# The Effect of Peer Tutoring on Students' Mathematics Achievement: Mediating Roles of Students' Perception of Mathematics and Students' Engagement

**Emmanuel Takyi, Akwaboah Sumaila**

**Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, kumasi, Ghana**

**DOI: https://dx.doi.org/10.47772/IJRISS.2025.90600004**

**Received: 22 May 2025; Accepted: 27 May 2025; Published: 26 June 2025**

## INTRODUCTION

Humans learn best when they repeat the same behavior multiple times, according to numerous research (Jennifer 2015; Kang, 2016). It implies that students learn more effectively and retain information longer when teachers create a supportive learning environment where students may practice and repeat topics meaningfully while getting positive feedback.

According to Dada et al., (2023), Active-learning pedagogies aim to include students in the development of knowledge and shift classroom learning toward a more self-personal approach. This setting is different from a standard lecture, which depends on students listening passively and focuses on imparting instructor information. The Ghanaian education community advocates for a change in teaching methods from traditional (conventional) approaches to learner centered approaches that prioritize students' accomplishments, active knowledge generation, retention, information transfer, and problem-solving skills.

Peer tutoring is a unique teaching technique in which students are paired up in pairs, sometimes with varying skills, to function as tutor and tutee during the learning process in order to maximize the advantages from one another." (Nawaz & Reman 2017). This method of teaching has advantages for both the tutees and the tutors because it allows the latter to strengthen their own comprehension and subject matter expertise.

According to Anita and Susilawati (2018), student engagement in the learning process is the degree of focus, curiosity, interest, optimism, and passion that students exhibit while learning or receiving instruction. According to Skinner et al. (2008), student involvement in mathematics education includes both intrinsic interest and curiosity about mathematical concepts and applications.

Students' perception of mathematics encompasses their beliefs, attitudes, and opinions regarding the subject (Boaler, 2020). This includes perceptions of relevance, interest, and self-efficacy in mathematics. Research suggests that when students perceive mathematics as meaningful, applicable, and personally relevant, they are more motivated to learn and engage with the material (Middleton et al 2017). Negative perception of students about mathematics significantly influence their interest in mathematics (Arthur et al., 2017). On the other hand, Students with positive attitudes towards mathematics are more likely to exhibit perseverance and resilience when encountering difficult problems (Di Martino & Zan, 2010).

**Keywords:** peer tutoring, students' perception, student's engagement, mathematics achievement

### Statement Of Problem

A study by Arthur et al., (2022) reveals peer tutoring as a major predictor of students' mathematics achievement. However, the study was limited to the direct effect of peer tutoring, teaching quality and motivation on mathematics achievement. Moreover, a study by Boadu et al (2023) reveals that peer tutoring is partially mediated by motivation; however, the study was limited to the mediating and moderating effect of peer tutoring on mathematics achievement. Despite its potential, the specific mechanisms through which peer tutoring impacts academic outcomes remain under-explored. In light of these findings, the researcher looked into expanding the

body of literature by including the mediation effect of students' engagement and perception on the relationship between peer tutoring and mathematics achievement in senior high schools.

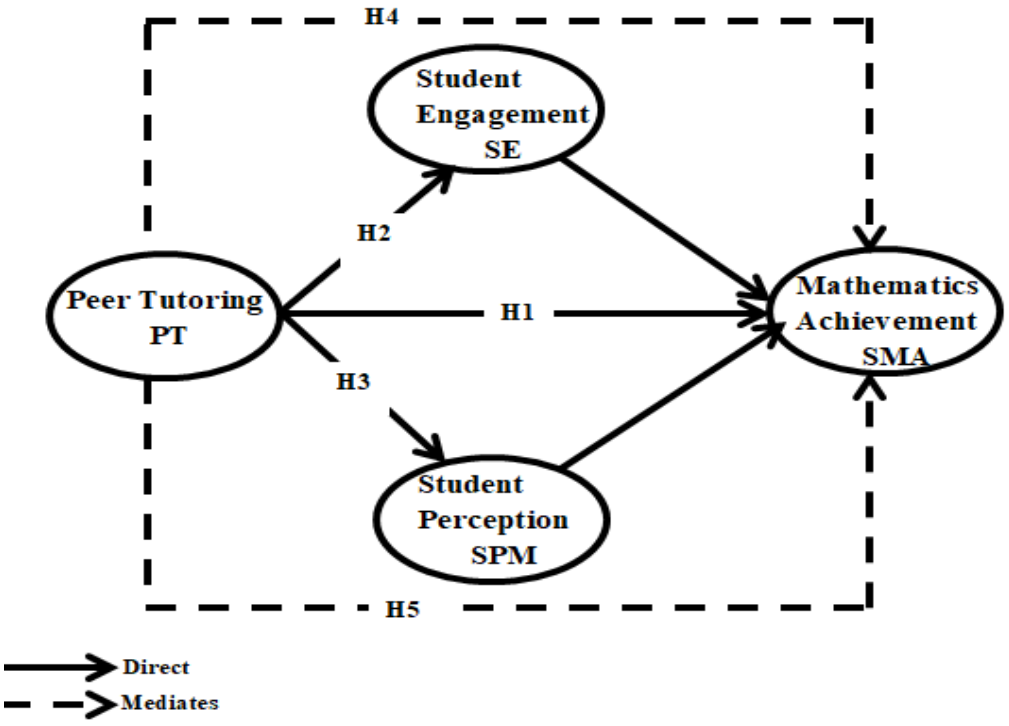
### Research Objectives

1. To determine the effect of peer tutoring on students' mathematics achievement in senior high school.
2. To determine the effect of peer tutoring on students' engagement in senior high school.
3. To determine the effect of peer tutoring on students' perception of mathematics in senior high school.
4. To determine the mediating effect of students' perception in the relationship between peer tutoring and students' mathematics achievement in senior high school.
5. To determine the mediating effect of students' engagement in the relationship between peer tutoring and students' mathematics achievement in senior high school

### Research Hypothesis

1. H1: Peer tutoring has a significant direct effect on senior high school students' mathematics achievement.
2. H2: Peer tutoring has a significant direct effect on senior high school students' engagement.
3. H3: Peer tutoring has a significant direct effect on senior high school students' perception of mathematics.
4. H4: Students' engagement significantly mediates the relationship peer tutoring and senior high school students' mathematics achievement.
5. H5: Students perception of mathematics significantly mediates the relationship between peer tutoring and high school students' mathematics achievement.

### Conceptual Framework




## LITERATURE REVIEW

### Peer Tutoring

Peer tutoring involves regular practice, active participation from all students, and reciprocal practice, where students can take turns being both the tutee and the tutor. Instant feedback and error correction are two of the most crucial aspects of the tutoring stage (Van der Kleij et al., 2015).

Students learn by teaching themselves and receive individualized, one-on-one instruction. During the tutoring process, each student receives instruction as well as the chance to instruct others. Peer tutoring benefits teachers

by lowering workload, enabling them to use the current curriculum, fitting sessions into existing class periods, and sharing outcomes with administrators and parents. Students benefit from often practicing or repeating academic work. Students gain confidence, sharpen their problem-solving abilities, and comprehend the topic through collaboration, error correction, and quick feedback from instructors and peers (Hattie 2019).

**Students' perception of mathematics**

Perception is the process by which we perceive other people. People evaluate individuals who they could encounter in their daily lives in this way (Fiske et al., 2023). Barker, G. (2022) expanded perception by including a cognitive layer in their research. Considering perception to be the method by which people give meaning to their experiences. Perceptions of mathematics are characterized as mental models or viewpoints that seem to have developed through social contacts, classroom interactions, or the influence of parents, instructors, classmates, or the media (Mutodi, et al 2014). As educational stakeholders look for a long-term solution to the issue of low performance and disinterest in mathematics, students' perceptions of the subject matter are still vital. These students' views of mathematics could be the consequence of early experiences that the students had (Arthur et al., 2017). Prior experiences influence perceptions and beliefs about mathematics and have cognitive and affective dimensions. (Mutodi, et al 2014) From a cognitive perspective, how students' minds process information, create knowledge and create mental representations of mathematical concepts influences their perceptions and views about mathematics. Individuals organize knowledge into mental structures known as schemas, (Carpenter et al., 2021). Students' mathematical schemas, which affect how they understand new information, solve problems, and perceive the topic as a whole, are formed in part by their prior experiences with mathematics.

**Students Engagement**

According to Reschly and Christenson (2012), the goal of enhancing student learning is one of the primary drivers of interest in engagement. Numerous scholars have examined engagement with educational settings, concentrating on school engagement (Skinner et al., 2009), academic engagement (Appleton et al., 2008; Suarez-Orozco et al., 2009), or classroom engagement, which refers to classroom activities.

While it has long been recognized that a student's academic performance is a result of both school-related and personal factors, there is currently a knowledge vacuum on the precise mechanism by which these elements interact to produce that achievement (Kahu & Nelson, 2018). As a remedy, Sa (2023) proposed that the relationship between school and student characteristics was facilitated by student involvement. Later, "student involvement" was replaced with the word "student engagement."

Diverse researchers have approached the topic of students' engagement in different ways. According to Reschly and Christenson (2012), student engagement is the glue or mediator, that links important contexts: home, school, peers, and community to students and in turn, to the outcome of interest. There is consensus on the multidimensional character of student engagement, according to Trowler & Trowler (2011) and Appleton (2008). Behavioral, emotional (or affective), and cognitive aspects of engagement. This study adopts the tripartite definition of the construct behavioral, emotional, and cognitive as proposed by Fredricks et al. (2004).

**The influence of Engagement on mathematics achievement**

Active participation and cognitive engagement help in constructing a deeper understanding of the material. Deci and Ryan (2022) also suggest that Engagement fosters intrinsic motivation, leading students to pursue mathematical learning with interest and enthusiasm. Engaged students are more persistent and resilient, even when faced with challenging problems. Numerous studies have shown a positive correlation between student engagement and academic performance in mathematics (Saeed et al. 2012, Widlund et al 2022). Engaged students tend to have higher grades and better test scores (Finn et al., 2023). Engagement in mathematics promotes the development of critical thinking and problem-solving skills. Students who are actively involved in learning activities are more likely to apply these skills in various contexts (Blumenfeld et al., 2023).

One important component affecting math achievement is engagement. Teachers can improve student engagement by establishing a growth mindset, utilizing interactive teaching techniques, connecting mathematics

to real-world applications, and creating a supportive learning atmosphere.

# METHOD

### Rsearch paradigm

The researcher used the positivist paradigm for the research. Positivism is the scientific perspective on the world (Pawlikowski, et al, 2018). According to Alharahshah and Pius (2020), positivist research philosophy centers on the researcher's use of observed reality within society to make generalizations.

### Research Approach

The researcher used the quantitative research approach. Creswell and Creswell (2018) define quantitative research as a method that involves the collection and analysis of numerical data to identify patterns, test hypotheses, and make predictions.

A descriptive survey research design was used for this research. In order to enable researchers to collect data, summarize, present, and evaluate data in order to provide clarification. The goal of descriptive survey research is to generate statistical data on aspects of education that are of interest to educators and policymakers. This study was appropriate for the descriptive survey research design since the data was gathered and reported by the researcher in the manner that respondents provided it, with no factors being changed.

### Population

Creswell (2014) Describes the population as a complete set of individuals or elements relevant to the research from which samples may be drawn for analysis. 1,400 senior high schools 1 and 2 students from Kumasi Technical Institute in the Kumasi metropolis located in Ghana's Ashanti region comprised the study's population.

### Sampling and sample size

The goal of using a sample is to generalize findings from this smaller group to the entire population, making the research process more practical and efficient. In 1970, Krejcie and Morgan developed a table to determine the sample size for a given population in order to close the gap. According to Krejcie and Morgan (1970), the sample size table for a population of 1,400 is 302, with a 95% confidence interval and an error margin of 5.0%.

Purposive, Stratified and simple random sample technique was employed in this study. The two Senior High School (SHS) classes' students in the Kumasi Technical Institute were selected using purposive sampling, a non-probability sample technique. Focusing on particular population features that were interested and would best address the research objectives was the main goal of purposive sampling. The Stratified Sampling technique was utilized, with each level representing a strata, due to the diverse populations seen in each level. The sample size for each level (stratum) was similarly determined by the proportionate stratified sampling technique, Simple random sampling was employed in each stratum and 302 samples were taken overall. Simple random sampling was employed in each stratum since it ensures sample consistency using random sampling together with all population parameters. Each member of the population had a fair opportunity of being chosen for the study.

### Instruments

A structured questionnaire was used to gather quantitative data for this descriptive study. This approach was used since questionnaires are the most often used data collection instrument for descriptive research due to their ease of distribution to a broad audience and ability to be thoroughly assessed through statistical techniques (Hair et al 2019).

The respondents completed the questionnaires in English language, with the researchers using one dependent variable; Students Mathematics Achievement (SMA), one independent variable Peer tutoring (PT) and two mediating variables Students' Perception of Mathematics (SPM) and students' engagement (SE). While the second segment had a series of questions meant to address the study questions, the first component collected

biographical information from the students. Based on the research questions of the study, the survey had 40 closed-ended statements that were separated into four sections.

**Data Analysis**

Using SPSS AMOS.V.23, the researcher used the Structural Equation Model (SEM) to analyze the data. Peer tutoring, students' mathematics achievement, students' perception of mathematics and students' engagement were the variables for the study. The study was descriptive in nature. To ascertain the demographic data of the study respondents, this analysis was done for every variable.

The frequency and proportion of each demographic feature, as well as the level of data reliability, were examined descriptively. After that, an exploratory factor analysis (EFA), was performed on the study items to ascertain how they were categorized in relation to the particular factors' structures. The proposed model was then tested using a structural equation model (SEM) that showed path analysis and CFA with a 95% confidence interval and a 0.05 alpha level. The researcher also looked for significant and normalcy assumptions, depending on the kind of statistical investigation. For inferential analysis, the bootstrap technique was applied to increase the accuracy of the findings

**Table 1: Demographic Information**

| **Demographics** | **Frequency (N)** | **Percentages** (%) |
|---|---|---|
| **Gender** | | |
| Male | 201 | 66.6 |
| Female | 101 | 33.4 |
| **Total** | **302** | **100.0** |
| **Age** | | |
| 13-15 years | 39 | 12.9 |
| 16-18 years | 251 | 83.1 |
| 19 years and above | 12 | 4.0 |
| **Total** | **302** | **100.0** |
| **Form** | | |
| Form 1 | 51 | 16.9 |
| Form2 | 351 | 83.1 |
| **Total** | **302** | **100.0** |
| **Program** | | |
| Electricals | 71 | 23.5 |
| Building and construction | 54 | 17.9 |
| Fashion Design Technology | 82 | 27.2 |
| Plumbing and Gas | 65 | 21.5 |
| Others | 30 | 9.9 |
| **Total** | **302** | **100.0** |
| **Source: Field Survey (2024)** | | |

## RELIABILITY ANALYSIS RESULTS

Cronbach's alpha was used to assess each construct's internal consistency. The analysis was carried out to purify the questionnaire items, and it provides proof that all aspects of the field under investigation were measured by

the study instrument sample items. Table 5 shows that the items obtained in this investigation have an alpha value larger than 0.6, which is considered adequate by Sekaran and Bougie (2010).

**Table 2: Reliability values of the study item**

| **Construct** | **Cronbach Alpha** | **Number of Items** |
|---|---|---|
| Peer Tutoring | 5 | 0.893 |
| Students' Perception of Mathematics | 5 | 0.939 |
| Students' Engagement | 5 | 0.908 |
| Students Mathematics Achievement | 6 | 0.921 |
| **Source: Field Survey, 2024** | | |

All four constructs in Table 2 with the twenty-one items have Cronbach alpha coefficient greater than 0.8. This suggests that the items are very consistent. Each of the four constructs was calculated, table five shows that Peer tutoring had an alpha value of 0.893 with five measurement items, students' perception of mathematics had an alpha value of 0.939 with 5 measurement items, Students' engagement had an alpha value of 0.908 with 5 measurement items and students' mathematics achievement had an alpha value of 0.921 with 6 measurement items.

**Exploratory Factor Analysis (EFA)**

Table 3 shows that the sampling adequacy KMO measure was 0.790, greater than 0.5 for the required factoring value. Given that this is an exemplary value, it demonstrates that each item is firmly connected to the others (Hair et al., 2014). With a p-value of 0.000 for Bartlett's sphericity test, which indicates statistical significance, there was sufficient correlation to allow for factor analysis, and the Chi-square value was 5505.209, indicating 210 levels of degree of freedom. To determine how many components needed to be retrieved, the researcher ran a factor analysis. After all, four components were removed and rotated, the determinant was 6.981E-5 and the total variance explained is 74.355%.

**Results for the Exploratory Factor Analysis (EFA)**

**Table 3: Exploratory Factor Analysis**

| | Component | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| PT1 | | | | .817 |
| PT2 | | | | .837 |
| PT3 | | | | .835 |
| PT4 | | | | .880 |
| PT5 | | | | .812 |
| SPM6 | | .892 | | |
| SPM7 | | .934 | | |
| SPM8 | | .887 | | |
| SPM9 | | .876 | | |
| SPM10 | | .881 | | |
| SE2 | | | .883 | |

| | | | | |
|---|---|---|---|---|
| SE4 | | | .791 | |
| SE5 | | | .911 | |
| SE9 | | | .742 | |
| SE10 | | | .920 | |
| SMA2 | .798 | | | |
| SMA3 | .861 | | | |
| SMA4 | .872 | | | |
| SMA5 | .870 | | | |
| SMA6 | .855 | | | |
| SMA7 | .810 | | | |
| **Total Variance Explained** | | | **74.355%** | |
| **KMO** | | | **0.790** | |
| Bartlett's Test of Sphericity | Approx. Chi-Square | | 5505.209 | |
| Df | | | 210 | |
| **Sig** | | | **0.000** | |
| **Determinant** | | | **6.981E-5** | |

**Confirmatory Factor Analysis (CFA)**

**Table 4: Confirmatory Factor Analysis**

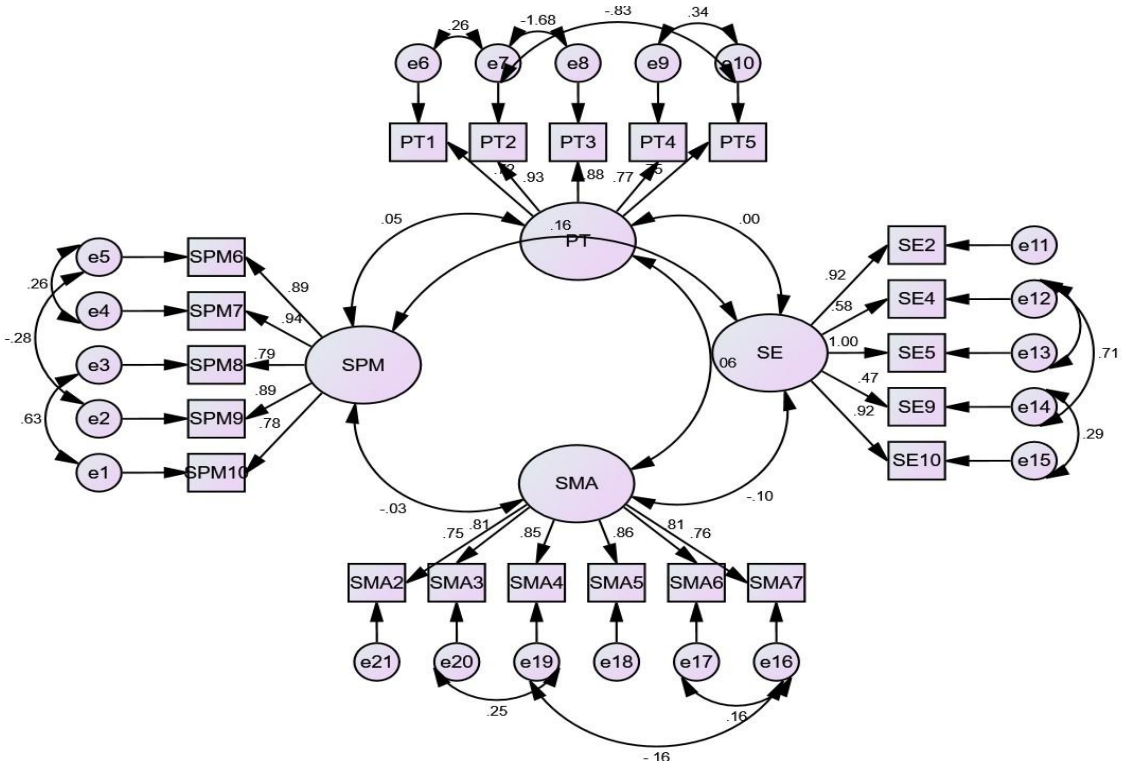
| **ITEMS** | **Factor Loading** |
|---|---|
| **STUDENTS PERCEPTION OF MATHEMATICS (SPM). CA= 0.939; CR =0.934 ; AVE = 0.739** | |
| (SPM10) I am proud of my abilities in mathematics | 0.783 |
| (SPM9) I am one of those people who just does not understand mathematics | 0.886 |
| (SPM8) mathematics is for students with high ability | 0.795 |
| (SPM7) I have interest in mathematics | 0.936 |
| (SPM6) I perceive mathematics to be a difficult subject | 0.889 |
| **PEER TUTORING (PT) CA = 0.893; CR = 0.907 ; AVE = 0.663** | |
| (PT1) Peer tutoring has improved my understanding of mathematics concepts | 0.721 |
| (PT2) I feel more confident in my math abilities because of peer tutoring | 0.932 |
| (PT3) I am more engaged in mathematics class because of peer tutoring | 0.884 |
| (PT4) Peer tutoring has helped me to complete math assignments more easily | 0.768 |
| (PT5) I feel comfortable asking questions during peer tutoring session | 0.746 |
| **STUDENTS' ENGAGEMENT (SE) CA =0.908; CR = 0.898 ; AVE = 0.654** | |
| (SE2) When I'm in class, I participate in class discussions | 0.923 |
| (SE4) when we work on something in class I feel interested | 0.580 |
| (SE5) I enjoy learning new things in class | 1.002 |

| | |
|---|---|
| (SE9) I believe that practicing mathematics regularly is essential for improvement | 0.470 |
| (SE10) I seek assistance from teachers or peers when faced with challenging math problems | 0.925 |
| **STUDENTS MATHEMATICS ACHIEVEMENT (SMA) CA = 0.921; CR =0.919 ; AVE = 0.654** | |
| (SMA7) During math class, I feel most fulfilled when I attain good scores in a test | 0.758 |
| (SMA6) Mathematics is an easy subject to pass | 0.813 |
| (SMA5) My present knowledge in mathematics is high | 0.862 |
| (SMA4) I feel happy when answering mathematics questions | 0.855 |
| (SMA3) Mathematics helps me to understand other subjects | 0.809 |
| (SMA2) I usually do well in mathematics | 0.750 |

Model fit indices: Chi square (CMIN) =316.132 ; degree of freedom (df) = 170; CMIN/df = 1.860 ; (TLI)= 0.967 ; RMSEA = 0.053 ; (CFI) =0.973 ; (GFI) = 0.916

**Source: field survey, 2024**

In addition to displaying the usual factor loading and CFA results, Table 8 includes details on the 302 samples that were used in the study. With a degree of freedom of 170, a TLI of 0.967, RMSEA of 0.053, and all modifications performed in accordance with the general model, the chi square (CMIN) value is 316.132. Since it does not exceed 3.0, the chi square to degree of freedom (CMIN/DF) ratio of 1.860 is widely accepted (Hu, L. T., & Bentler, P. M., 1999). The model's validity is confirmed by the CFI = 0.973, which is greater than 0.90, indicating compatibility between the data and the model (Hu, L. T., & Bentler, P. M., 1999). The model's reliability is indicated by the GFI value of 0.916. Since the RMSEA value is less than 0.08, it is likewise acceptable (Hu, & Bentler, P. M., 1999). When the TLI is more than 0.90, it suggests that the model fit the data well. It is clear from the foregoing that the model fits well and is appropriate.




**Results of the Path Analysis**

Table 9 below shows the objectives and the summary of the hypothetical path: (direct and indirect) effects together with the model fit indices.

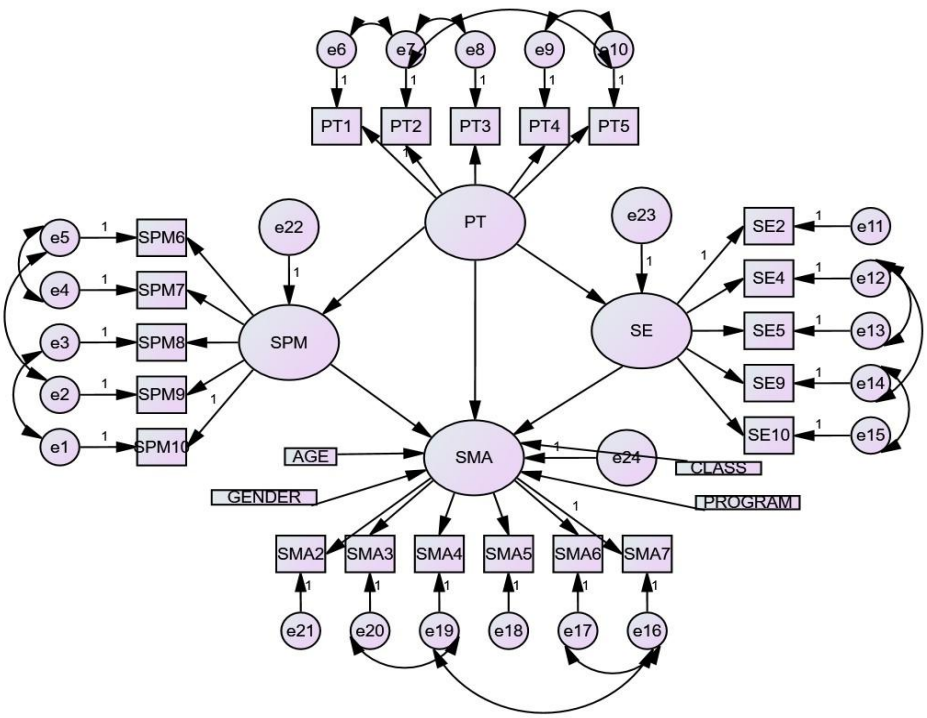
**Table 5: summary of hypothetical analysis results.**

| Path Direct | Estimate | B.S.E | BCp CI 95% CI LL | UL | P VALUE |
|---|---|---|---|---|---|
| PT → SMA | 0.541 | 0.028 | 0.312 | 0.584 | 0.032 |
| PT → SPM | 0.615 | 0.160 | 0.415 | 0.640 | 0.000 |
| PT → SE | 0.405 | 0.043 | 0.241 | 0.629 | 0.010 |
| SPM → SMA | 0.317 | 0.104 | 0.113 | 0.172 | 0.001 |
| SE→ SMA | 0.071 | 0.022 | 0.946 | 1.214 | 0.003 |
| **Indirect Path (mediators)** | **Estimate** | **B.S.E** | **BCp CI 95% CI LL** | **UL** | **P VALUE** |
| PT→ SP → SMA | 0.195 | 0.053 | 0.213 | 0.482 | 0.000 |
| PT → SE → SMA | 0.029 | 0.039 | 0.017 | 0.041 | 0.000 |

Model fit indices: Chi square (CMIN) = 462.729; degree of freedom (df) =257 ; CMIN/df =1.801 ; NFI = 0.920; (TLI)=0.956 ; RMSEA = 0.052; (CFI) = 0.963 ; (GFI) = 0.899 ; Note. CI: Confidence interval; LL: Lower limit; UL: Upper limit; SE: Standard error; BCpCI: Bias corrected & accelerated 95% CI for 5,000 bootstrap resamples of sample size of 302.

Source: field survey, 2024

Table 5 shows that the path analysis chi-square value of 462.729 demonstrates the goodness of fit model. Additionally, the two fit indices, NFI and TLI, were both larger than 0.9, suggesting a very good fit to the factor model, and the RMSEA of 0.052, which is less than 0.08, suggests a strong fit model for an absolute fit index with a 95% confidence interval (Hu & Bentler, 1999). Additionally noteworthy is the direct impact of the exogenous variable on the endogenous variables as indicated in Table 9, The direct effect of peer tutoring (PT) on students' perception of mathematics (SPM) students' engagement, and students' mathematics achievement is statistically significant, as indicated by the p-value ($p<0.005$). Below is an explanation of the direct and indirect effects based on the research questions and objectives



# RESULTS AND DISCUSSION

**H1: Peer tutoring has a significant direct effect on senior high school students' mathematics achievement**.

The estimate of 0.541 represents the direct effect of the predictor variable peer tutoring (PT) on the outcome variable students mathematics achievement (SMA). A positive estimate of 0.541 indicates that an increase in peer tutoring (PT) is associated with an increase in students' mathematics achievement (SMA). With standard error (B.S.E) of 0.028, which is smaller relative to the estimate, it suggests that the estimate is precise. The lower (LL) and the upper (UL) bounds of the 95% confidence interval for the path using the bias- corrected and accelerated (BCa) bootstrap method, the confidence interval (0.312 – 0.584) provides a range within which the true path coefficient is likely to fall with 95% confidence. Since both bounds are positive, this confirms that the path estimate is consistently positive and there is no indication it could be zero or negative. A p value of 0.032 is less than the commonly used significant level of 0.05. This suggests that the effect of peer tutoring on students' mathematics achievement is statistically significant (β = 0.541; BCpCI 95% (0.312, 0.584)). Hence, there is sufficient evidence to conclude that peer tutoring (PT) has a significant effect on students' mathematics achievement (SMA).

This result is consistent with a study conducted in 2023 by Adeneye et al., which revealed that using peer tutoring as a teaching approach has a major impact on senior secondary school students' mathematics achievement.

H2: **Peer tutoring has a significant direct effect on senior high school students' engagement.**

the estimate of 0.405 represents the direct effect of the predictor variable peer tutoring (PT) on the outcome variable students engagement (SE). A positive estimate of 0.405 indicates that an increase in peer tutoring (PT) is associated with an increase in students' engagement (SE). With standard error (B.S.E) of 0.043, which is smaller relative to the estimate, it suggests that the estimate is precise. The lower (LL) and the upper (UL) bounds of the 95% confidence interval for the path using the bias- corrected and accelerated (BCa) bootstrap method, the confidence interval (0.241 – 0.629) provides a range within which the true path coefficient is likely to fall with 95% confidence. Since both bounds are positive, this confirms that the path estimate is consistently positive and there is no indication it could be zero or negative. A p value of 0.010 is less than the commonly used significant level of 0.05. This suggests that the effect of peer tutoring on students' engagement is statistically significant (β = 0.405; BCpCI 95% (0.241, 0.629)). Hence, there is sufficient evidence to conclude that peer tutoring (PT) has a significant effect on students' engagement (SE).

According to a study by Adesope et al. (2021), students who took part in peer tutoring engaged in class at a considerably higher rate than those who did not. Self-reported data and classroom observations were used to measure this level of engagement. A study by Van der Kleij et al. (2020) found that peer tutoring participants spent more time on task, which is associated with improved academic achievement and higher levels of engagement.

H3: **Peer tutoring has a significant direct effect on senior high school students' perception of mathematics**

The estimate of 0.615 represents the direct effect of the predictor variable peer tutoring (PT) on the outcome variable student's perception of mathematics (SPM). A positive estimate of 0.615 indicates that an increase in peer tutoring (PT) is associated with an increase in students' perception of mathematics (SPM). With standard error (B.S.E) of 0.160, which is smaller, relative to the estimate, it suggests that the estimate is precise. The lower (LL) and the upper (UL) bounds of the 95% confidence interval for the path using the bias- corrected and accelerated (BCa) bootstrap method, the confidence interval (0.415 – 0.640) provides a range within which the true path coefficient is likely to fall with 95% confidence. Since both bounds are positive, this confirms that the path estimate is consistently positive. This indicates that the estimate is consistently positive and the true effect is likely to be positive. A p value of 0.000 is less than the commonly used significant level of 0.05. This suggests that the effect of peer tutoring on students' perception of mathematics is statistically significant (β = 0.615; BCpCI 95% (0.415, 0.640)). Hence, there is sufficient evidence to conclude that peer tutoring (PT) has a significant effect on perception of mathematics (SPM).

The finding is consistent with a study by Liu and Li (2021), that students who tutored others had a greater understanding of mathematical ideas, which enhanced their opinion of the subject as something they could become proficient in and like. Through peer tutoring, students are encouraged to describe mathematical ideas in their own terms, which can help them grasp the subject matter more thoroughly.

**H4**: **Students' engagement significantly mediates the relationship peer tutoring and senior high school students' mathematics achievement.**

A positive estimate of 0.029suggest that a peer tutoring (PT) influences students' mathematics achievement (SMA) indirectly through students' perception of engagement. With standard error (B.S.E) of 0.039, which indicates a reasonable level of precision for the estimate of the indirect effect. The lower (LL) and the upper (UL) bounds of the 95% confidence interval for the path using the bias- corrected and accelerated (BCa) bootstrap method, the confidence interval (0.017 – 0.041) this interval is narrow and entirely positive reinforcing the presence of a statistically significant indirect effect.. A p value of 0.000 indicates that the indirect effect is statistically significant providing strong evidence that the mediation effect of students engagement (SE) on the relationship between peer tutoring and students' mathematics achievement.

Huang and Zhang (2021) found that students are more likely to feel confidence in their abilities if they think peer tutoring is helpful in enhancing their comprehension of mathematics. Peer tutoring and achievement are mediated by this higher self-efficacy since math performance is more likely to come from students who feel secure in their abilities.

**H5**: **What is the mediating effect of students' perception in the relationship between peer tutoring and students' mathematics achievement in senior high school?**

A positive estimate of 0.195 indicates that a peer tutoring (PT) influences students' mathematics achievement (SMA) indirectly through students' perception of mathematics. With standard error (B.S.E) of 0.053, which indicates a reasonable precision for the estimate of the indirect effect. The lower (LL) and the upper (UL) bounds of the 95% confidence interval for the path using the bias- corrected and accelerated (BCa) bootstrap method, the confidence interval (0.213 – 0.482) provides a range within which the true path coefficient is likely to fall with 95% confidence. Since both bounds are positive, this confirms that the path estimate is consistently positive. This indicates that the estimate is consistently positive and the true effect is likely to be positive. A p value of 0.000 indicates that the indirect effect is statistically significant providing a strong evidence that the mediation effect of students perception of mathematics (SPM) on the relationship between peer tutoring and students' mathematics achievement is real. A study by Carter et al. (2022) reveals that there is a significant cumulative effect of peer tutoring on accomplishment through engagement, as evidenced by a total effect size that was significantly larger than 0.041. According to their findings, peer tutoring and achievement are mediated by engagement to a considerable extent. Additionally, peer tutoring had greater overall impacts on achievement, according to Jones and Moore (2021), highlighting the role that engagement plays as a mediator.

## CONCLUSION

Through peer tutoring, they become more inclined to share their opinions with their friends—something they are unable to do with their teachers. Students feel more confident and satisfied with themselves when they help other students demonstrate what they have learned. Peer tutoring improves understudies' retention, drive, and career choice (Schinske et al 2020)

According to the study's findings, peer tutoring significantly improved mathematics achievement. On the other hand, peer tutoring directly improved students' perception of mathematics. It also directly improved students engagement. . Lastly, student perception and student engagement mediated the relationship between peer tutoring and math achievement, and both mediators significantly improved senior high school students' mathematics achievement.

## RECOMMENDATION

Based on the findings of the study, the following recommendations were made;

1. Schools and educational institutions should consider implementing peer tutoring programs, especially in mathematics, as it has shown to significantly improve students' mathematics achievement.
2. Schools and educational institutions should consider incorporating peer tutoring strategies that actively involve students, making learning more interactive and engaging.
3. Teachers should consider using peer tutoring as a strategy to enhance students' attitudes towards mathematics. Positive experiences with peers can help simplify the subject and reduce mathematics phobia.
4. Teachers should provide extensive training for peer tutors to equip them with effective teaching strategies, ensuring they can facilitate learning effectively and foster positive attitudes among their peers

## REFERENCES

1. Adeneye, M. M., Adebisi, A. A., & Olawole, S. O. (2023). Effect of peer tutoring on the mathematics achievement of senior secondary school students. Journal of Education and Practice, 14(8), 11-18
2. Alharahshah, A. & Pius, A. (2020). Positivism and its implications for social science research. Journal of Critical Social Studies, 35(4), 27-39.
3. Anita, S., & Susilawati, S. (2018). Student Engagement in Learning Process. Journal of Educational Science and Technology (EST), 4(1), 1-10. https://doi.org/10.26858/est.v4i1.6128
4. Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). "Student Engagement with School: Critical Conceptual and Methodological Issues of the Construct." Psychology in the Schools, 45(5), 369-386. https://doi.org/10.1002/pits.20303
5. Arthur, Y. D., Asiedu-Addo, S., & Assuah, C. (2017). Students' perception and its impact on Ghanaian students' interest in mathematics: Multivariate statistical analytical approach. Asian Research Journal of Mathematics, 4(2), 1-12. https://doi.org/10.9734/arjom/2017/33023
6. Arthur, Y. D., Boadu, S. K., & Asare, B. (2022). Effects of peer tutoring, teaching quality and motivation on mathematics achievement in senior high schools. Int. J. Educ. Sci, 37(3), 35-43.
7. Barker, G. (2022). Cognitive Processes in Perception: Understanding How We Interpret Our World. Journal of Cognitive Psychology, 34(7), 872-888. https://doi.org/10.1080/20445911.2022.2065591
8. Blumenfeld, P. C., Kempler, T., & Krajcik, J. S. (2023). Engaging Students in Learning: How Active Participation Enhances Problem-Solving and Critical Thinking. Educational Psychologist, 58(2), 115-130.
9. Boadu, S. K., Arthur, Y. D., & Bonyah, E. (2023). Mediation and moderation effects of motivation and teaching quality on the relationship between peer tutoring and mathematics achievement. Journal of Mathematics and Science Teacher, 3(2).
10. Boaler, J. (2020). Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages, and Innovative Teaching. Jossey-Bass.
11. Carpenter, P. A., & Just, M. A. (2021). The Psychology of Mental Models: Schema Theory and Cognitive Processes. Annual Review of Psychology, 72, 175-201
12. Carter, N. T., Smith, E. R., & O'Brien, K. E. (2022). The effects of cooperative, collaborative, and peer-tutoring strategies on student engagement and achievement: A meta-analysis. SAGE Open, 12(1), 21582440211060823. https://doi.org/10.1177/21582440211060823
13. Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). SAGE Publications.
14. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.
15. Dada, D., Laseinde, O. T., & Tartibu, L. (2023). Student-centered learning tool for cognitive enhancement in the learning environment. Procedia Computer Science, 217, 507-512. https://doi.org/10.1016/j.procs.2022.12.246
16. Deci, E. L., & Ryan, R. M. (2022). Intrinsic Motivation and Self-Determination in Human Behavior. New York: Plenum.
17. Di Martino, P., & Zan, R. (2010). "Me and maths": Towards a definition of attitude grounded on students' narratives. Journal of Mathematics Teacher Education, 13(1), 27-48.

18. Finn, J. D., & Zimmer, K. S. (2023). Student Engagement and Academic Achievement: A Meta-Analysis of Research. Journal of Educational Psychology, 115(1), 10-27.
19. Fiske, S. T., & Taylor, S. E. (2023). Social Cognition: From Brains to Culture. Sage Publications.
20. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. Review of educational research, 74(1), 59-109.
21. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). Multivariate data analysis (7th ed.). Pearson.
22. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate Data Analysis (8th ed.). Cengage Learning
23. Hattie, J., & Clarke, S. (2019). Visible Learning: Feedback. Routledge
24. Hu, L. T., & Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives. Structural Equation Modeling, 6, 1-55.
25. Huang, X., & Zhang, Y. (2021). The mediating role of self-efficacy in the relationship between peer tutoring and mathematics achievement. Journal of Educational Research, 113(4), 235-248.
26. Jennifer (2015). Practice Does make perfect learning through repetition. Retrieved from http://zurapps.com/all/index.php/jennifer
27. Jones, A. B., & Moore, C. D. (2021). Engagement as a Mediator in the Relationship Between Instructional Strategies and Academic Achievement. Journal of Educational Research, 114(2), 123-134. https://doi.org/10.1080/00220671.2020.1827285
28. Kahu, E. R., & Nelson, K. (2018). "Student Engagement in the Educational Interface: Understanding the Mechanisms of Student Success." Higher Education Research & Development, 37(1), 58-71. https://doi.org/10.1080/07294360.2017.1344197
29. Kang, S. H. K. (2016). Spaced Repetition Promotes Efficient and Effective Learning: Policy Implications for Instruction. Policy Insights from the Behavioral and Brain Sciences, 3(1), 12–19.
30. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30(3), 607-610.
31. Liu, J., & Li, M. (2021). Peer tutoring and its impact on students' mathematical conceptual understanding and perception of the subject. Educational Studies in Mathematics, 108(2), 237-255
32. Marshall, C. & Rossman, G. (2011). Designing qualitative research. (5th ed.).
33. Middleton, J. A., & Jansen, A. (2017). Motivation Matters and Interest Counts: Fostering Engagement in Mathematics. National Council of Teachers of Mathematics.
34. Mutodi, P., & Ngirande, H. (2014). The Influence of Students' Perceptions on Mathematics Performance: A Case of a Selected High School in South Africa. Mediterranean Journal of Social Sciences, 5(3), 431-445. https://doi.org/10.5901/mjss.2014.v5n3p431
35. Nawaz, A. & Rehman, Z.U. (2017). Strategy of peer tutoring and students' success in mathematics: An analysis. Journal of Research and Reflection in Education 1I(1), 15-30.
36. Pawlikowski, J., Sak, J., Marczewski, K., & Klimasiński, M. (2018). Positivism and the natural sciences: The philosophical foundations of research and scientific inquiry. Philosophy of Science Review, 25(3), 213-230.
37. Reschly, A. L., & Christenson, S. L. (2012). "Jingle, Jangle, and Conceptual Haziness: Evolution and Future Directions of the Engagement Construct." In Christenson, S. L., Reschly, A. L., & Wylie, C. (Eds.), Handbook of Research on Student Engagement (pp. 3-19). Springer. Retrieved from http://www.specialconnections.ku.edu.
38. **Sa, P.** (2023). The Influence of School and Student Characteristics on Educational Outcomes: The Mediating Role of Student Engagement. Journal of Educational Research and Practice, 15(2), 45-60.
39. Saeed, N., & Zyngier, D. (2012). How motivation influences student engagement: A qualitative case study. Journal of Social Sciences Review, 3(2), 855.
40. Schinske, J., Cardenas, M., & Bhatt, I. (2020). Peer Tutoring and Student Outcomes: A Meta-Analysis. Journal of College Student Development, 61(5), 609-625. https://doi.org/10.1353/csd.2020.0067
41. Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic. Journal of educational psychology, 100(4), 765-781.
42. Suarez-Orozco, C., Rhodes, J., & Milburn, M. (2009). "Unraveling the Immigrant Paradox: Academic Engagement and Disengagement Among Recently Arrived Immigrant Youth." Youth & Society, 41(2), 151-185. https://doi.org/10.1177/0044118X09333647

43. Trowler, V., & Trowler, P. R. (2011). Student Engagement Evidence Summary. Higher Education Academy.
44. Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. (2015). Effects of Feedback in a Computer-Based Learning Environment on Students' Learning Outcomes: A Meta-Analysis. Review of Educational Research, 85(4), 475-511. https://doi.org/10.3102/0034654314564881
45. Van der Kleij, F., Segers, M., & Eggen, T. (2020). The influence of peer tutoring on students' on-task behavior and engagement in mathematics education. Learning and Instruction, 66, 101301.
46. Widlund, A., Tuominen, H., & Aunola, K. (2022). Reciprocal effects of mathematics performance, school engagement, and burnout. British Journal of Educational Psychology.