Relationship between Peer Assisted Learning and Students' Academic Achievement: The Mediating Effect of Students' Attitude.

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ABSTRACT

This study examined the relationship between peer-assisted learning (PAL) and students' mathematics achievement, with a focus on the mediating role of students' attitudes toward mathematics. The research was conducted in the Sekyere-Kumawu District of Ghana, involving 367 students drawn from Banksmen Senior High School and Dadease Agric Senior High School through stratified random sampling. A cross-sectional survey design was employed, and data were collected using a structured questionnaire. Structural equation modeling (SEM) confirmed the model's good fit (CFI = 0.973, RMSEA = 0.053). Results indicated that PAL significantly and positively predicted students' mathematics achievement ($\beta = 0.768$, $p < 0.001$). Furthermore, students' attitudes toward mathematics were found to partially mediate this relationship (indirect effect = 3%, $p < 0.01$), suggesting that PAL not only improves performance directly but also indirectly by fostering more positive attitudes. These findings underscore the potential of structured PAL programs to enhance mathematics outcomes in secondary schools. It is recommended that schools adopt PAL strategies alongside initiatives such as motivational workshops and supportive classroom environments to cultivate positive mathematical attitudes and maximize student achievement.

Keywords: Peer-Assisted Learning, Mathematics Achievement, Students' Attitudes, Structural Equation Modeling.

INTRODUCTION

Overview

This section covers the background of the study, statement of the problem, purpose, objectives, research questions, significance, delimitation, and organization of the study.

Background to the study

Since the 1960s, innovative mathematical concepts and their application across various fields of research, technology, and engineering have significantly influenced both our everyday lives and the scientific community (Kanbolat, 2011). In light of the current technology era, it is imperative that educators and learners alike completely appreciate the value and applicability of mathematics education as well as how to embrace it. In most Sub-Saharan African countries, passing the subject of mathematics is mandatory for admission to postsecondary education. It is a crucial part of the school curriculum (Abreh, Anokye, & Tawiah, 2018). Mathematics is instructed in primary schools, secondary schools and college of education (CoE) curricula in Ghana, as it is in the majority of African nations. Every student at these educational levels must take mathematics, which serves as both a prerequisite and a crucial screening tool for future study in the nation (Ampofo, 2019). In the modern world, mathematics is a vital tool for progress and plays a significant role in the construction of civilization (Gulnaz & Fatima, 2019).

Mathematics is one of the core disciplines taught in schools across the world. This subject is necessary to direct

and shape the advancement of other scientific fields. The ability to operate effectively in life is facilitated by mathematics' numeracy function (Gafoor & Kurukkan, 2015). Mathematics is essential across fields like science, technology, and economics, yet students' performance in the subject remains a widespread challenge, especially in Ghana, where passing mathematics is critical for educational advancement (Blackmore, Healey, & Pettigrew, 2021); Numerous factors have been identified over the years as contributing to pupils' poor performance in mathematics at all educational levels. (Mutegi, 2021) state that a number of studies have linked factors such as insufficient teaching staff and resources, students' anxiety and fear of mathematics, ineffective teaching strategies, crammed classrooms, and students' attitudes toward the subject to their poor performance in the subject. (Elshami, et al., 2020) defines peer-assisted learning as a concept or learning approach in which students from various classrooms, or from the same department, help each other learn, with the awareness that they are not always studying the same subject. Peer-assisted learning, according to (Santhanalakshmi & Naomi, 2021), is a planned program meant to support children with special needs in the classroom rather than to replace the current curriculum and teaching strategies.

Students' enthusiasm in learning mathematics is also influenced by peer-assisted learning. Both low-performing pupils without impairments and those with learning problems benefit from peer-assisted learning (Santhanalakshmi, 2021). Increasing students' interest is crucial because it helps them to enjoy studying mathematics instead of viewing it as a hardship or a challenging assignment. Peer-assisted learning was found to be a significant determinant of student achievement (Arthur, Peer-assisted learning and student achievement, 2022). Through peer-assisted learning, students can develop their quantitative thinking skills and academic achievement. Students in study groups are more motivated and enthusiastic about their peers when they receive peer assistance (Usman; Jamil, 2019).

The attitude of students toward mathematics has been the subject of a great deal of attention from educators (Chen, 2018). Students with a positive attitude toward mathematics tend to enjoy the subject, understand its value, have confidence in it and they are likely to prioritize the study of mathematics which could lead to high performance (Martin, TIMSS 2019 international results in mathematics and science. , 2020). Some previous studies have found that students' attitude toward mathematics positively impacts their mathematics achievement (Chen, 2018). In examining the relevance of these variables, this study sought to investigate the relationship between Peer Assisted Learning and students' academic performance, with the mediating effect of students' attitude, and students' efficacy and moderating effect of students' mathematics Interest.

Statement of the Problem

Mathematics serves as a critical gateway subject in Ghana's education system, determining students' access to senior high schools, colleges, polytechnics, and universities (Denteh, Osei, & Ofosu, 2017). However, mathematics performance among students remains persistently low, limiting educational advancement and career opportunities. Over the past three decades, researchers have identified various factors contributing to students' underachievement in mathematics, including ineffective teaching methods, large class sizes, lack of resources, and students' negative attitudes, low interest, and weak self-efficacy (Reardon & Robinson, 2009; Mutegi, 2021).

Among these factors, peer-assisted learning (PAL) has emerged as an effective strategy to enhance mathematics outcomes, providing students with collaborative learning opportunities that build understanding and engagement (Arthur, 2022). Additionally, students' attitudes toward mathematics have been repeatedly linked to achievement, with positive attitudes fostering confidence, motivation, and persistence (Martin, 2020; Chen, 2018).

Despite this knowledge, little research has explored how students' attitudes may function as a mediator in the relationship between PAL and mathematics achievement, particularly within the Ghanaian context. Without understanding this mediating mechanism, educational interventions may overlook key psychological processes that determine their success.

To address this gap, the present study investigates the relationship between peer-assisted learning and students' mathematics achievement, focusing specifically on the mediating role of students' attitudes. By clarifying these pathways, the study aims to inform more effective teaching strategies and intervention programs that target both academic and attitudinal improvement.

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Objectives of the Study

1. To assess the effect of peer assisted learning on students' mathematics achievement.
2. To examine the mediating effect of students' mathematics attitude through peer assisted learning and students' academic performance.

Research Questions

1. What is the effect of peer assisted learning on students' mathematics performance?
2. What is the mediating effect of students' mathematics attitude through peer assisted learning and students' academic performance?

Population, sample, and Data methods

Research Design

According to Siedlecki (2020), the study design serves as a comprehensive framework for collecting, assessing, and analyzing data. It outlines the overall strategy for integrating the various study elements in a coherent and logical manner to ensure the research question is effectively addressed. Researchers have access to a range of study methods. This particular study employed descriptive research design, as the researcher conducted an in-depth analysis of the study topic's background before further investigation. Descriptive surveys, commonly used in social science research, examine and document the nature and scope of an issue, identify emerging patterns and trends, and provide a basis for further research. The findings from descriptive research can inform decision-making, policy development, and program planning. Specifically, this study utilized a cross-sectional design, analyzing data from a population at a single point in time. This design was chosen to describe and analyse the characteristics of the entire population at that specific moment, as well as to gather information about participants' attitudes, perceptions, and opinions on the subject. Aubert et al. (2006) describe a descriptive survey as a design that examines existing relationships and conditions, such as identifying attitudes, practices, views, and ongoing processes or emerging patterns. Descriptive research offers the advantage of allowing the researcher to evaluate the study's context.

Population

A population, according to Best and Kahn (2009), is any group of individuals who share one or more characteristics that are relevant to the researcher's interest. This population may include all individuals of a certain type or a specific segment of them. In this study, the target population comprises senior high school students in the Sekyere-Kumawu District. The final data collection involved two schools: Bankoman SHS and Dadease Agric Senior High School, with a combined student population of 4,400.

Sample size

A sample is a subset of a population selected to represent the broader group and provide insights about it. It serves as a smaller version of the entire population from which it is drawn. In this study, the accessible sample consisted of 367 students from the study site, representing approximately 8% of all senior high school students within the study area. This sample size was determined using Yamane's formula for calculating sample sizes from a population, with a significance level (e) of 0.05, as shown below:

$$n = N/(1+Ne^2)$$

$where$

$N = 4400$

$$n = \frac{4400}{1+4400(0.05)^2}$$

$n \approx 367$

Sampling Procedure

The practice of selecting a smaller subset of the community being studied is known as sampling in research. While it would be ideal, logistical constraints may prevent every person of the community you are examining from taking part in your study. As a result, we can generalize the findings and make judgments about the entire population by examining a more condensed and representative sample of your community of interest. In each school, proportional random sampling was used to calculate and sample the participants based on their population. A stratified random sample is one in which two or more categories from your community of interest are represented. When the community being sampled is reasonably heterogeneous or there are noteworthy subgroups present, stratified random sampling is more commonly used. According to (Acharya, Prakash, Saxena, & Nigam, 2013), stratified sampling entails splitting your community into smaller groups and then arbitrarily choosing a sample from each in effect, handling it as if it has two populations.

Stratification by age, gender, race, religion, school, college etc are common instances. For Bankoman SHS with a population of two thousand one hundred, the number of participants that were sampled proportionally using $sample\ (n) =\ \times 367$ was

$sample\ (n) \approx 175$

For Dadease, sample used for this study was one hundred and ninety-two (192). This was also calculated using the formula $sample\ (n) =\ \times 367$

$sample\ (n) \approx 192$

In each school, A simple random sampling method was employed to choose the required number of participants. At Bankoman SHS, one hundred and seventy-five (175) 'YES' and some 'NO' were written on pieces of paper and folded for entire students to pick. The students who selected 'YES' formed the sample that took part in this study. At Dadease Agric SHS, one hundred and nine two (192) 'YES' and some 'NO' were written on pieces of paper and folded for entire students to pick. The students that selected 'YES' also formed the sample that took part in this study in that school.

Ethical Consideration

When conducting a study, (Saunders, Lewis, and Thornhill, 2007) emphasize how crucial it is to get respondents' consent and follow research ethics. Thus, the researcher assured the respondents of their privacy and confidentiality. The researcher reassured the participants one more time, stressing that any information they submitted would be treated with the utmost discretion and that their names would stay secret. In addition, the participants were made aware of their right to decide not to participate in the study. Finally, the researcher was open and honest; neither did he purposefully mislead the volunteers about any of the components of the investigation, including any risks, discomforts, or rewards.

Research Instrument

In almost all educational research, the questionnaire is the most extensively used data collection instrument (Taherdoost, 2018). Instrument employed for this study was a questionnaire. The main objective of a questionnaire in research is to gather crucial data in the most precise and reliable manner feasible. Thus, the consistency and correctness of the survey or questionnaire are an important part of the research technique. With this knowledge, the researcher used a questionnaire which was developed comprehensively. The main aim of this research was to investigate the effect of peer tutoring among students' and students'' mathematics interests on students' mathematical problem solving, a closed-ended type of questionnaire format was developed from all three constructs (Peer Assisted Learning, Self-efficacy, Student Mathematics Attitude, Mathematics Interest of students and students' mathematics performance).

Ten (10) standard and structures questions were developed from each construct named above using a Likert scale of rating 1 to 5 (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree). In all, there were fifty (50) questions for the participant to respond to in addition to their background information. This is so

purposeful to examine the participant's degree of agreement with their Peer Assisted Learning, Self-efficacy, Student Mathematics Attitude, Mathematics Interest of students and students' mathematics performance. Section A elicited background information of participants on their sex, level/form, age, and parent background, among others. Section B also elicited from participants' perceived engagement in

Peer Assisted Learning. Section C required participants to answer questions on students' Self efficacy. Section D requires participants to answer questions on their perceived students' Student Mathematics Attitude. Section E required participants to answer questions on Mathematics Interest of students.

Data Collection Procedure

The questionnaire was individually distributed by the researcher in each of the two schools. Students of mathematics at high schools within the district were given a questionnaire to respond. The questionnaire that was given out received responses from all 367 participants in total. It took one month, and three weeks to administer the questionnaire and responses were obtained for further analysis.

Data Analysis Procedure

The data analysis tool that the researcher employed in the analysis was Structural Equation Modelling (SEM). According to (Fan, et al., 2016), because of the vast range of problems it may help solve, structural equation modelling (SEM) is a popular analysis tool for quantitative data. The term "structural equation modelling" (SEM) refers to a broad range of techniques used by researchers in both quantitative and empirical studies in the social sciences, business, and other disciplines. The social and behavioural disciplines use it the most. To depict the various components of a visible or hypothetical event that are said to be directly structurally linked to one another, SEM entails the construction of a model. The structural characteristics of the model suggest theoretical connections between the factors that most accurately depict the studied event. The hypothesized causal structuring is frequently portrayed by lines showing the causal relationships between the variables, but these relationships can also be represented by equations. When using structural equation modelling, various pieces of information relevant to this technique should be reported. A collection of statistical techniques known as structural equation modelling analyses connections between one dependent variable and several independent variables.

Validity and Reliability of Instrument

According to (Taherdoost, 2018), validity describes the extent to which the data cover the subject of the inquiry. In essence, "measure what is supposed to be measured" is what is meant by the term "validity" (Moses & Yamat, 2021). The appearance of the questionnaire is assessed for validity in terms of its feasibility, readability, consistency of style and formatting, and the use of clear language. Validity was defined by (Surucu & Maslakci, 2020) as getting data that is suitable for the intended application of the measurement instruments. The term "reliability" describes the stability and consistency of the test instruments over some time. In other words, the ability to measure instruments so they provide comparable findings when used at various periods is known as reliability. To ensure that this research instrument is valid and reliable, the researcher modified existing instruments on the various constructs under study. Moreover, the instruments were given to experts to check for their comments on it. The reliability of the data was guaranteed by using the data from the piloting of the instrument to calculate the Cronbach alpha as the reliability coefficient for the various variables. All the variables had a reliability coefficient above 0.8.

Structural Equation Modeling (SEM) Results

Structural Equation Modeling (SEM) was performed using AMOS version 23 to test the hypothesized relationships among peer-assisted learning (PAL), students' attitudes toward mathematics, and mathematics achievement. The structural model demonstrated a good fit to the data, with fit indices meeting recommended thresholds: CFI = 0.973, TLI = 0.967, RMSEA = 0.054, and GFI = 0.881. The chi-square to degrees of freedom ratio (χ^2/df) was 1.725, indicating a good model fit (Hair et al., 2014).

The analysis supported Hypothesis 1, showing that peer-assisted learning had a significant positive effect on

mathematics achievement (β = 0.695, CR = 2.633, p = 0.013).

Hypothesis 2 was also supported, as students' attitudes toward mathematics partially mediated the relationship between PAL and achievement. The indirect effect was significant (β = 0.164, 95% CI [0.098, 0.245], p = 0.001), with both the lower and upper confidence intervals being positive, confirming the mediation effect.

These findings indicate that peer-assisted learning not only directly improves mathematics achievement but also exerts an indirect effect through enhancing students' attitudes toward mathematics.

Table 1: Exploratory Factor Analysis (EFA)

Rotated Component Matrix[a]			
	Component		
	1	2	3
SMA1			
SMA2		.727	
SMA3		.801	
SMA4		.771	
SMA5		.687	
SMA6		.628	
ACH1	.845		
ACH2	.855		
ACH3	.891		
ACH4	.879		
ACH5	.783		
PEER1			.869
PEER2			.822
PEER3			.695
PEER4			.776
PEER5			.673

EFA Factor Analysis

Table 2 KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.746
Bartlett's Test of Sphericity	Approx. Chi-Square	3590.904
	df	120
	Sig.	.000

Total variance explained= 75.124%, Chi-square value = 6237.245 and Significant level=0.000, Determinant=5.235E-04

Source: Field Survey, 2025

An Exploratory Factor Analysis (EFA) was conducted to examine the factor structure and validity of the measurement items. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.746, indicating that the sample was suitable for factor analysis. Bartlett's Test of Sphericity was significant ($\chi^2 = 3590.904$, df = 120, $p < 0.001$), confirming that the correlation matrix was factorable.

The determinant value was 5.235×10^{-4}, which exceeds the acceptable threshold, suggesting no multicollinearity issues among the items. The EFA results showed that the extracted factors accounted for 75.124% of the total variance, demonstrating a strong factor structure.

These findings confirm that the dataset was appropriate for factor analysis, and the observed items loaded effectively onto their respective latent constructs. This provided a solid foundation for subsequent confirmatory factor analysis (CFA) and structural equation modeling (SEM).

Descriptive Analysis

A quantitative overview of a data collection is provided by descriptive statistics like the mean and standard deviation (Marsh, Craven, & Debus, 1998). The mean scores for three constructs, peer assisted learning, students' attitudes toward mathematics, and their accomplishment in mathematics are highlighted in this study. A 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was employed to evaluate these constructs.

Table 3: Descriptive Statistics

Variable	Mean	Std. Deviation
ATTITUDE OF STUDENTS IN MATHEMATICS I have trouble understanding anything related to mathematics	3.2329	1.11583
I'm just not good at mathematics.	3.6082	.93904
I get very nervous during mathematics class.	3.0932	1.03620
I often worry that it will be difficult for me to attend math lectures	3.9233	.64589
I often feel helpless when trying to solve a math problem	3.7836	.59277
Mathematics makes me feel uneasy and confused.	3.9288	.81562
Total	**3.5950**	**0.8575**
STUDENTS' ACHIEVEMENT IN MATHEMATICS I am good at working out difficult mathematics tasks	3.2959	1.32396
Mathematics is not one of my strengths	3.5671	1.23769
I am just not good at mathematics	3.4849	1.14734
Mathematics is extra problematic for me than for many of my classmates	3.8192	1.16740
I think learning mathematics will help me in my daily life	3.1781	1.17134
Total	**3.4690**	**1.12095**
PEER-ASSISTED LEARNING IN MATHEMATICS Peer assisted learning is an effective intervention for the improvement of content knowledge, and increase understanding of subject matter.	3.6740	.91117
Peer assisted learning is found to be effective in assisting students improve teaching practices in the classroom.	3.6356	.69641

In peer assisted learning, students work in one-on-one pair which increase academic commitment in the school environment.	3.6329	.65214
Peer assisted learning creates a friendly learning environment in the school.	3.7507	.80574
Peer assisted learning helps the teacher to engage all students of the classroom in learning activity according to their individual needs	3.8575	.91776
Total	**3.71014**	**0.79664**
STUDENTS' INTEREST IN MATHEMATICS		
I enjoy learning mathematics	3.4822	.56727
I like mathematics	3.5534	.62505
Mathematics is boring	3.0110	1.02437
I learn many interesting things in mathematics	3.6712	.77486
I like to solve mathematics problems	3.4411	1.40641
Total	**3.43178**	**0.80759**

Source: Field Survey (2024)

The study employed descriptive analysis to evaluate the model fit and test the normality of the questionnaire items. This analysis utilized mean and standard deviation to assess whether the data adhered to one of the key assumptions of multivariate statistics. Specifically, it is assumed that measurement items should be normally distributed, with mean scores on a 5-point scale (ranging from 1, strongly disagree, to 5, strongly agree) ideally exceeding the midpoint of 3.0. Based on mean scores and standard deviations, Table 2 presents an examination of the descriptive statistics for each latent variable: students' interest in mathematics, math efficacy, attitudes toward math, peer-assisted learning, and math achievement. Less than two standard deviations suggest that the data is centered around the mean.

Every latent and observable variable had mean values greater than 3.0 and standard deviations within ±2, indicating a normal distribution. A standard deviation of less than 1.5 indicates an even closer distribution of the data around the mean.

Confirmatory Factors Analysis (CFA)

This factor analysis was performed to test the various claims within the research questions (hypotheses) that, a relationship between the observed variables and their latent constructs variable exists. CFA was performed also to evaluate how well each observed data point corresponds to each element. The computation of the CFA was also to assess how the observed variables fit the prior conceptualized and theoretically grounded model to specify the hypothesized causal relationship between the latent factors.

Amos (version 23) was employed to perform the CFA. The CFA is more versatile than other statistical methods, as evidenced by numerous studies that have employed it. This is because the CFA can estimate a variety of statistical tests (Sakaria, 2023). Table 4 outlines the CFA analysis. The observed variables from the rotated components were used to conduct the CFA following the EFA. In this analysis, factor loadings greater than 0.5 were considered, and observable variables from the EFA with weak factor loadings below 0.5 were excluded. From the table 4, all the confirmatory factor loading had a correct loadings greater than 0.5 and it signifies that they are all good for further analysis.

Table 4: Confirmatory Factor Analysis

Model Fit Indices: Chi-square (CMIN)=401.906; Degree of freedom (df)=233 $CMIN/df$=1.725; (TLI) = 0.968; RMSEA=0.053; Comparative fit index (CFI)=0.973; & Goodness-of-fit index (GFI)=0.891, PCLOSE = 0.618

Attitude of Students in Mathematics AVE=0.571;CR=0.887;CA=0.685;	**Factor Load**
I have trouble understanding anything related to mathematics	.717
I'm just not good at mathematics.	.898
I get very nervous during mathematics class.	.811
I often worry that it will be difficult for me to attend math lectures	.764
I often feel helpless when trying to solve a math problem	.691
Mathematics makes me feel uneasy and confused.	.621
Students' Achievement in Mathematics AVE=0.671; CR=0.910; CA=0.726;	
I am good at working out difficult mathematics tasks	.844
Mathematics is not one of my strengths	.866
I am just not good at mathematics	.840
Mathematics is extra problematic for me than for many of my classmates	.824
I think learning mathematics will help me in my daily life	.714
Peer-Assisted Learning in Mathematics AVE=0.592; CR=0.878; CA=0.931;	
Peer assisted learning is an effective intervention for the improvement of content knowledge, and increase understanding of subject matter.	.866
Peer-assisted learning is found to be effective in assisting students improve teaching practices in the classroom.	.821
In peer assisted learning, students work in one-on-one pair which increase academic commitment in the school environment.	.596
Peer assisted learning creates a friendly learning environment in the school.	.777
Peer assisted learning helps the teacher to engage all students of the classroom in learning activity according to their individual needs	.669

Source: Field Survey (2024)

Confirmatory Factor Analysis (CFA) results

A Confirmatory Factor Analysis (CFA) was conducted using AMOS version 23 to validate the factor structure identified through EFA. The model demonstrated a good fit to the data, with fit indices meeting recommended thresholds: CFI = 0.973, TLI = 0.968, RMSEA = 0.053, and GFI = 0.891 (Hair et al., 2014). The chi-square statistic was significant ($\chi^2 = 401.906$, df = 233, $p < 0.001$), but the ratio of $\chi^2/df = 1.725$ fell within the acceptable range (below 3), indicating good model fit.

All factor loadings exceeded 0.5, supporting the convergent validity of the constructs. Average Variance Extracted (AVE) values ranged from 0.571 to 0.671, exceeding the 0.50 threshold, and Composite Reliability (CR) values were above 0.87, indicating strong reliability (Fornell & Larcker, 1981). Discriminant validity was confirmed as the square roots of AVE values were greater than the inter-construct correlations.

These results confirm that the measurement model has acceptable reliability and validity, supporting its use for subsequent structural equation modeling (SEM) analysis.

Figure 1: Confirmatory Factor Aanalysis

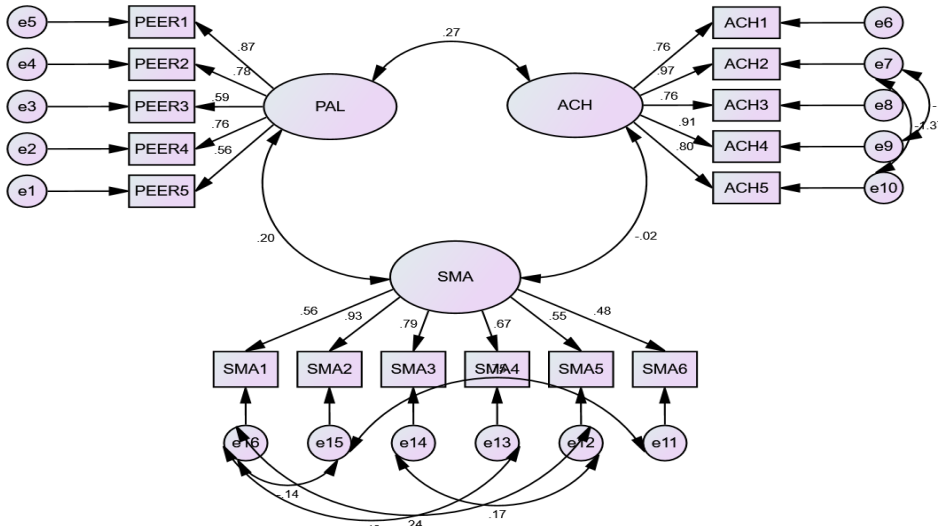


Table 5: Discriminant Validity

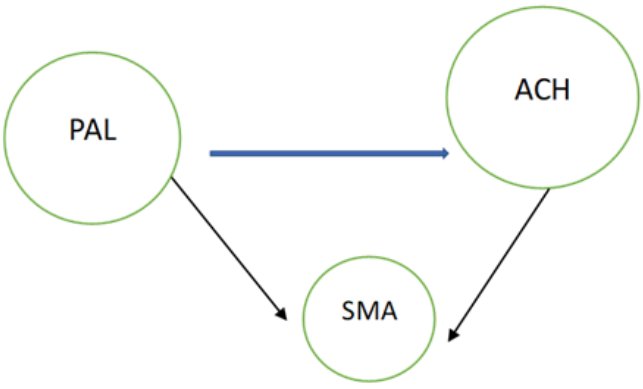
Variables	PEER	SMA	SME	SMI	ACH
PEER	**0.722**				
SMA	0.220	**0.707**			
SME	0.081	0.026	**0.721**		
ACH	0.229**	0.069	0.103	-0.039	**0.819**

** ~ P-value significant at 1% (0.01)

√AVE are bold and underlined

From Table 5, since √AVE is greater than the correlation values of the latent variables where the highest √AVE value is 0.918 with the highest correlation coefficient value as 0.229. This explains that discriminant validity is achieved. This explains that the observable items under each of the five constructs are good for further analysis.

Conceptual Framework



PAL ----- Peer assisted learning

ACH ---- Achievement

SMA ---- student's mathematics attitude

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Path Analysis

The study used covariance-based structural equation modeling (SEM) with AMOS version 23 to estimate the route coefficients. The findings of the investigation are displayed in Table 7 and Figure 3. The study accounted for potential influences by controlling for variables like gender, age, form, religion, parents' highest level of education, and study program.

Figure 3: Path analysis.

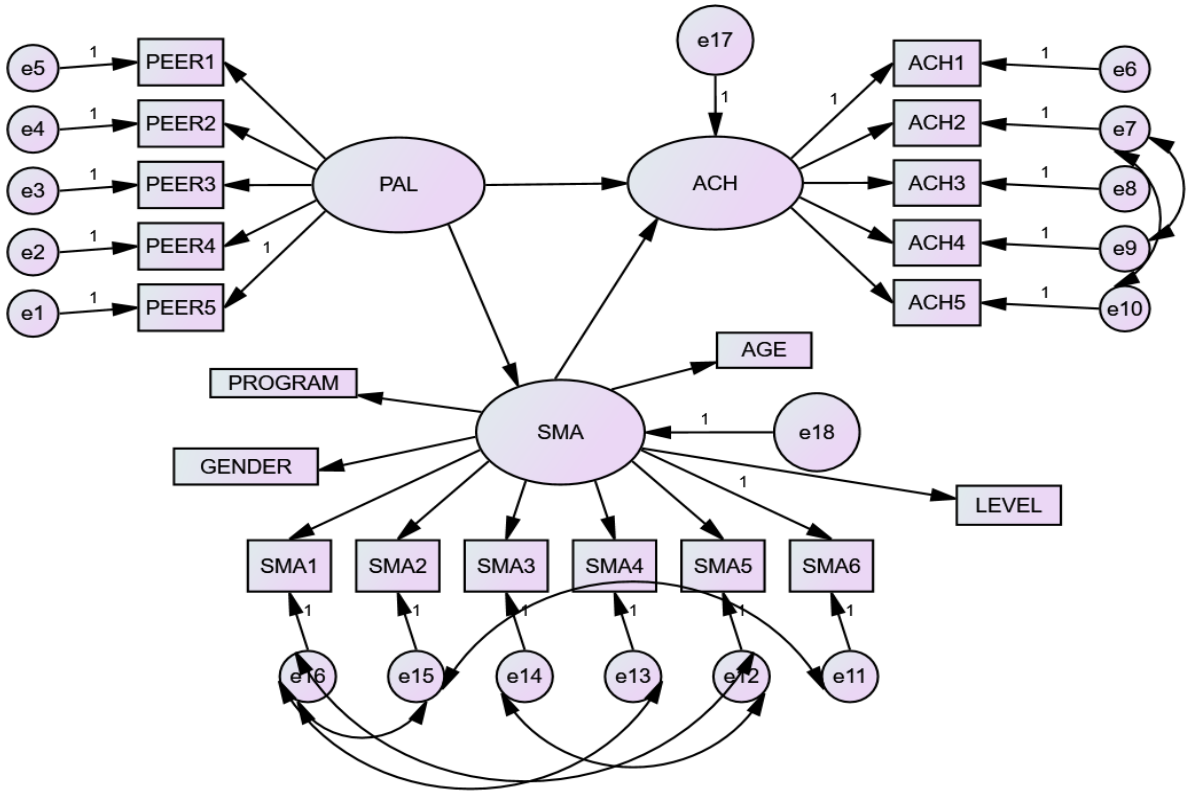

Table 7: Path Coefficient of Hypotheses

Path estimate Direct	**Estimate**	**B.S.E.**	**CR**	**BCp CI 95% CI**		**P VALUE**
				LL	**UL**	
PAL→ACH	0.695	0.264	2.633	0.370	0.921	0.013
PAL→SMA	0.521	0.053	9.830	0.213	0.628	0.000
SMA→ACH	0.314	0.073	4.301	0.140	0.460	0.001
Indirect Paths (Mediators)	**Estimate**	**B.S.E.**		**BCp CI 95% CI**		**P VALUE**
				LL	**UL**	
PAL→ SMA→ACH	0.164	0.042		0.098	0.245	0.001

.973; TLI = .967; NFI=0. 917; GFI= 0.881; RMSEA = 0.054; RMR=0.068 PCLOSE=0.074

Note. CI=confidence interval; LL=lower limit UL=upper limit. B.S. E= Standard Error. BCpCI= Bias Corrected and Accelerated 95% CI for 5000 bootstrap resamples of the sample size (260) Source: Field survey (2024)

* ~ P-value significant at 5% (0.05)

Source: Field Survey (2024)

DISCUSSION AND FINDINGS'

The Effect of Peer-Assisted Learning on Students' Mathematics Achievement

This path represents Hypothesis 1 (H1), which proposed that peer-assisted learning (PAL) positively influences students' mathematics achievement.

As shown in Table 7, the structural equation modeling (SEM) results indicated that PAL had a significant positive effect on mathematics achievement ($\beta = 0.695$, CR = 2.633, $p = 0.013$). The critical ratio (CR = 2.633) exceeds the threshold of 1.96, confirming that the effect is statistically significant at the 0.05 level.

Therefore, the null hypothesis is rejected, and Hypothesis 1 is supported. These findings suggest that peer-assisted learning significantly and positively predicts students' mathematics achievement in the two study areas.

The Mediating Effect of Students' Mathematics Attitude

This path represents Hypothesis 2 (H2), which proposed that students' mathematics attitude mediates the relationship between peer-assisted learning (PAL) and students' mathematics achievement.

As shown in Table 7, the direct effect of PAL on students' mathematics attitude was significant ($\beta = 0.521$, CR = 9.830, $p < 0.001$), and students' mathematics attitude also had a significant direct effect on mathematics achievement ($\beta = 0.314$, CR = 4.301, $p = 0.001$).

The indirect effect of PAL on mathematics achievement, mediated by students' attitude, was also statistically significant ($\beta = 0.164$, 95% BC CI [0.098, 0.245], $p = 0.001$). The bootstrap confidence interval did not include zero, indicating a significant mediation effect (Preacher & Hayes, 2008).

Therefore, the null hypothesis is rejected, and Hypothesis 2 is supported. These results confirm that students' mathematics attitude partially mediates the relationship between peer-assisted learning and mathematics achievement.

Table 8. Summary of Hypotheses Testing Results

Hypothesis Code	Hypothesis Statement	Path Estimate (β)	CR	p-value	Result
H1	Peer-assisted learning positively influences students' mathematics achievement.	0.695	2.633	0.013	Supported (Significant at $p < 0.05$)
H2	Students' mathematics attitude mediates the relationship between peer-assisted learning and mathematics achievement.	Indirect effect = 0.164	—	0.001	Supported (Significant mediation at $p < 0.01$)

CONCLUSION

The purpose of this study was to examine the influence of peer-assisted learning (PAL) on students' mathematics achievement, with a focus on the mediating role of students' attitudes toward mathematics. The findings provide evidence that PAL significantly and positively predicts mathematics achievement among senior high school students in the Sekyere-Kumawu District of Ghana. Additionally, students' attitudes toward mathematics were found to partially mediate this relationship, indicating that PAL not only directly enhances achievement but also does so indirectly by fostering more positive attitudes.

The result supporting Hypothesis 1 confirms that peer-assisted learning has a significant positive effect on

students' mathematics achievement. This aligns with previous research by Fuchs and Fuchs (2008) and Kucharski and Jackson (2015), who demonstrated that PAL improves students' academic outcomes through active engagement and collaborative learning. More recent studies, such as Arthur (2022) and Usman and Jamil (2019), have similarly shown that PAL fosters deeper understanding and retention, particularly in mathematics. Our findings extend this body of knowledge by providing evidence from a Ghanaian context, supporting the argument that structured peer-assisted learning programs can be effective even in resource-constrained educational settings.

The significant mediating effect of students' mathematics attitude, as confirmed in Hypothesis 2, highlights the psychological mechanism through which PAL exerts its influence. This result is consistent with the work of Ginsburg-Block et al. (2006) and Leung (2019), who found that peer learning environments positively shape students' attitudes and motivation, leading to improved academic outcomes. In the African context, studies by Hagan (2020) and Kiwanuka et al. (2020) have emphasized the critical role of attitudes in shaping mathematics performance. Our study contributes to this literature by empirically demonstrating that improving students' attitudes through PAL is an effective pathway to boosting achievement.

Beyond confirming prior findings, these results carry important practical implications. Schools should consider integrating structured peer-assisted learning models into their mathematics instruction, providing students with regular opportunities for collaborative problem-solving and peer tutoring. Additionally, programs aimed at enhancing students' attitudes toward mathematics—such as motivational workshops, mentoring schemes, and positive reinforcement strategies—may further amplify the benefits of PAL. Given the significant mediation effect observed, fostering positive mathematics attitudes should be a core component of interventions aimed at improving achievement.

In summary, this study underscores the dual role of peer-assisted learning in enhancing mathematics performance both directly and indirectly through attitudinal change. By adopting PAL strategies and promoting positive mathematics attitudes, educators can create more supportive and effective learning environments that drive student success.

RECOMMENDATION

The following recommendations are suggested by the study's findings:

1. Given the significant positive impact of peer-assisted learning on students' mathematics achievement, schools should consider integrating structured peer-assisted learning programs into their curriculum. Training sessions for both students and teachers on effective peer-assisted learning strategies can enhance this approach's success.
2. Since students' mathematics attitudes partially mediate the relationship between peer-assisted learning and academic performance, it is essential to foster a positive attitude toward mathematics. This can be achieved through motivational workshops, positive reinforcement, and creating a supportive classroom environment.

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