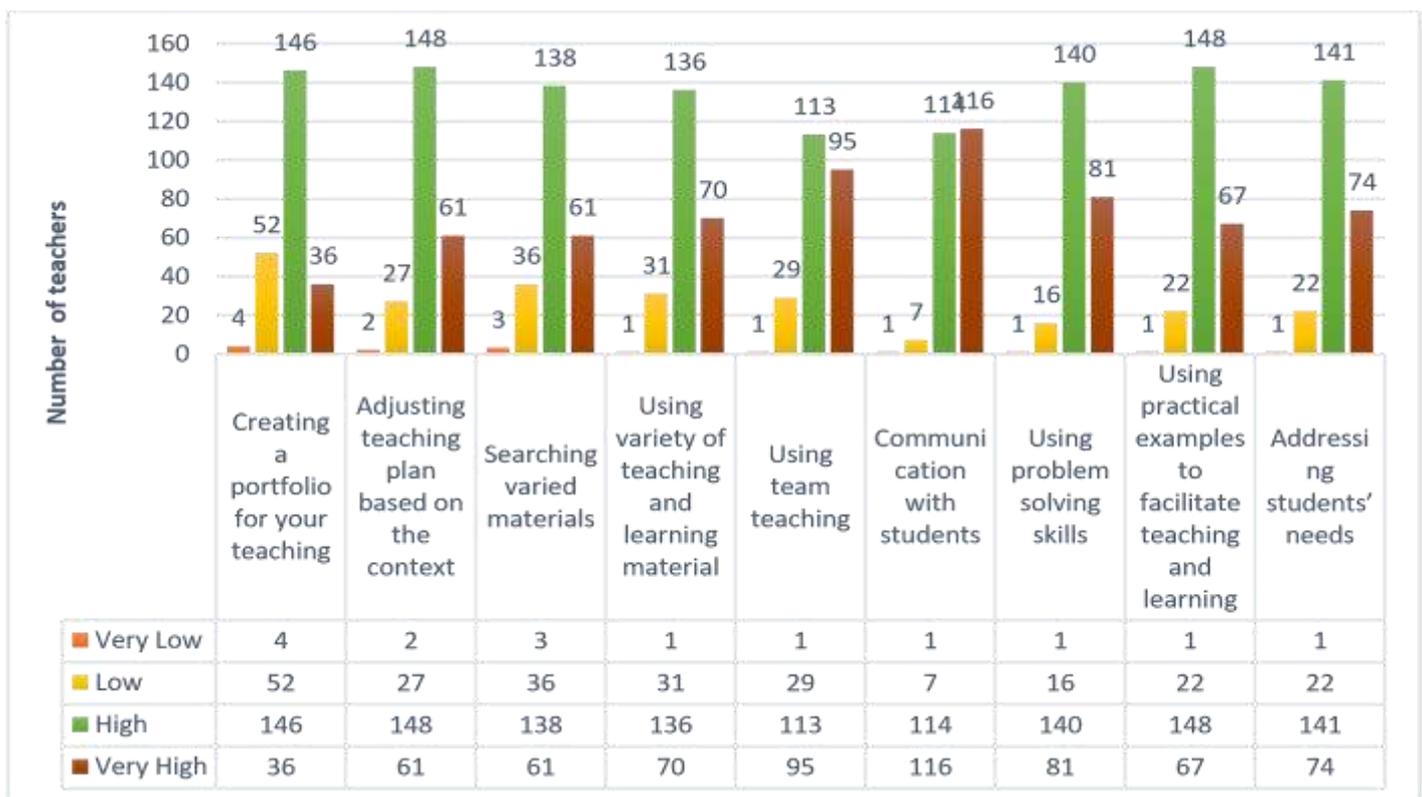
*I think teachers have no problem with subject content. Infact most teachers are very good in mastery of subject content. Otherwise how would someone teach what he/she doesn't understand?*

Regarding teachers' competence in planning a lesson, one teacher responded that;

*Teachers are good in lesson preparation i.e., preparation of schemes of work and lesson plans. Teachers make sure that lesson plans and schemes of work are approved before use. However, they are not very good when it comes to preparation of portfolio.*

In general, there is agreement in respect to the competence of mathematics teachers. Majority of the teachers who participated in the FDGs reported that their competence in most of the aspects was high.

Figure 2. displays the findings on teacher competence in other aspects of teaching and learning.



**Figure 2. Additional teachers' competence simulated data collected October, 2021.**

Figure 2 shows nine additional teacher competence variables that were assessed. The results revealed that teacher competence was generally high in; creating portfolio for teaching (146,61.3%), adjusting teaching plan based on the context (148, 62.2%), searching varied material (138, 58.0%) and using variety of teaching and learning material (136, 57.1%). It was also noted that a large percentage of teachers had high competence in; using practical examples to facilitate teaching and learning (148, 62.2%) addressing learners needs (141, 59.2%) and problem solving skills (140, 58.8%).

### 3.4 Relationship between teacher pedagogical competence and academic performance in mathematics

The outcome variable was students’ academic achievement in mathematics while the independent variable was teacher competence in selected aspects.

### 3.5 School performance in Mathematics at KCSE

Analysis of school performance in Mathematics at KSCE based on the aggregated school mean scores for 2019 and 2020 are presented in Table 2.

Table 2. Descriptive Statistics for School Performance in Mathematics											
	Range	Min	Max	Mean		SD	Var.	Skewness		Kurtosis	
				Statistic	S.E			Statistic	SE	Statistic	SE
MAT mean	6.53	1.66	8.19	3.7381	0.1013	1.4473	2.095	1.254	0.170	1.306	0.339
Valid N (list wise)	35										

SD= Std. Dev. Var.= variance SE= Standard Error

The results presented in Table 2 reveal that the highest school mean score in mathematics was 8.190 while the lowest was 1.660 out of maximum possible 12.000 points. The overall mean for the 35 schools sampled was 3.7381; SD= 1.44731, SE=0.10133. These results suggest that performance in mathematics was generally below average.

An independent sample t-test was conducted to compare mathematics performance in boys’ schools and that of girls schools. The results revealed that there was a significant difference in mean score for boys’ schools (M=4.8924, SD = 1.54723) and that of girls schools (Mean= 4.0368, SD = 1.20336);  $t(68) = 2.556, p = 0.013$ . From the findings, it was concluded that type of school has significant effect on students’ performance in mathematics. Specifically, the results suggest that boys’ schools were more likely to perform better in mathematics than girls’ schools.

### 3.6 Relationship between teaching experience and students’ performance in Mathematics

This study sought to establish the relationship between teaching experience and students’ performance in Mathematics. A chi-square test of independence was conducted to examine the relationship between teaching experience and students’ performance in mathematics.

The findings revealed that the relationship between teaching experience and students’ performance in mathematics was significant  $\chi^2(342, 204) = 98.754, p = 0.019$ . The findings therefore suggested that students taught by experienced teachers were more likely to perform better than those taught by inexperienced ones. This finding agreed with Clotfelter et al. (2014) and also Ogbonnaya (2009). Rice (2010) also had the same opinion. This results are important for the government. As a result, the government should work towards retaining experienced teachers for better performance in mathematics.



### 3.7 The relationship between teacher competence and students' performance in Mathematics

Table 3 presents the correlation matrix of the relationship between teacher competence

Table 3. The Pearson correlation between the variables																			
Var.	MAT mean	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	q16	q17	q18
MAT mean	1																		
q1	0.104	1																	
	0.139																		
q2	0.056	.308**	1																
	0.429	0																	
q3	0.079	.234**	.231**	1															
	0.261	0.001	0.001																
q4	.180**	.312**	.352**	-0.013	1														
	0.01	0	0	0.85															
q5	.144*	.352**	.263**	0.073	.435**	1													
	0.04	0	0	0.298	0														
q6	.164*	.209**	.337**	.266**	.304**	.439**	1												
	0.019	0.003	0	0	0	0													
q7	.177*	.233**	.241**	.359**	.212**	.203**	.294**	1											
	0.011	0.001	0.001	0	0.002	0.004	0												
q8	0.091	.189**	.424**	.321**	.266**	.252**	.407**	.478**	1										
	0.197	0.007	0	0	0	0	0	0											
q9	.191**	.262**	.243**	.273**	.158*	.219**	.256**	.321**	.355**	1									
	0.006	0	0	0	0.024	0.002	0	0	0										
q10	.140*	.324**	.228**	.142*	.385**	.380**	.292**	.230**	.335**	.254**	1								
	0.045	0	0.001	0.042	0	0	0	0.001	0	0									
q11	0.136	.220**	.286**	.192**	.329**	.405**	.299**	.250**	.274**	.346**	.456**	1							
	0.052	0.002	0	0.006	0	0	0	0	0	0	0								



q12	.188**	.245**	.243**	0.135	.353**	.357**	.228**	.204**	.236**	.293**	.416**	.457**	1						
	0.007	0	0	0.055	0	0	0.001	0.003	0.001	0	0	0							
q13	.149*	.371**	.221**	.251**	.349**	.347**	.329**	.193**	.302**	.278**	.353**	.269**	.475**	1					
	0.034	0	0.001	0	0	0	0	0.006	0	0	0	0	0						
q14	0.056	0.121	.247**	0.117	.163*	.193**	.365**	.174*	.246**	.206**	.181**	0.083	.206**	.281**	1				
	0.427	0.085	0	0.095	0.02	0.006	0	0.013	0	0.003	0.01	0.236	0.003	0					
q15	0.097	.147*	.238**	.228**	.164*	.263**	.339**	.191**	.316**	.462**	.299**	.397**	.282**	.283**	.422**	1			
	0.169	0.036	0.001	0.001	0.019	0	0	0.006	0	0	0	0	0	0	0				
q16	0.122	0.109	.321**	.234**	.158*	.284**	.391**	.217**	.359**	.316**	.269**	.389**	.316**	.295**	.351**	.455**	1		
	0.081	0.121	0	0.001	0.024	0	0	0.002	0	0	0	0	0	0	0	0			
q17	.183**	0.129	.335**	.164*	.288**	.252**	.410**	.220**	.355**	.325**	.285**	.371**	.331**	.373**	.319**	.398**	.505**	1	
	0.009	0.067	0	0.019	0	0	0	0.002	0	0	0	0	0	0	0	0	0		
q18	0.061	.166*	.244**	.224**	.242**	.275**	.322**	.152*	.295**	.260**	.350**	.315**	.234**	.329**	.426**	.433**	.490**	.493**	1
	0.383	0.018	0	0.001	0	0	0	0.03	0	0	0	0	0.001	0	0	0	0	0	

\*\* . Correlation is significant at the 0.01 level (2-tailed). \* . Correlation is significant at the 0.05 level (2tailed).

Table 3 presents the correlation matrix between teacher competence variables and students' achievement in mathematics at KCSE. The results revealed that out of the eighteen teacher competence variables being correlated with students' achievement, nine of them returned statistically significant correlation with students' achievement (MAT mean) at  $\alpha = 0.05$ . These were; designing teaching and learning aid using local material (q4), involving learners in preparation of teaching aid (q5), using participatory learning methods (q6), constructing tests and examination (q7), giving assessment feedback to students (q9) and creating portfolio (q10). Other variables which were statistically significant were; searching varied material (q12), using variety of teaching and learning material (q13) and use of practical examples to facilitate teaching and learning (q17)

### 3.8 The effect of teacher pedagogical competence on students' performance in Mathematics

The study sought to examine the effect of teacher competence on students' performance in mathematics. The hypothesis being tested was H0: there is no statistically significant relationship between teacher competence and students' academic achievement in mathematics. The regression results for the effect of teacher competence on students' achievement in Mathematics are shown in Table 4 and Table 5.

Table 4 Summary of the teacher pedagogical regression model

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics					
						R Change	Square	F Change	df1	df2	Sig. F Change
1	.491 <sup>a</sup>	.837	.831		1.42424	.036		7.628	1	202	.006

a. Predictors: (Constant), q1\_9q1\_9 b. Predictors: (Constant), q1\_9, q1\_4 c. Dependent Variable: MAT mean

Multiple regression model, by enter method, excluded variables involving learners in preparation of teaching aid (q5), creating portfolio (q10), searching varied material (q12) and constructing tests and examination (q7) and found that designing teaching and learning aid using local material ( $\beta= 0.313, p=0.000$ ), giving assessment feedback to students ( $\beta= 0.242; p=0.014$ ), using variety of teaching and learning material ( $\beta=0.144, p=0.000$ ), and use of practical examples to facilitate teaching and learning ( $\beta=0.357, p=0.051$ ) are significant predictors of student achievement in mathematics with explained variance of 49.1%.

The regression equation estimated with unstandardized coefficients was as follows; Student Math Score=  $0.571+0.465$  (designing teaching and learning aid using local resources)  $+0.234$  (giving assessment feedback to students)  $+ 0.018$  (using variety of teaching and learning material)  $+ 0.035$  (use of practical examples to facilitate teaching and learning)

In Table 5, P- values below 0.05 are considered statistically significant.

Table 5.

Regression linear regression analysis statistics

Variable	Unstandardized coefficients		Standardized coefficients	Collinearity Statistics			
	B	Std. Error	Beta	t	p-value	Tolerance	VIF
Constant	0.571	0.112	0.213	4.465	0.000	0.242	3.1324
q4	0.465	0.024	0.313	11.9376	0.000	0.314	2.7154
q9	0.234	0.011	0.242	0.9735	0.014	0.241	1.4476
q13	0.018	0.067	0.144	1.0935	0.000	0.635	2.2093
q17	0.035	0.208	0.357	2.9375	0.051	0.524	1.1198

The study contributes with empirical evidence to the body of literature on effects of teacher pedagogical competence on student achievement. Literature has acknowledged the relationship between use of local material (Tabia et.al., 2024), Other studies have expanded this to include giving assessment feedback to students, using variety of teaching and learning material and use of practical examples to facilitate teaching and learning



(Charalampous & Darra, 2024; Adarkwah 2021; Solis Trujillo et al. 2025; Garay Abad & Hattie, 2025; Abdulraziq & Geedallah, 2025; Ebon & Gamutan, 2025). Consistent with these findings, this study identifies use of local material, giving assessment feedback to students, using variety of teaching and learning material and use of practical examples to facilitate teaching and learning as significant predictors of students' achievement in mathematics.

## CONCLUSIONS AND RECOMMENDATIONS

The findings of this study led to the conclusion that teacher competence in giving student feedback was a predictor of students' achievement in mathematics. Based on the forgoing conclusion, it was recommended that teacher professional development programmes and support should focus on enhancing teachers' competence in providing effective feedback on assessments, use of locally available material in teaching and learning, using practical examples while teaching and giving assessment feedback to students.

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## Data Availability

This research is funded by IDRC. Data is available with approval from the funder.

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