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Research Article

Investigating the impact of classroom management, teacher quality, and mathematics interest on mathematics achievement

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This study examines the impact classroom management, quality of teachers, and student's mathematics interest on their mathematics achievement in a few senior high schools in Ghana. The respondents' information was gathered using well-structured questionnaires. Three senior high schools were chosen, and 300 final-year students were chosen using convenience sampling, stratified sampling, and simple random sampling techniques. Three days prior to the letter's sending, permission was obtained. The teacher on duty at the time of the data collection gave authorization for data to be collected during class hours. Using Amos and SPSS software, the study used structural equation modeling to evaluate the various correlations among the variables based on the 285 complete questionnaires. The findings of the study revealed that, effective classroom management and student enthusiasm in mathematics positively influenced math achievement. Also, math achievement was negatively impacted by teacher quality, but this effect was statistically significant. In order to raise students' math achievement, teachers must use effective teaching and learning strategies to gain students' attention in mathematics teaching and learning. Moreover, mathematics teachers must consider individual differences when teaching.

Keywords: Classroom management, teacher quality, mathematics interest, mathematics achievement, structural equation modeling

1. Introduction

The mathematics proficiency of students has long been a matter of intense interest and concern in the field of education. Not only does math ability play a crucial part in determining future employment prospects, but it also plays a crucial role in the development of critical thinking and problem-solving skills. Therefore, it is crucial for academics, policymakers, and educators to understand the elements that affect arithmetic achievement. Among the factors that stimulate students' mathematics performance, classroom management is the most variable in most studies.

For instance, Hepburn et al. (2020) found that classroom management and mathematics interest are determinants of mathematics achievement. Fadda et al. (2022) found classroom organization and management as contributing factors for mathematics achievement. Pan and Franklin (2011) found that classroom management and motivation influenced students' mathematics achievement. Owusu et al. (2022) also identify that the relationship between classroom management and mathematics achievement was positive and significant. Classroom management, student motivation, and self-determination were identified by Irfan et al. (2020) as determinants of mathematics achievement.

Additional research has revealed additional elements that affect students' mathematical achievement. Arthur et al. (2017) also discovered that students' mathematical achievement was influence by the quality of the teacher, the motivation of the teacher and the students, the effectiveness of the instruction, and the teacher's own efficacy. According to Santhanalakshmi and Naomi (2021), peer-assisted learning, classroom management, topic mastery, student perceptions, and parental interest all affect students' math achievement. According to studies by Chand et al.

(2021) and Hossain and Rezal (2018), factors that influence students' math proficiency include teacher attitude, teacher quality, cooperative learning, motivation, self-efficacy, and teacher-student relationships.

The effect of classroom management combines with teacher quality, and mathematics interest on mathematics achievement is limited in research in mathematics education. This study contributes to the existing literature by investigating the impact of classroom management, teacher quality, and mathematics interest on mathematics achievement. More precisely, interest in mathematics improves students' cognitive development and achievement in mathematics (Arhin & Gideon, 2020). Students' interest in mathematics determines their duration and involvement in mathematics learning.

Classroom management refers to the strategies and techniques that teachers use to establish and maintain an environment conducive to learning and positive classroom behavior (Tosto et al., 2016). It includes various aspects, such as discipline, organization, classroom rules, instructional strategies, and building positive student-teacher relationships. Effective classroom management helps create a safe and supportive learning environment where students feel respected, engaged, and motivated to learn. Classroom management minimizes disruptions and allows teachers to focus on delivering instruction and meeting the needs of students.

Teacher quality refers to the overall effectiveness, skills, and qualities of an individual teacher that contribute to the successful instruction and development of students (Kowalski & Mark, 2020). Schools must prioritize attracting, developing, and retaining high-quality teachers. This can be achieved through comprehensive pre-service and in-service teacher training programs, ongoing professional development opportunities, mentorship programs, and competitive compensation. By investing in teacher quality, schools can ensure that students receive the best possible education and support for their academic and personal growth.

Interest in mathematics refers to an individual's curiosity, fascination, and enjoyment of mathematics. This is an intrinsic motivation to explore and engage with mathematical concepts, problems, and activities. Developing a genuine interest in mathematics can have numerous benefits for individuals. It promotes critical thinking, problem-solving skills, logical reasoning, and abstract thinking. A strong interest in mathematics can also lead to academic success in related fields such as science, engineering, technology, and finance (Burić & Kim, 2020). Fostering mathematical interests involves creating a positive and engaging learning environment, making connections to the real world, providing hands-on activities, and offering opportunities for exploration and personalization. By nurturing curiosity and passion for mathematics, individuals are more likely to develop a deep understanding, excel academically, and appreciate the beauty and usefulness of mathematics.

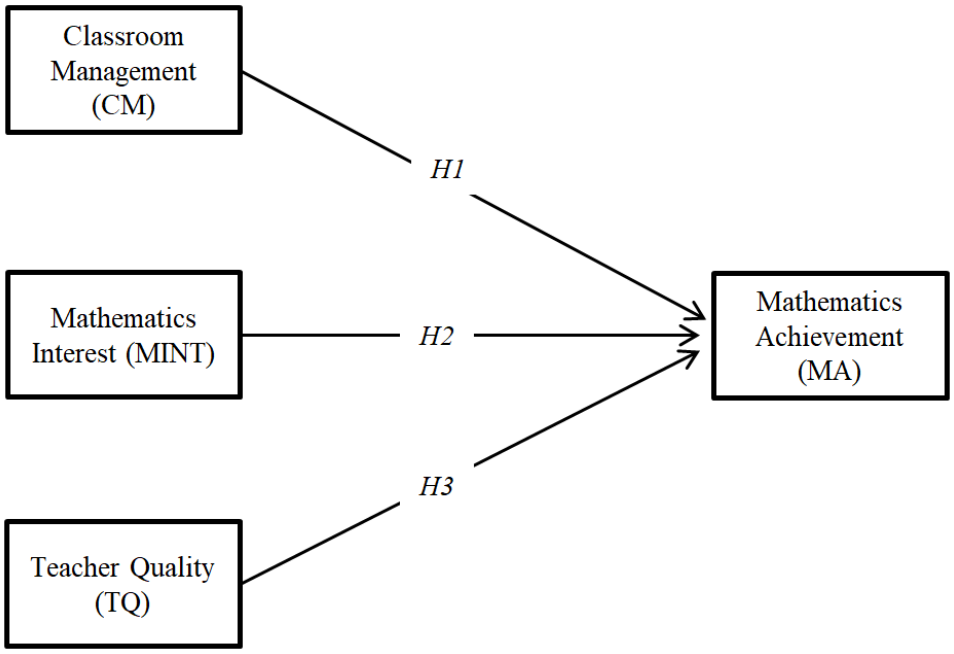
Mathematics achievement can be assessed in various ways, including standardized tests, classroom assignments, quizzes, and exams. Mathematics achievement is typically evaluated based on a combination of knowledge of mathematical concepts, understanding of mathematical procedures, the ability to apply mathematical skills to solve problems, and demonstration of logical reasoning. Effective teaching, prior knowledge, practice and perseverance, instructional resources, a supportive learning environment, and a growth mindset are factors contributing to mathematics achievement (Rayner & Papakonstantinou, 2018). It is important to note that mathematics achievement is not solely dependent on inherent abilities or intelligence, with proper instruction, support, and effort; individuals can improve their mathematics achievement and develop a deeper understanding and appreciation of the subject. Teachers, parents, and educational institutions play a crucial role in promoting mathematics achievement by providing high-quality instruction, motivating students to mathematics learning (Franklin & Harrington, 2019).

1.1. Conceptual Framework

A conceptual framework in research is a theoretical structure that lists the main ideas, variables, connections, and presumptions that guide a study. In addition, researchers can use the conceptual

framework as a guide to help with study design, hypothesis development, and result interpretation. Figure 1 shows the relationships between the variables.

Figure 1
Conceptual framework



In this study, the dependent variable is mathematics achievement, and the independent variables are classroom management, mathematics interest, teacher quality, and how these connect to one other. According to this study, mathematics achievement is directly impacted by teacher effectiveness, classroom management, and students' enthusiasm in mathematics. That is, based on factors like classroom management, student engagement in mathematics, and teacher quality, mathematics achievement is likely to differ. The current study examines the effect of classroom management, teacher quality and mathematics interest on mathematics achievement. The goals that underpin the investigation are as follows:

a) To determine the effect of classroom management on mathematics achievement.
b) To determine the effect of mathematics interest on mathematics achievement.
c) To determine the effect of teacher quality on mathematics achievement.

In line with this aim, the following research questions were addressed:

RQ 1) What is the effect of classroom management on mathematics achievement?
RQ 2) What is the effect of mathematics interest on mathematics achievement?
RQ 3) What is the effect of teacher quality on mathematics achievement?

2. Literature Review

2.1. Classroom Management and Mathematics Achievement

Effective classroom management enhances mathematics achievement by creating an engaging, focused, and supportive learning environment. It facilitates student participation, individualized instruction, positive attitudes, and collaboration, all of which contribute to improved math skills and achievement. Effective classroom management strategies create an environment where students are engaged and motivated to learn mathematics. Classroom management helps to establish clear expectations, efficient routines, and organized structures in the classroom. When students feel supported and have a sense of ownership over their learning, they are more likely to actively participate in and focus on mathematics tasks. Teachers who effectively manage their classrooms can minimize disruptions and the time spent on non-academic activities. This allows more time for direct instruction, practice, and feedback, which are crucial for improving math

achievement. A positive and supportive classroom climate created through effective management strategies promotes a growth mindset and builds students' confidence in their mathematical abilities (Dimosthenous et al., 2020). Students are more at ease taking chances, making errors, and growing from them. Students are more likely to acquire a favorable attitude toward mathematics in such a setting, which will boost their achievement. Effective classroom management fosters collaborative learning and peer interaction, which has a positive impact on mathematics achievement (Shoshani, 2021). Collaborative learning and group work foster communication, problem-solving skills, and deeper understanding of mathematics concepts (Lissett Olaya & González González, 2020).

H1: Classroom management has a direct positive effect on mathematics achievement.

2.2. Mathematics Interest and Mathematics Achievement

Interest is defined as an individual's desire to do something. On the other hand, interest in mathematics is defined as a student's passion for studying mathematics. Students' performance in mathematics depends mostly on their interest in mathematics. Students who developed much interest in mathematics learning performed better than those who devoted less time to studying mathematics. When students are interested in mathematics, they are motivated to learn and engage in mathematical tasks. Their curiosity and desire to explore mathematical concepts and problems fuels their intrinsic motivation, leading to increased effort and perseverance in their studies. As a result, their mathematics achievements improved. Interest in mathematics helps students pay more attention to mathematical concepts and problem solving (Lai et al., 2020). They are more likely to actively engage in class discussions, pose inquiries, and look for explanations, all of which contribute to a deeper comprehension of mathematical ideas. This improved focus allows students to absorb and retain mathematical information more effectively, which positively affects their achievement. When students find mathematics interesting and enjoyable, they experience intrinsic satisfaction and a sense of accomplishment when they achieve success on the subject (Doño & Mangila, 2021). This positive emotional experience reinforces their interest and motivates them to pursue higher mathematical achievement. Students' interest in mathematics significantly influences their self-confidence (Jawad et al., 2021). When students are interested in the subject, they are more likely to believe in their capability to succeed and perform challenging tasks with confidence. This self-assurance enables students to tackle complex mathematical problems and push themselves to achieve a higher level of mathematical proficiency.

H2: Mathematics interest has a direct positive effect on mathematics achievement.

2.3. Teacher Quality and Mathematics Achievement

Mathematics achievement refers to a person's level of success or proficiency in mathematics (Doo et al., 2021). It measures the extent to which an individual has mastered mathematical concepts, problem-solving skills, and mathematical reasoning. Previous research has shown that teacher quality has a positive effect on mathematics achievement. Teacher quality depends on the classroom where the teacher teaches. High-quality teachers have a deep understanding of mathematics concepts and pedagogy. They possess the knowledge and skills to present mathematical concepts clearly and engagingly, thus catering to the diverse learning needs of their students. Effective instructional strategies include providing relevant examples, scaffolding learning, and employment by quality teachers (Onyishi & Sefotho, 2020). These instructional practices promote understanding, critical thinking, and problem-solving abilities among students, ultimately leading to improved mathematics achievements. Recognizing the diverse needs and abilities of their students, quality teachers implement differentiated instruction in mathematics classrooms (Guo & Leung, 2021). They tailored their teaching methods, resources, and assessments to meet individual students' needs, ensuring that all students had the opportunity to succeed. Individualized support can include additional practice, small-group instruction, and one-to-one assistance. This personalized approach increases students' understanding and mastery of mathematical concepts, enhancing their overall achievement. Teachers' expectations have a

profound impact on student achievement (Ndijuye, 2023). High-quality teachers have higher expectations for their students' performance in mathematics. They believed in their students' potential and communicated these expectations. This positive reinforcement motivates students to strive for excellence and work to meet their performance and mathematical achievements.

H3: Teacher quality has a direct positive effect on mathematics achievement.

3. Method

A survey approach was used to gather data for the study, and descriptive and inferential statistics were then employed to further evaluate the quantitative data. While inferential statistics makes assumptions or predictions about a population based on a sample of data taken from the target population, descriptive statistics are used to summarize and characterize the key elements of a dataset.

Convenience, stratified, and simple random sampling strategies were used in this study. Three Senior High Schools were chosen by the use of a convenience sampling. Following the intentional targeting of these schools, stratified sampling techniques were employed to classified the students according to their respective classes, levels, and program of study. Finally, simple random sampling approach, on the other hand, are used to choose students from their respective classes, levels, and program of study during the data gathering process. Finally, a total of 285 students participated in the study (see Table 1).

The target students were the subjected to the structured questionnaire, which was employed as a data collection tool. A permission letter was written to the school administration, in particular the heads of the several selected schools, prior to the questionnaire being distributed to the three senior high schools that were chosen. Permission was obtained after sending the letter to the various heads of the schools. The teacher in charge of the data collection session gave authorization for data to be collected during class hours.

Table 1
Demographics Information

Demographics	*Frequency (N)*	*Percentage (%)*
Gender		
Male	192	67.4
Female	93	32.6
Age		
12-17 years	115	40.4
18-25 years	89	32.2
Above 25 years	81	28.4
Religion		
Christianity	173	48.1
Muslim	73	25.6
Traditional	30	10.5
Others	45	15.8
Course of Study		
General Arts	98	34.4
General Science	45	15.8
Agric	92	32.3
Business	30	10.5
Visual Arts	20	7.0

3.1. Instruments

A questionnaire is a type of research tool made up of several inquiries intended to elicit data from subjects. It exists in various forms such as online survey, written documents, or oral interviews which are commonly used in research, surveys, and data collection in various fields. Classroom

management, interest in mathematics, teacher quality, and mathematics achievement were the four key factors considered in this study. The respondents were asked to select between 1 (strongly agree) to 5 (strongly disagree) on a five-point Likert scale used to quantify the variables.

Five measurement items for mathematics interest were adopted from Asare et al. (2023). The items were "I am bored when working on mathematics"," I give up easily when working on mathematics", "Ever since elementary school, I have enjoyed math", "I like reading mathematics to another subject", and "Attending math lessons is exciting for me". Five measurement items for classroom management were adopted from the study of Nisar et al. (2019). The measurement items for teacher quality were adopted from the study of (Adeniyi et al., 2014). The items were "My teacher easily understands every mathematics concept", "I know what my teacher expects from me", and "My teacher explains a topic again when we do not understand". Five measurement items for mathematics achievement were adopted from Ozkal (2019). The items were "I learn things quickly in mathematics"," Mathematics is one of my strengths", "I think learning mathematics will help me in daily life"," I am more worried about my achievement in mathematics than any other subject", and "No matter how much I study mathematics, mathematics is always difficult for me".

The study used four control variables: gender (1 = male, 2 = female), age (1 = 12-17 years, 2 = 18-25 years, 3 = above 25 years), religion (1 = Christianity, 2 = Muslim, 3 = Traditionalist, 4 = Others), and study program (1 = General Arts, 2 = General Science, 3 = agricultural, 4 = business, 5 = Visual Arts).

3.2. Data Analysis

Measurement items were coded into SPSS (ver. 23) prior to data analysis. The data was analyzed using AMOS (ver. 23) in five distinct ways: path analysis, exploratory factor analysis (EFA), confirmatory factory analysis (CFA), discriminant validity analysis, and descriptive analysis. The descriptive analysis aided in knowing the number of respondents for the study. The EFA was performed to identified the number of indicators that loaded at a particular construct with its loading at least 0.5. The CFA analysis was estimated to determining the model fitness of the research data. The discriminant validity was performed to determining the co-linearity of the constructs. Lastly, using AMOS (ver. 23) software, a path analysis was carried out to address the research questions.

3.3. Model-fit Specification

To evaluate the impact of both the independent variable (i.e., the path specification) and the dependent variable as seen in Figure 1. The general structural equation modeling (SEM) model may be expressed as follows:

$$X = \varphi\tau + \theta \quad (1)$$

$$Y = H\mu + \varepsilon \quad (2)$$

$$\mu = \rho\mu + \omega\tau + \beth \quad (3)$$

The observed dependent and independent variables which are classroom management, teacher quality, mathematics interest, and mathematics performance represent the vectors of x and y. H and φ are the matrix coefficients associated with the measured constructs. μ and τ represent vectors of constructs' dependent and independent variables. The measurement error is represented by vectors ε and θ. The coefficient matrices are denoted by ω and ρ. Finally, the system error for the variable is represented by the vector. The different SEM equations displayed above can be recast in linear form to include the important research variables:

$$MA = \alpha_i + \beta_{i1}CM + \beta_{i2}MINT + \beta_{i3}TQ + \varepsilon_i \quad (4)$$

Where MA represents mathematics achievement which stands for the dependent variable, CM represents classroom practices which are the independent variable, TQ represents teacher quality independent variable, and MINT represents mathematics interest which also represents another

independent variable for the study. The ε_i represents the error term. The specific hypotheses are obtained from equation Eqn (4) to guide the study:

Hypothesis 1 $MA = \alpha_i + \beta_{i1} CM + \varepsilon_i$ (5)
Hypothesis 2 $MA = \alpha_i + \beta_{i1} MINT + \varepsilon_i$ (6)
Hypothesis 3 $MA = \alpha_i + \beta_{i1} TQ + \varepsilon_i$ (7)

3.4. Reliability Analysis

The instrument's reliability and validity Instrument validity, in general, is the degree to which a tool accurately measures the variables it is designed Kimberlin and Winterstein 2008). It was used in this study because it mainly focuses on figuring out whether the instrument appears to measure what it is intended to assess on the surface. In order to assure the validity of research tools, questionnaire items were evaluated while they were being developed. After rearranging the questionnaire's questions for the main study, the researcher conducted a pilot study to determine whether the instruments would accomplish what they were intended to. The results of the pre-test helped in restructuring the questionnaire and making the necessary corrections. The questions were also discussed with other researchers to ensure accuracy. This was done to eliminate any ambiguity or lack of clarity. Reliability is the ability of the tools to consistently get data from several respondents. The Cronbach's alpha reliability test was used to examine the reliability coefficient. Fornell and Larcker (2014) stated that a reliability coefficient of 0.70 is quite respectable for determining whether an instrument is appropriate; as a result, this value was thought to be good enough to support the instrument's use in the study.

Reliability analyses were computed with SPSS (ver. 23) and Cronbach's alpha. The purpose of the study was to determine the internal consistency of the latent variables. The dependability analysis is simplified in Table 3. The comparable coefficients for mathematics achievement, teacher quality, classroom management, and mathematics interest are .877, .942, .921, and.955. For all four of the constructs in this research, the dependability coefficients exceed the minimal cutoff values of 0.6.

3.5. Exploratory Factor Analysis (EFA)

SPSS (ver. 23) was utilized to compute the EFA. EFA was used to evaluate the connected components and determine how each of the observable variables loaded on the relevant latent variable. By using this technique, some of the survey's seen variables that weren't loading correctly in relation to the latent variable may be reduced or eliminated. Table 2 displays the final EFA, which places the observed variables under the appropriate latent variables.

The analysis in Table 2 indicates how many observed variables are loaded onto the corresponding latent variables on the right. Further data analysis employed observed variable loading larger than 0.5 and under the right latent variable. It was identified that a number of observed variables in their right definiteness for classroom management has four (4) items, Mathematics interest has five (5) items, teacher quality has four (4) items and Mathematics Achievement with four (4) items. With a Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .886, the determinant's coefficient was calculated to be 1.06E-07.

In 88.6% of the cases, the KMO explained why the observable variables were loading in the correct dimension on the latent variables. Bartlett's Test of Sphericity yielded a significant p-value of 0.000 based on a Chi-square of 4457.787 and 136 degrees of freedom. In addition to the EFA, the four latent variables displayed a cumulative variance of 87.137%. Nevertheless, every other observed variable that was incorrectly positioned on the rotated component matrix was removed. Table 2 displays the final EFA, which places the observed variables next to the appropriate latent variables.

Table 2
Exploratory Factor Analysis (EFA)

Rotated Component Matrix				
Measurement Items	Component			
	1	2	3	4
Classroom Management (CM)				
CM2			.860	
CM3			.890	
CM4			.874	
CM5			.845	
Mathematics Interest (MINT)				
MINT1	.648			
MINT2	.832			
MINT3	.867			
MINT4	.839			
MINT5	.798			
Teacher Quality (TQ)				
TQ2		.934		
TQ3		.936		
TQ4		.948		
TQ5		.925		
Mathematics Achievement (MA)				
MA1				.580
MA2				.843
MA3				.817
MA4				.843
KMO and Bartlett's Test				
TVE				81.2367
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.				.886
Bartlett's Test of Sphericity	Approx. Chi-Square			4457.787
	df			136
	Sig.			0.000
a. Determinant				1.06E-07

Note. Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 5 iterations.

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3.6. Confirmatory Factor Analysis (CFA)

A statistical method called confirmatory factor analysis (CFA) is employed in the study of psychometrics and social sciences to evaluate the reliability of a measurement model. It is a kind of structural equation modeling (SEM) that uses observable variables or indicators to confirm or support a postulated structure of latent (unobserved) variables. Theoretical models for CFA are put out by researchers and include latent variables and the related observable indicators. Although the latent variables cannot be measured directly, they are thought to affect the observed variables.

The CFA was run in Amos (ver. 23) to calculate the fitness and the path coefficient results (Fornell & Larcker, 2014). The major objectives of CFA are to evaluate the model's fit to the observed data and determine whether the data obtained support the proposed structure. According to Dogbe et al. (2020), the goodness of fit index results for the measurement items must follow the following conditions: chi-square statistics divided by degree of freedom (χ^2/df) should not exceed 3, goodness of fit index and comparative of Fit Index (CFI) should exceed .9, Tucker-Lewis Index (TLI) should exceed .90, Root Mean Square Error Approximation (RMSEA) should be less than 0.06, Standardized Root Mean Square Residual (SRMR) should not exceed .06. The measurement items for the four constructs were significant at (p > .0001), according to Table 3. The four-measurement model for this investigation had a superior model fit, according to the findings of the confirmatory factor analysis.

For classroom management, mathematics interest, teacher quality, and math achievement, the AVE scores were .804, .720, .834, and .649 respectively as presented in Table 3. According to Roemer et al. (2021), the AVE results for the four distinct constructions were over the cutoff point of .50. The factor loadings for the four constructs examined were also above the cutoff of .50 and statistically significant at p > .001 as presented in Table 3. The results for the goodness of fit index for this study were in line with Kline (2018) recommendation for the goodness of fit index.

Table 3
Confirmatory factor analysis

Model Fit Index: *CMIN = 211.582; DF = 106; CMIN/DF = 1.996; TLI = .969; CFI = .976; RMSEA = .059; SRMR = .0482; PCLOSE = .095*	Factor Loadings
Classroom Management (CM): CA = .942; CR = .942; AVE = .804	
CM1: My teacher involves students in establishing rule and procedures.	***
CM2: My teacher provides positive reinforcement to students for appropriate behavior (extra classroom times).	.866
CM3: Teachers ignore misbehavior that is non-disruptive.	.869
CM4: Teacher use self-assessment forms for students to evaluate their own behavior	.943
CM5: Teacher used nonverbal signals to stop misbehavior (i.e. eye contact)	.905
Mathematics Interest (MINT): CA = .921; CR = .927; AVE = .720	
MINT1: I am bored when working on mathematics.	.724
MINT2: I give up easily when working on mathematics.	.872
MINT3: Ever since elementary school, I have enjoyed math.	.908
MINT4: I like reading mathematics to another subject.	.883
MINT5: Attending math lessons is exciting for me.	.842
Teacher Quality (TQ): CA= .955; CR = .952; AVE = .834	
TQ1: Mathematics teachers understand students mathematics learning challenges and needs	***
TQ2: My teacher is easy to understand every mathematics concept.	.845
TQ3: I know what my teacher expects from me.	.921
TQ4: My teacher explains a topic again when we do not understand.	.918
TQ5: Mathematics teachers do offer individual attention to students.	.964

Table 3 continued

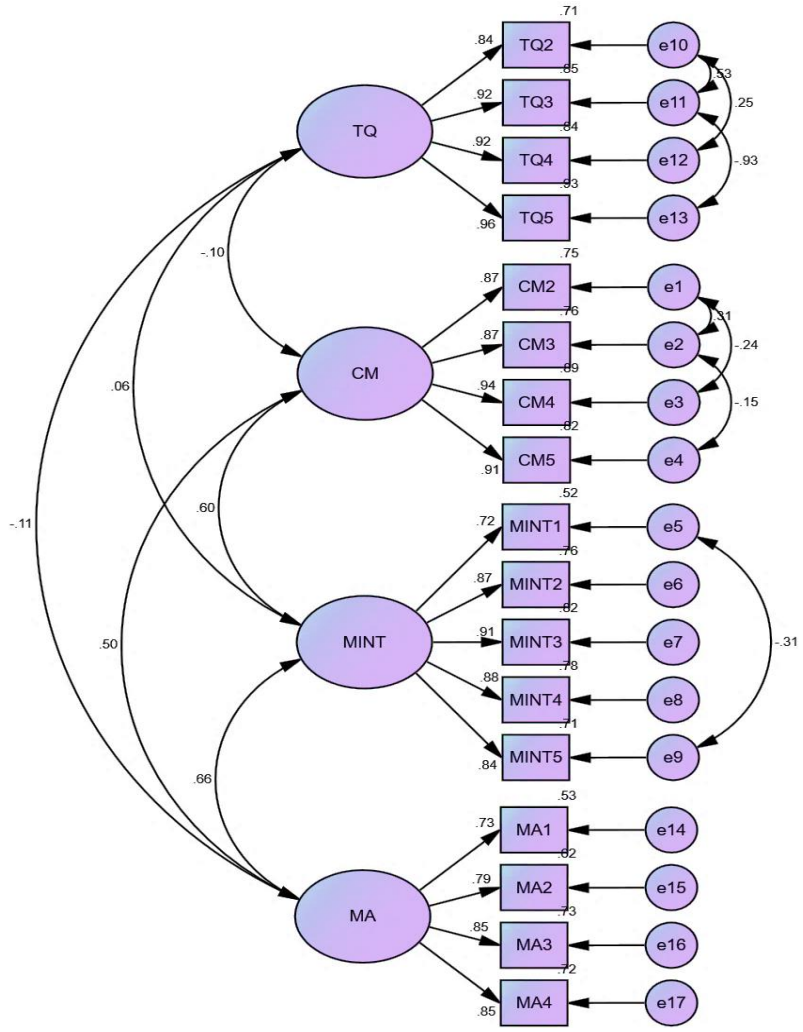
Mathematics Achievement (MA): CA = .877; CR = .880; AVE = .649	
MA1: I learn mathematics concepts quickly.	.728
MA2: Mathematics is one of my strengths.	.786
MA3: I think learning mathematics will help me in daily life.	.851
MA4: I am more worried about my achievement in mathematics than any other subject.	.849
MA5: No matter how much I study mathematics; mathematics is always difficult for me.	***

Note: *** represents item (s) with poor factor loading

3.6.1. Confirmatory factor analysis illustration

Figure 2 demonstrate the framework for the confirmatory factor analysis. From Figure 2, four main variables were used. Teacher quality (TQ) had four (4) measurement items that measures teacher quality, classroom management (CM) had four (4) measurement items that measure classroom management, mathematics interest (MINT) had five (5) measurement items that measured mathematics interest, and mathematics achievement (MA) had four (4) measurement items that measured mathematics achievement. The symbol 'e' is the unique variables that are added to the measurement items to modify the measurement items for better model fitness. As part of the model fitness, Figure 2 also shows the correlation among the variables under study at is, teacher quality (TQ), classroom management (CM), mathematics interest (MINT), and mathematics achievement (MA).

Figure 2
Confirmatory Factor Analysis (Source: Field Survey, 2024)



3.7. Discriminant Validity

Average Variance Extracted (AVE) and Composite Reliability (CR) were found to be the means of objectively analyzing the convergent validity and reliability on the final observed variables that estimate the CFA. According to Do et al. (2020), convergence validity assesses how closely two observable variables correlate with each other when applied to the same notion. The AVE and CR must each have an expected value of at least 0.5 and 0.7, respectively. The AVE and CR were calculated in order to further analyze the study and achieve convergence validity. The results support Dijk et al. (2019) AVE and CR requirements with an AVE of 0.665 and a CR of 0.888, respectively. Table 4 presents the discriminant analysis results for the study.

Table 4
Discriminant Validity

Variables	*CR*	*AVE*	*CM*	*MINT*	*TQ*	*MA*
CM	.942	.804	.897			
MINT	.927	.720	0.602***	.848		
TQ	.952	.834	−0.104	0.063	.913	
MA	.880	.649	0.503***	0.661***	−0.107	.805

Note. *** Significant at 0.01; $\sqrt{\text{AVE}}$ are not bolded but underlined.

4. Results and Discussion

Analysis of Moment Structure (Amos ver. 23) was used to assess the various hypothesized paths for the study. The control variables selected for the study were gender, religion, course, and age of the respondents. The strong p-value (.832) indicates that gender does not directly affect mathematics achievement (MA) in a statistically meaningful way. Additionally, religion does not have a statistically significant direct impact on mathematics achievement (MA), as the *p*-value (.241) is higher than the typical significance level (e.g., .05). According to the low *p*-value (.001), the course has a statistically significant positive direct influence on Mathematics Achievement (MA). This shows that better mathematics performance may be related to the type of course taken. Age does not directly affect mathematical achievement (MA) in a statistically significant way because the *p*-value (.701) is higher than the level of significance.

Table 5 presents the results for the path analysis for the study. From Table 5, the direct path arrows indicates that, gender, religion, course, and age have a direct effect on mathematics achievement as indicated by MA. Moreover, classroom management (CM), mathematics interest (MINT), and teacher quality (TQ) also found to have a direct effect on mathematics achievement (MA).

Table 5
Path Analysis

Direct Paths	*UnStd. Estimates*	*Std. Estimates*	*S. E*	*C. R*	*p-value*
Gender → MA	−.016	−.010	.077	−.212	.832
Religion → MA	.052	.062	.042	1.242	.241
Course → MA	.114	.176	.033	3.480	.000
Age → MA	−.017	−.019	.044	−.384	.701
CM → MA	.115	.136	.057	2.014	.044
MINT → MA	.545	.550	.080	6.827	.000
TQ → MA	−.115	−.128	.046	−2.478	.013

4.1. The Effect of Classroom Management on Mathematics Achievement

The first hypothesis (H1) with a p-value of .044, found that classroom management (CM) significantly and positively influences mathematics achievement (MA) directly. This implies a link between improved classroom management and improved math performance, and we accept H1. The finding of the current confirmed the previous study done by Dijk et al. (2019). According to their research, the importance of classroom management affected kids' math achievement. A study

on the impact of teacher classroom management on students' motivation and academic achievement was undertaken by Adedigba Olabisi (2020) with a sample size of 250 students in the state of Kwara. According to the study's results, effective classroom management significantly improved students' motivation (β= 121.155***) and academic performance (β = 28.947***). In a similar vein, Barksdale et al. (2021)performed a systematic review and meta-analysis on classroom climate and children's academic and psychological wellbeing. According to their study findings, classroom climate had a small-to-medium positive correlation with children's academics.

4.2. The Effect of Mathematics Interest on Mathematics Achievement

The second hypothesis (H2) asserted that mathematics interest influences achievement in mathematics directly. A very low p-value (.001) indicates a strong statistically significant positive direct relationship between mathematics interest (MINT) and mathematics achievement (MA). This suggests that higher mathematical achievement and interest are strongly correlated, and we accept H2. The results of the current study are consistent with those of a prior investigation on the relationship between student interest in mathematics and academic achievement conducted by Yeh et al. (2019). The study's findings demonstrated that the degree of interest pupils have in mathematics greatly predicts their mathematical ability. Students' enthusiasm in learning mathematics strongly predicts their ability in the subject, and there is a positive association between students' interest in mathematics and math achievement, according to Callaman and Itaas (2020). A study on the association between mathematics interest and mathematical achievement conducted by Zhang and Wang (2020) with the help of 158161 participants revealed that mathematics interest had a strong direct impact on mathematical achievement. Similar research was conducted by Karlina et al. (2021) to ascertain the relationship between math achievement in grade VII SMP PGRI Bengkulu and learning interest. According to Arthur et al. (2022), students' enthusiasm in mathematics greatly predicts how well they would achieve in arithmetic

4.3. The Effect of Teacher Quality on Mathematics Achievement

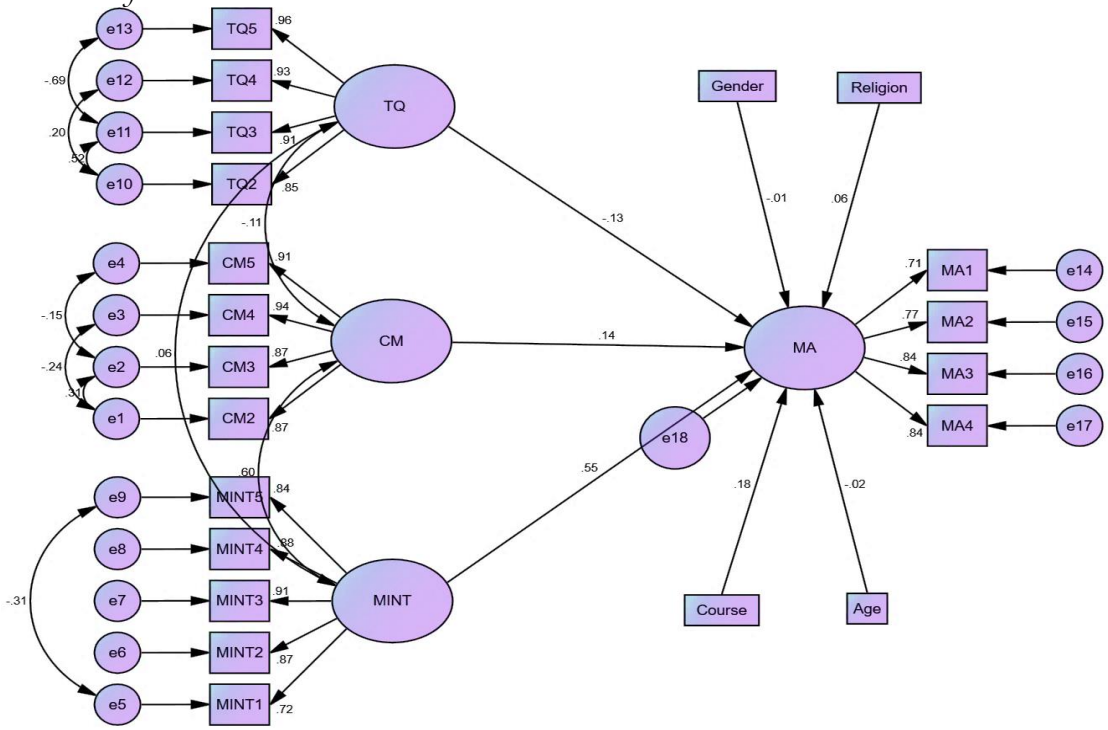
The third hypothesis asserted that teachers' quality directly influences students' achievement in mathematics. A statistically significant negative direct relationship between Teacher Quality (TQ) and Mathematics Achievement (MA) exists, with a *p*-value of .013. This may mean that students' mathematical achievement is negatively correlated with increased teacher quality. Based on the analysis's findings in Table 4, we reject H3 because teacher quality had a detrimental impact on students' mathematics achievement. The results also showed a statistically significant negative correlation between student math achievement and teacher quality. The conclusions of the current study are refuted by other studies. A study by Boadu et al. (2023) found that math achievement of children is significantly predicted by the quality of the teacher. Similar findings were made by Fosu et al. (2022) who examined Sakafia Islamic Senior High School (SHS) and Kumasi Academy Senior High School (SHS) with a sample size of 300 students. They discovered that teacher quality had a favorable but small impact on students' achievement in mathematics. Ambusaidi and Yang (2019) looked into the relationship between teacher quality and student achievement using the ordinary Least Square (OLS) statistical method. The results demonstrate that teacher quality has a beneficial impact on the mathematics achievement of eighth grade students in Taiwan and Oman. Teodorović et al. (2022) came to the conclusion that teacher quality has a considerable and beneficial influence on students' achievement in mathematics as well as their mathematical interests.

4.4. Path Analysis Illustration

Figure 3 represents a summary of the path results. From Figure 3, Teacher quality (TQ) had a direct negative and statistically significant effect on mathematics achievement whiles classroom management (CM) and mathematics interest (MINT) had positive direct and statistically significant effect on mathematics achievement. Moreover, there was a positive correlation between teacher quality (TQ) and mathematics interest, teacher quality (TQ) had a positive correlation with

classroom management, classroom management too had a positive correlation with mathematics interest. In addition, religion and course offered by students had a positive direct but statistically insignificant effect on mathematics achievement. Moreover, age and gender of the students had a negative direct but statistically insignificant effect on mathematics achievement.

Figure 3
Path Analysis



5. Conclusion

The study concluded that, math achievement (MA) is positively impacted by effective classroom management (CM) in a statistically meaningful way. This shows that teachers who successfully manage their classrooms can help pupils do better on arithmetic tests. The significance of this link emphasizes how crucial it is to have a structured and stimulating learning environment for mathematics training. Moreover, math achievement (MA) benefits statistically significantly from effective classroom management (CM). This implies that teachers who successfully manage their classes can help students attain better arithmetic standards. This relationship's relevance emphasizes how crucial it is to develop a structured and stimulating learning environment for mathematics training. Math achievement (MA) is significantly and significantly positively influenced by mathematics interest (MINT). This result underlines the crucial part that students' inherent passion for mathematics and excitement play in determining how well they perform in math. For mathematics instruction to improve student results, cultivating and maintaining enthusiasm in the subject should be a top emphasis. Finally, mathematical achievement (MA) is negatively impacted by teacher quality (TQ) in a statistically significant way. According to this finding, lower mathematical achievement is linked to better teacher quality. It is significant to emphasize that this conclusion necessitates further research in order to discover potential areas for development in teacher preparation and support as well as to comprehend the precise elements of teacher quality that may be causing this negative association.

6. Recommendations and Practical Implication

Mathematics is the key subject that has an impact on another subject whether related or not. Stakeholders must develop a strategy to improve students' achievement in mathematics as a subject. The study recommends that parents, school heads, and teachers must do well to improve

students' achievement of students in mathematics. Moreover, teachers must use effective teaching and learning strategies to gain students' attention in mathematics teaching and learning. Finally, mathematics teachers must consider individual differences when teaching.

As a practical implication, finding the relationship between arithmetic achievement and teacher quality may help educators design more focused professional development initiatives. This can entail providing instruction in efficient teaching techniques, integrating technology into the classroom, and cultivating a good rapport between the teacher and the student. Moreover, the creation of workshops or other tools to assist instructors in strengthening their classroom management techniques may arise from an understanding of the significance that classroom management plays in students' progress in mathematics. This could involve methods for fostering a supportive learning environment and successfully controlling student conduct.

Also, the study's conclusions may help curriculum designers understand how important it is to provide captivating and intriguing mathematical information. This might result in the creation of educational resources that pique students' curiosity and encourage hands-on learning. Teachers may be inspired to look for strategies to increase students' interest in mathematics if they realize the impact that interest in the subject has on academic performance. To increase students' interest in mathematics, this could entail introducing interactive exercises, real-world applications, and a variety of teaching strategies.

In addition, teachers may be inspired to look for strategies to increase students' interest in mathematics if they realize the impact that interest in the subject has on academic performance. To increase students' interest in mathematics, this could entail introducing interactive exercises, real-world applications, and a variety of teaching strategies. The findings of the study might affect district, national, or even school-level educational practices. The results could be used by policymakers to guide decisions about the recruiting and training of teachers, resource allocation, and the creation of educational standards. Finally, the study's identification of areas in need of ongoing attention and development could aid in long-term educational planning. Future studies and instructional programs aiming at improving general mathematics education can be guided by the information provided here.

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Data Availability: The data used to support the findings of this study are available from the corresponding author upon request.

Ethical statement: The authors stated that the study was approved by the Department of Mathematics Education Research Ethics Committee of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) on the 3rd March, 2023. Written informed consent was obtained from Heads of the Departments and lecturers, as well as from students.

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