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Exploring Attitudinal Predictors of Mathematics Achievement Among Senior High School Students in Ghana: A Theory of Planned Behaviour Approach

Mathematics Attitudes and Performance in Cape Coast

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Summary

This study investigates the impact of attitudes on mathematics performance among senior high school students in Cape Coast Metropolis, Ghana. Despite curriculum reforms and government interventions, students' performance in mathematics remains suboptimal. The study employs a quantitative research design, utilising an achievement test and a modified Fennema-Sherman Mathematics Attitude Scale questionnaire. Data from 2,575 students reveal a moderate correlation between attitude and achievement scores. Four sub-constructs of attitude—confidence, learned helplessness, enjoyment, and perseverance—were identified, with confidence emerging as the strongest correlate of achievement. The findings suggest that enhancing students' self-confidence in mathematics could significantly improve their performance. The study recommends targeted interventions to address learned helplessness and promote positive attitudes towards mathematics among students.

Keywords: Ghanaian Senior High Schools, Learned Helplessness, Mathematics Achievement, Self-Confidence, Student Attitudes

1 Introduction

Mathematics is widely acknowledged as a foundational subject for success in science, technology, engineering, and mathematics (STEM) education. Numerous international studies have shown that affective variables such as self-confidence, enjoyment, and learned helplessness are strongly linked to students' mathematics performance (Lim & Chapman, 2015; Chen et al., 2018; Hannula et al., 2016). Positive attitudes have been associated with higher achievement, while negative affect—such as anxiety or low self-efficacy—can undermine performance (Andamon & Tan, 2018; Biber & Baser, 2012).

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Despite the volume of research globally, studies examining these relationships in African contexts—especially within sub-Saharan countries like Ghana—are limited. Most existing studies in Ghana focus either on general academic performance or on the cognitive domain, with limited attention given to affective dimensions such as attitudes (Abreh et al., 2018; Agyei et al., 2022). This leaves a critical gap, particularly since affective factors may operate differently in contexts shaped by teacher-centered instruction, high-stakes testing, and systemic resource challenges.

This study aims to address that gap by investigating the relationship between four sub-constructs of attitude—confidence, enjoyment, perseverance, and learned helplessness—and mathematics performance among senior high school (SHS) students in the Cape Coast Metropolis of Ghana. Using the Theory of Planned Behaviour (Ajzen, 1991) and the Fennema-Sherman Mathematics Attitude Scales (Tapia & Marsh, 2000) as the analytic framework, this research offers empirical insights into which affective constructs most strongly predict achievement outcomes. In doing so, it contributes to the international discourse by providing evidence from an underrepresented context, while also offering practical implications for improving mathematics teaching and learning in Ghanaian classrooms.

One of Ghana's key educational objectives is to prioritise mathematics and science as foundational pillars for national development in an era marked by rapid technological advancement (Awoniyi & Fletcher, 2013; National Council for Curriculum and Assessment, 2018). Mathematics is viewed not only as a core academic subject but also as critical to Ghana's vision of becoming a mathematics-friendly society, aligned with its Science, Technology, Engineering, and Mathematics (STEM) policy agenda (NaCCA, 2020).

The National Pre-Tertiary Education Curriculum Framework has undergone several revisions aimed at improving the quality of education, with a focus on promoting methodical thinking, creativity, and self-confidence in learners. These reforms also emphasise equipping students with the right attitudes toward science, mathematics, and technology (Hagan et al., 2020). However, despite these policy intentions, mathematics continues to be perceived by many students as a difficult and anxiety-inducing subject. Research by Aguilar (2021), Capuno et al. (2019), and Mazana et al. (2020) has shown that affective barriers—such as lack of motivation, fear of failure, and negative classroom experiences—significantly affect students' engagement and achievement in mathematics.

Further challenges include a continued emphasis on the cognitive domain in curriculum implementation, with minimal attention given to affective development. National assessments such as the WASSCE prioritise rote learning and procedural fluency over deeper understanding or emotional engagement with mathematics (Ministry of Education, 2010). Though the revised curriculum introduces strategies to assess students' attitudes and behaviours, practical implementation remains inconsistent. This context underscores the need to examine affective constructs—such as confidence, enjoyment, and helplessness—in relation to mathematics performance. Doing so can inform both national policy and classroom practices aimed at improving learning outcomes.

2 Literature Review

Research over the last three decades consistently shows that student attitudes toward mathematics significantly influence achievement. Positive attitudes—such as enjoyment and confidence—are associated with higher performance (Andamon & Tan, 2018; Mazana et al., 2020; Hwang & Son, 2021), while negative affective factors like anxiety and learned helplessness are known to hinder learning (Hannula, 2006; Biber & Baser, 2012). These studies underline the importance of affective constructs in mathematics education and confirm that attitude is a multidimensional concept encompassing beliefs, emotions, and motivation (Fishman, Yang, & Mandell, 2021).

This study is grounded in the Theory of Planned Behaviour (TPB) (Ajzen, 1991), which posits that behaviour is guided by three key components: attitude toward the behaviour, subjective norms, and perceived behavioural control. In mathematics education, these translate into how students feel about learning mathematics (attitude), how their peers and teachers influence their engagement (subjective norms), and their beliefs about their capability to succeed (perceived control).

To operationalise these components in a mathematics context, this study integrates validated constructs from the Fennema-Sherman Mathematics Attitude Scales (FSMAS) (Tapia & Marsh, 2000), which identify key dimensions such as confidence, enjoyment, usefulness, and teacher effectiveness. These constructs align closely with TPB: (i) Attitude toward behaviour is reflected in enjoyment and usefulness, (ii) Subjective norms align with perceived teacher influence, (iii) Perceived behavioural control is expressed through confidence and self-efficacy. This alignment enables a cohesive framework for examining how student beliefs, emotions, and perceptions interact to influence mathematics performance.

Drawing from both TPB and FSMAS, this study focuses on four sub-constructs of attitude: (a) Confidence: A belief in one's ability to succeed in mathematics tasks (Lim & Chapman, 2015), (b) Enjoyment: The extent to which students derive satisfaction and pleasure from learning mathematics, (c) Learned Helplessness: A feeling of powerlessness rooted in past failures and perceived inability to improve (Raps et al., 1982), (d) Perseverance: The willingness to persist in solving mathematics problems, even when difficult. These constructs were chosen not only for their theoretical relevance but also because they emerged strongly from exploratory and confirmatory factor analysis in this study. Moreover, they reflect cognitive, affective, and motivational dimensions that are often shaped by classroom practices, assessment policies, and curriculum focus.

While the influence of attitude on mathematics achievement has been widely studied in Western and Asian contexts (Chen et al., 2018; Hwang & Son, 2021; Lim & Chapman, 2015), there is a limited body of research from sub-Saharan Africa, and Ghana in particular. Studies within Ghana have typically prioritised the cognitive domain, with less focus on affective factors (Abreh et al., 2018; Fletcher, 2018). Furthermore, the role of attitudes within the context of Ghana's teacher-centred pedagogy, high-stakes assessment culture, and under-resourced schools remains largely unexplored. This study addresses that gap by investigating how students' affective dispositions—conceptualised through the constructs above—correlate with mathematics performance. It offers context-specific insights while also contributing to international comparative understandings of the role of attitudes in mathematics learning.

2.1 Theoretical Framework

This study adopts the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and integrates it with sub-constructs of attitude as outlined by the Fennema-Sherman Mathematics Attitude Scales (Tapia & Marsh, 2000). The TPB explains that behaviour is influenced by attitudes toward behaviour, subjective norms, and perceived behavioural control. It emphasises the interplay of beliefs, emotions, and the perception of control in shaping actions.

To align with the TPB, the study utilises three variables as the analytic lens: (1) Value of Mathematics which represents the cognitive component of attitude, focusing on the belief in the usefulness, relevance, and applicability of mathematics to real-world situations (Tapia & Marsh, 2000), (2) Enjoyment of Mathematics which measures the degree to which students derive satisfaction and pleasure from engaging with mathematics (Tapia & Marsh, 2000). It corresponds to the affective component of attitude, (3) Self-Confidence in Mathematics, which aligns with the control belief aspect of the TPB, encompassing perceptions of control and capability, and the belief in one's ability to succeed in mathematics (Tapia & Marsh, 2000; Lim & Chapman, 2015). By categorising attitudes into these three constructs, this study investigates how each contributes to students' performance in mathematics. The theoretical framework provides a robust basis for analysing the data, focusing on both individual beliefs and broader societal influences on attitudes.

Many fields, including education, have widely validated and applied the TPB to understand and predict behaviours. Its components—attitudes toward behaviour, subjective norms, and perceived behavioural control—are particularly useful in examining how beliefs and perceptions shape student behaviour and performance. In education, the TPB has been instrumental in studies investigating attitudes toward STEM subjects, including mathematics. For example, Schunk and DiBenedetto (2020) used TPB to examine students' motivation in mathematics, emphasising how perceived usefulness and self-efficacy contribute to academic engagement and success. Similarly, Lim and Chapman (2015) validated TPB's relevance in understanding mathematics attitudes by demonstrating a strong relationship between perceived control, self-confidence, and academic performance.

The validation of TPB as a framework for understanding attitudes and behaviour in educational settings is supported by its flexibility and ability to integrate with other constructs. It provides a structured approach for examining how beliefs and attitudes drive actions, aligning well with the goals of this study to explore sub-constructs of attitude that correlate with mathematics performance.

2.2 Relationships between TPB, Kiwanuka's Sub-Constructs, and FSMAS

TPB includes three primary constructs: Attitude toward behaviour, which has to do with beliefs about outcomes of behaviour and evaluations of these outcomes. Subjective norms connote beliefs about what others think the individual should do. Perceived behavioural control involves beliefs about the ease or difficulty of performing the behaviour, linked to self-efficacy.

Furthermore, Kiwanuka et al. (2020) identified sub-constructs of mathematics attitudes to include: Perseverance, that is, sustained effort in overcoming challenges in mathematics. Interest is about enjoyment and curiosity in mathematics. Self-confidence is about belief in one's ability to succeed in mathematics. These sub-constructs align with TPB's emphasis on attitudes and perceived behavioural control. For example, perseverance and interest reflect attitudes toward behaviour, as they encapsulate positive or negative feelings about mathematics engagement. Self-confidence aligns with perceived behavioural control, representing a belief in one's ability to overcome challenges.

The Fennema-Sherman Mathematics Attitudes Scales (FSMAS) includes constructs such as: Confidence, that is, assurance in one's abilities to solve mathematical problems. Usefulness which is the perception of mathematics as valuable for future goals. Teacher effectiveness deals with the belief in the teacher's role in promoting mathematics learning. These constructs provide an empirical basis for operationalising the TPB's components. Attitude toward behaviour is reflected in confidence and perceived usefulness; subjective norms relate to teacher effectiveness, as teachers influence students' perceived expectations. Perceived behavioural control connects with confidence, underscoring self-efficacy in mathematics.

The three theories aligned to form the theoretical framework for this study. TPB's attitude toward behaviour aligns with interest (Kiwanuka) and confidence and usefulness (FSMAS). TPB's subjective norms align with teacher effectiveness (FSMAS), highlighting external influences on attitudes. TPB's perceived behavioural control aligns with self-confidence (Kiwanuka) and confidence (FSMAS), emphasising the belief in one's capability.

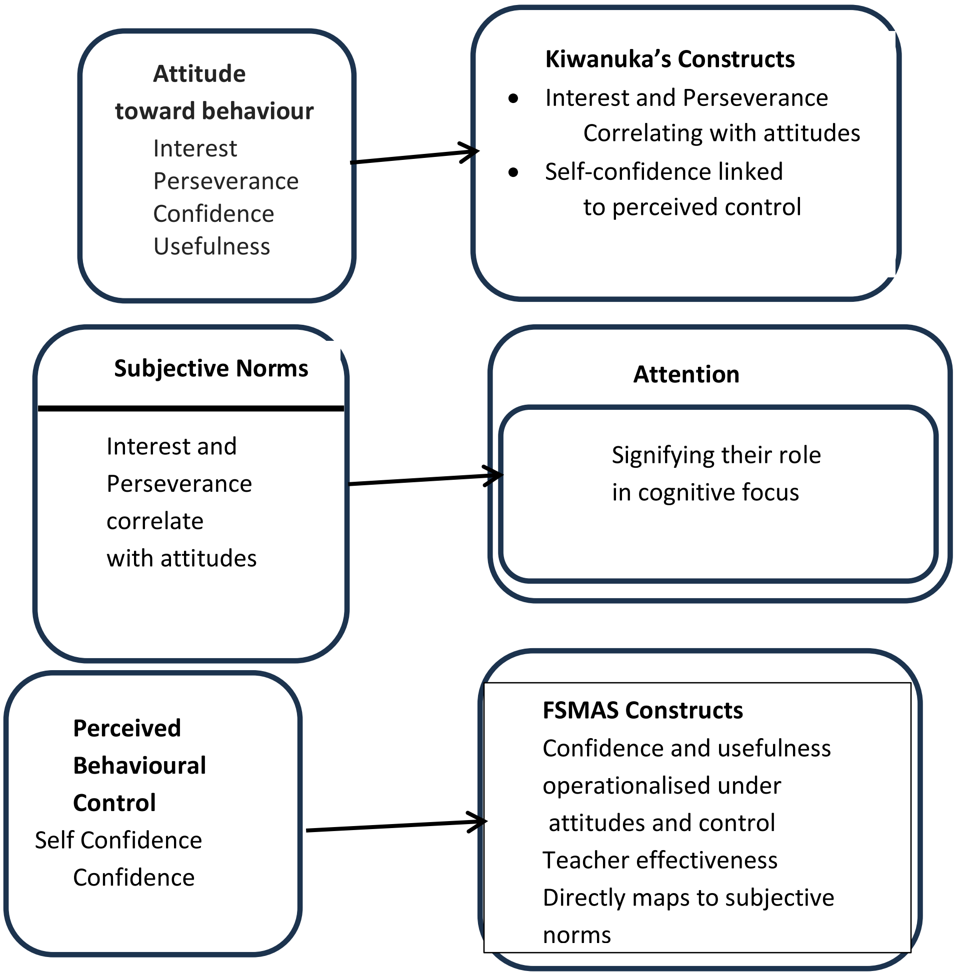

Figure 1: Visual Representation of Relationships (Self-drawn by Awoniyi)

Established instruments such as the FSMAS provide the sub-constructs of attitude (e.g., perseverance, interest, and self-confidence), which have undergone extensive validation through research. These constructs capture cognitive, affective, and motivational dimensions of attitudes, which are critical for understanding performance in mathematics. For instance, Lim and Chapman (2015) demonstrated that self-confidence is a key predictor of mathematics success, providing empirical support for its inclusion in this study.

Hence, this research investigates the relationship of attitude sub-constructs and the mathematics performance of senior high school (SHS) students in the Cape Coast Metropolis. To guide the investigation, the subsequent research question was devised:

2.3 Research Question

Which attitudinal factors are correlated to the performance of Ghanaian senior high school students in mathematics?

3 Materials and Method

This study employed a quantitative research design, involving the administration of an achievement test and a questionnaire. Data were collected from 2,575 Grade 11 students from ten public senior high schools in the Cape Coast Metropolis, Ghana. The sample consisted of 54% males and 46% females, representing a 77% response rate from the 3,342 students initially sampled.

3.1 Instruments

The instruments used to collect data for the study were an achievement test and a questionnaire. The achievement test was based on the SHS syllabus, with a sample of West Africa Senior School Certificate Examination (WASSCE) mathematics questions as a guide in constructing the test items. The test was made up of 40 multiple-choice questions that were answered for one hour. The Modified Fennema-Sherman Mathematics Attitude Scales (FSMAS), which recorded a high reliability of Cronbach-α, from .777 to .942 was adapted in this study. The Fennema-Sherman Mathematics Attitude Scales (FSMAS) was selected for this study due to its strong theoretical foundation and extensive use in measuring students' affective responses toward mathematics. The instrument has been validated across numerous cultural and educational contexts and aligns well with the constructs underpinning the Theory of Planned Behaviour (Ajzen, 1991), which forms the theoretical basis of this study. Specifically, FSMAS captures attitudes such as confidence, enjoyment, and perceived usefulness—dimensions that are central to understanding behavioural intentions and actual engagement in mathematics.

Despite the original FSMAS containing 57 items across multiple subscales, only 28 items were retained for this study. This decision was made following a feasibility study involving a sample of students from the target population and consultations with four senior mathematics education experts. During this preliminary phase, students indicated that some items, particularly those related to gender roles and social expectations (e.g., "My parents think boys are better at math than girls"), were outdated or culturally irrelevant in the current Ghanaian educational context. Feedback revealed that both male and female students expressed similar levels of confidence and engagement in mathematics, with female students even reporting that they often supported male peers in problem solving. Additionally, items relating to social perception, such as peer stigma associated with being good at mathematics, were not endorsed as valid concerns in this cohort.

As a result, subscales explicitly measuring gender differences and social influence were excluded from the adapted version. Instead, the retained 28 items focused on four empirically and theoretically relevant sub-constructs: confidence, enjoyment, perseverance, and learned helplessness. These items were rigorously reviewed for contextual relevance, clarity, and theoretical alignment. Each item was phrased in language that matched the comprehension level of SHS Form Two students and piloted to test for reliability and construct validity. The retained items demonstrated high internal consistency, with Cronbach alpha values ranging from .863 to .962 across the four sub-constructs.

This modification ensured that the attitude scale used in this study was both culturally appropriate and psychometrically sound for the Ghanaian context. A detailed breakdown of the final items and their factor loadings is presented in Table 1, while the theoretical justification for each sub-construct is addressed in the literature and theoretical framework sections.

To provide greater clarity on the mathematical context of this study, the achievement test was developed in alignment with the Ghana Education Service's Senior High School (SHS) Core Mathematics syllabus. It focused on five fundamental content areas typically covered during the first and second years of SHS. These included: algebraic expressions and equations, geometry (particularly involving angles and plane shapes), mensuration (calculations involving area and volume), statistics (such as interpreting graphs and calculating measures of central tendency), and applied word problems involving simple interest and proportional reasoning.

The test was designed to assess various forms of mathematical thinking—specifically, procedural fluency (e.g., solving equations), conceptual understanding (e.g., recognising geometric properties), and problem-solving (e.g., applying knowledge to contextual scenarios). A sample item read: "If the volume of a cube is 125 cm^3, what is the length of one side?" with four multiple-choice options. This format required students to apply both recall and reasoning skills.

Comprising 40 multiple-choice questions, each valued at one point, the test was constructed using both WASSCE-style questions and teacher-developed items based on the syllabus. The instrument was reviewed by experienced mathematics educators and underwent a pilot phase in a school outside the study area. Minor adjustments were made for clarity based on feedback. The test was administered in 60 minutes under examination conditions.

To contextualise the findings, the study also accounted for the mathematical background of participants. The students were in Form Two (Grade 11), having completed at least one full academic year of SHS mathematics. School-based assessment records indicated that most participants exhibited moderate proficiency, with scores typically ranging between 50% and 70%. Some students had participated in mathematics clubs or competitions, suggesting varying levels of engagement and aptitude across the sample. The diagnostic analysis conducted included parametric tests and factor analyses, while other analysis included frequencies, percentages, means, standard deviations, correlations, and multiple regressions.

3.2 Parametric tests

To ensure the reliability of the regression analysis conducted to answer the research question, the study assessed the key assumptions of multiple linear regression: linearity, normality of residuals, homoscedasticity, independence of errors, and multicollinearity. The assumption of multicollinearity was carefully examined using Variance Inflation Factor (VIF) and Tolerance values. Multicollinearity inflates the variances of the regression coefficients, leading to instability in the model. Following Field (2013), VIF values above 10 or Tolerance values below 0.2 are considered problematic. In this study, the VIF was 1.988 and the Tolerance value was .503, confirming the absence of multicollinearity among the predictors (i.e., the four attitude sub-constructs), and ensuring that the regression coefficients are interpretable and robust.

The normality of the residuals was assessed both statistically and visually. Skewness and kurtosis values (–0.092 and –0.708, respectively) fell within acceptable ranges (±1), indicating that the residuals were approximately normally distributed. This is further supported by the Normal Q-Q plot shown in Figure 2, where the points align closely along the diagonal line, suggesting minimal deviation from normality. A box plot of achievement test scores (Figure 3) was also used to examine the distribution of scores and detect any potential outliers. The plot showed a symmetrical distribution with no significant outliers, reinforcing the assumption of normality and supporting the appropriateness of parametric analysis.

In addition, the Normal Q-Q plot of the regression-standardized residuals (Figure 4) confirmed that residuals closely followed a normal distribution, while the scatter plot of standardized residuals (Figure 5) displayed a random, rectangular pattern around the horizontal axis. This pattern indicates that the assumptions of linearity and homoscedasticity were met, with no visible patterns suggesting heteroscedasticity or non-linearity. Together, these diagnostic checks confirmed that all key regression assumptions were satisfied, validating the use of multiple linear regression for this study and supporting the credibility of the model's predictive outcomes.

The achievement scores data underwent scrutiny for adherence to assumptions regarding sample size, normality, multicollinearity, Variance Inflation Factor, and Tolerance. The sample size of 2,575 was deemed appropriate for the investigation (Pallant, 2020; Pituch & Stevens). According to Field (2013), the Tolerance below 0.2 and VIF greater than 10 indicate a serious problem. However, the Tolerance is .503 and the VIF is 1.988. This is an indication of absence of multicollinearity. Subsequently, the normality of the data was assessed. The data appears to exhibit a roughly normal distribution, as indicated by the skewness (-0.092) and kurtosis (-0.708) falling within acceptable ranges, and the actual mean (53.72) being close to the trimmed mean (53.90) (Field, 2013). Additionally, normal probability plots, labelled "Normal QQ Plots" in Figure 2, were utilised for visual assessment of normality (Gosselin, 2024; Das & Imon, 2016), showing a reasonably straight-line indicative of normal distribution. Furthermore, a box plot (Figure 3) of the achievement test score distribution corroborates normality, revealing the absence of outliers in the dataset.

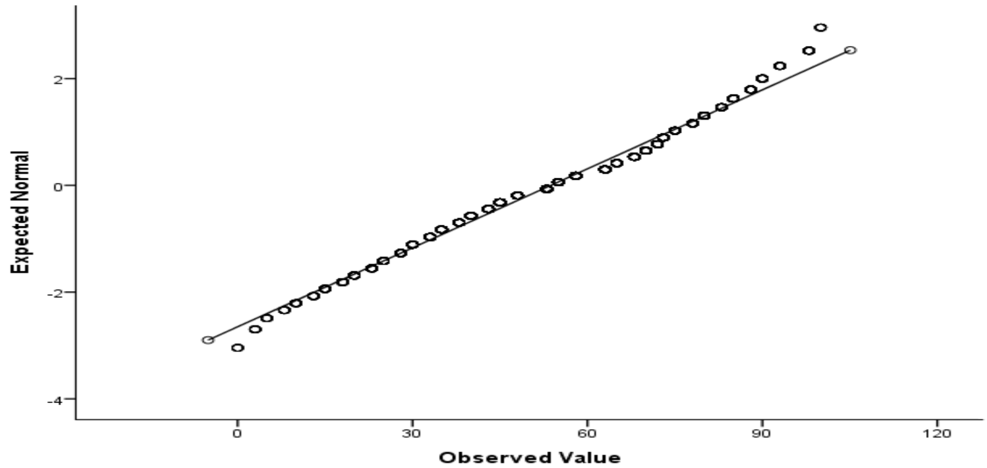

Figure 2: Normal QQ Plot of Achievement test scores

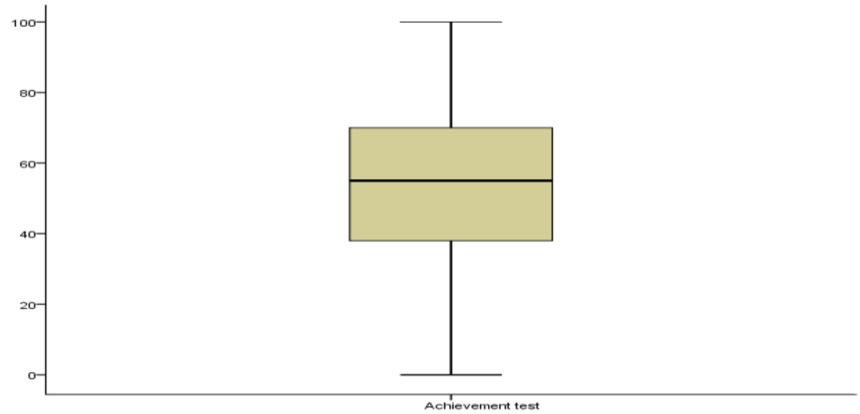

Figure 3: Box plot showing the Achievement scores distribution

Furthermore, an examination of the residuals was conducted to evaluate their normality and suitability for regression analysis. Figures 4 and 5 depict the Normal QQ Plot and the scatter plot of the regression-standardized residual of the achievement test scores, respectively.

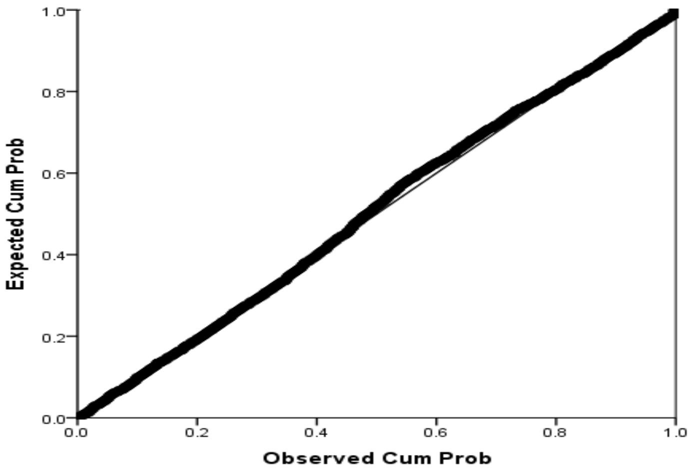

Figure 4: Normal QQ Plots displaying the achievement test scores' regression-standardized residual.

Analysing the Normal QQ plots of the Regression Standardized Residual, the alignment of points along a straight diagonal line from bottom left to top right indicates minimal deviations from normality.

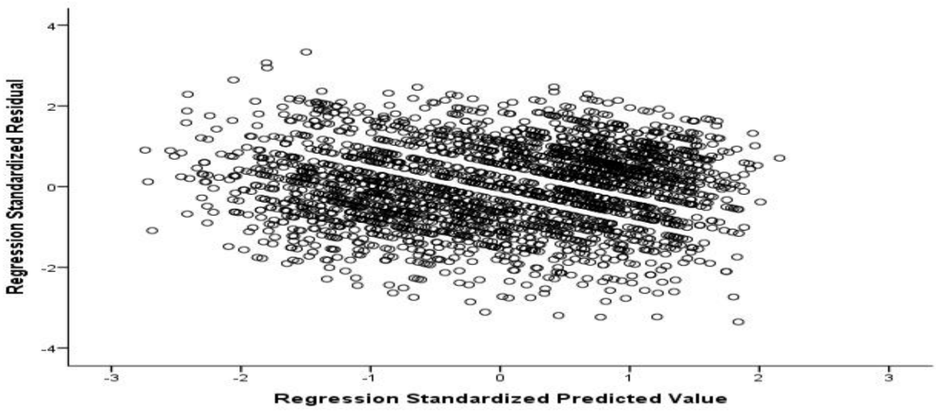

Figure 5: Scatter Plots displaying the regression standardized residual of Achievement test scores

The residual has a nearly rectangular distribution, with the center showing the greatest concentration of scores. The plot depicted a clustering of residuals around the center for each predicted score, accompanied by a symmetrical decline in the distribution of residuals. A correlation analysis revealed a moderate (.388 value) association between attitude and the achievement test. In conclusion, the data satisfied all the parametric (diagnostic) tests for further analysis to be carried out.

3.3 Factor Analysis

Upon subjecting the 28 items to a principal component analysis (with a Kaiser-Meyer-Olkin measure of sampling adequacy of 0.969 and Bartlett's test statistic of 55101.490), four components with eigenvalues greater than Kaiser's threshold of 1 were found to account for 66.30% of the variance. The scree plot exhibited inflections that advocate for retaining the four elements: ‘learned helplessness’ (13 items, α = .926), ‘perseverance’ (3 items, α = .954), ‘confidence’ (5 items, α =.962) and ‘enjoyment’ (6 items, α =.863). The attitude questionnaire's overall reliability coefficient, α, was .845. The item ‘Thinking out mathematics problems does not appeal to me’ did not load on any of the sub-constructs, hence, it was entirely excluded from further analysis. Table 1 shows the factor loading of the attitude questionnaire after rotation.

ITEM	1	2	3	4
I do badly in tests of mathematics as compared to that of my friends.	.748			
My friends do better than me in mathematics.	.748			
I do not have the ability to do well in Mathematics.	.722			
I do not see myself becoming successful in the learning of mathematics.	.713			
In mathematics class, I see others to be better than me.	.669			
Mathematics is the most difficult subject for me.	.631			
I do not see myself to be good in mathematics.	.608			
I am not good in the study of mathematics.	.586			
Mathematics related subjects have been my worst subjects.	.572			
Even though I work hard on mathematics, it seems difficult for me.	.537			
Most subjects I can handle well, but I have problems with mathematics.	.512			
I do not enjoy learning mathematics.	.450			
I feel I cannot do well in Mathematics.	.355			

When I am faced with mathematics related problem that I cannot solve immediately I stick with it until I solve it.		.959		
Even when a mathematics question is difficult, I keep working until I find an answer.		.945		
When I am left with a question that requires the use of Mathematics to answer, I will keep on trying until I answer it.		.944		
I am sure I can do advance work in mathematics.			.967	
I can learn advanced mathematics.			.945	
I can handle more difficult mathematics problems.			.913	
I have a lot of confidence when it comes to mathematics.			.911	
I am capable of solving difficult mathematics questions.			.887	
I usually feel relax when solving mathematics questions.				.690
A mathematics test is always welcome by me.				.682
I feel comfortable with Mathematics.				.581
I feel good solving Mathematics questions.				.512
I like Mathematics.				.408
Generally, I feel secure about undertaking Mathematics related program in future.				.310
Initial Eigenvalues	**13.413**	**1.797**	**1.549**	**1.142**
% of variance explained	**49.677**	**6.657**	**5.737**	**4.230**
Cumulative % of variance explained		**66.301**		
Cronbach Alpha	**.926**	**.954**	**.962**	**.863**
Overall Cronbach Alpha		**.845**		

Table 1: Factor Loading of the Attitude Construct

The mean and standard deviation were calculated for each of the four sub constructs: 'learned helplessness' (M = 2.57, SD = .95), 'perseverance' (M = 2.49, SD = 1.18), 'confidence' (M = 3.01, SD = 1.20), 'enjoyment' (M = 2.72, SD = .94). According to the overall mean value (M = 2.67, SD =.57), the students had a negative attitude towards their mathematics learning because many of the negative statements were agreed upon and many of the positive statements were disagreed upon. However, a consideration of the standard deviations for "perseverance" and "confidence" showed bigger variations compared to other sub-constructs in the same group. This could indicate that the respondents differed in their perseverance and confidence in succeeding in mathematics learning on the one hand, and their learned helplessness and enjoyment of mathematics on the other.

4 Results

Regression analysis was conducted out on the subscales: *learned helplessness* (r_1 = –.516, *p*< .05), *perseverance* (r_2 = –.310, *p*< .05), *confidence* (r_3 = .607, *p*< .05) and *enjoyment* (r_4 = –.383, *p*< .05). Achievement scores and attitude variables have a variance of about 40% in common (R square = .399 and Adjusted R Square = .398). The model is statistically significant (*p* <.05). Evaluating the four subscales: "confidence" (*β* = 0.541, *p* = 0.000), "learned helplessness" (*β* = –0.305, *p* = 0.000), "enjoyment", (*β* = 0.206, *p* = 0.000), and 'perseverance' (*β* = 0.027, *p* = 0.145) meaning that with the exception of perseverance, when the variance explained by all other sub constructs in the model was controlled, each sub construct of the attitude variable made a statistically significant unique contribution to the prediction of the achievement test scores. The variance uniquely explained in achievement scores by the sub-constructs is 29.3%, 9.3%, 4.2%, and 0.07%, for confidence, learned helplessness, enjoyment, and perseverance, respectively. As a result, the regression model with F (4, 2570) = 425.782, *p*<.05, between the attitude variable and achievement scores is as follows:

Achievement scores = 29.883 – .326 (learned helplessness) + .024 (perseverance) + 0.456(confidence) + .222 (enjoyment).

However, with the removal of 'perseverance', the Final model with F(3, 2571) = 566.755, p=0.000 < .05 is:

Achievement scores = 30.700 + .451 confidence – .319 learned helplessness + .227 enjoyment.

4.1 Discussion on Regression Analysis of Achievement Scores and Attitude Variables

The regression analysis conducted on the subscales of learned helplessness, perseverance, confidence, and enjoyment provides insightful findings regarding their impact on achievement scores. The analysis reveals several key points:

The subscales of learned helplessness (r = –.516), perseverance (r = –.310), confidence (r = .607), and enjoyment (r = –.383) all show significant correlations with achievement scores ($p < .05$). This indicates that each of these variables has a meaningful relationship with achievement scores. Secondly, the overall model explains approximately 40% of the variance in achievement scores ($R^2 = .399$, Adjusted $R^2 = .398$), which is statistically significant ($p < .05$). This suggests that the attitude variables collectively account for a substantial portion of the variability in achievement scores. Thirdly, when evaluating the unique contributions of each subscale, confidence (β = 0.541, p = 0.000), learned helplessness (β = –0.305, p = 0.000), and enjoyment (β = 0.206, p = 0.000) all make statistically significant contributions to predicting achievement scores. However, perseverance (β = 0.027, p = 0.145) does not significantly contribute when the variance explained by other subscales is controlled. Fourthly, the variance uniquely explained by confidence, learned helplessness, enjoyment, and perseverance in achievement scores are 29.3%, 9.3%, 4.2%, and 0.07%, respectively. This highlights that confidence is the most influential predictor among the subscales. Lastly, the initial regression model, including all four subscales, is:

Achievement scores = 29.883 - 0.326 (learned helplessness) + 0.024 (perseverance) + 0.456 (confidence) + 0.222 (enjoyment). This model is statistically significant with $F(4, 2570) = 425.782$, $p < .05$.

Upon removing perseverance, the final model is:

Achievement scores = 30.700 + 0.451 (confidence) - 0.319 (learned helplessness) + 0.227 (enjoyment). This refined model is also statistically significant with $F(3, 2571) = 566.755$, $p < .05$.

4.2 Interpretation

The results indicate that confidence, learned helplessness, and enjoyment are all significant predictors of achievement scores, with confidence having the most positive impact. Learned helplessness has a negative impact on achievement, with higher levels connected with worse achievement results. Enjoyment also positively influences achievement, though to a lesser extent than confidence. Perseverance, despite its theoretical importance, does not significantly predict achievement scores in this model. Various factors, including measurement issues or the possibility of other variables not included in the model mediating perseverance's effects, could explain this.

Overall, the analysis underscores the importance of fostering confidence and enjoyment while addressing learned helplessness to enhance achievement outcomes. The removal of perseverance from the final model simplifies the predictive equation without compromising the model’s explanatory power, making it more practical for application.

The attitudes measured in this study—confidence, enjoyment, and learned helplessness—are not formed in isolation but are closely shaped by how mathematics is taught and experienced in the classroom. In Ghanaian senior high schools, mathematics instruction is often characterised by teacher-centred methods, large class sizes, and a focus on procedural fluency for exam preparation (Abreh, Owusu, & Amedahe, 2018; Fletcher, 2018). These structural and pedagogical factors can limit opportunities for student engagement, exploration, and discourse—conditions necessary for fostering enjoyment and self-confidence. For example, when students are not encouraged to ask questions, engage in problem-solving discussions, or see real-life applications of mathematics, their sense of competence may decrease, leading to feelings of helplessness and disengagement. Conversely, students who encounter supportive teachers, collaborative group tasks, or differentiated instruction tend to develop more positive attitudes. This study's identification of confidence as the most powerful predictor suggests that Ghanaian mathematics classrooms need to incorporate pedagogical approaches that affirm students' ability to succeed—such as formative feedback, growth mindset language, and context-based tasks. Therefore, the affective dimensions uncovered by this study have direct implications for instructional design, classroom management, and assessment strategies in mathematics teaching.

The findings of this study contribute to mathematics education by offering a nuanced, evidence-based account of how affective sub-constructs—specifically confidence, learned helplessness, and enjoyment—predict students' achievement in mathematics within the Ghanaian context. While international literature has extensively examined the relationship between attitude and mathematics performance, this study is among the few that localise the Theory of Planned Behaviour (TPB) and the Fennema-Sherman Mathematics Attitude Scales (FSMAS) to sub-Saharan Africa. It does so with empirical rigour, using a large sample and robust statistical analyses. The identification of confidence as the most influential predictor offers actionable insight for curriculum planners, teacher educators, and classroom practitioners aiming to improve outcomes through affective interventions. In doing so, this study not only affirms global theories but also enriches them with locally grounded evidence, thereby extending current knowledge in a meaningful and culturally relevant way.

While this study is situated in Ghana, its findings resonate with and extend existing international research on students' attitudes and mathematics achievement. For instance, consistent with studies conducted in high-performing contexts such as Singapore (Lim & Chapman, 2015) and the United States (Chen et al., 2018), this research confirms that self-confidence is a strong predictor of success in mathematics. Similarly, the negative impact of learned helplessness aligns with research findings from Turkey (Biber & Baser, 2012) and China (Wang, Du, & Liu, 2009), reinforcing the universality of this construct across educational systems. What this study adds is a perspective from a sub-Saharan African context, where systemic challenges such as curriculum reforms, limited resources, and affective neglect in classroom assessment practices uniquely shape student attitudes. Therefore, the findings not only validate cross-cultural patterns but also highlight the contextual nuances that may inform international comparative studies, curriculum design, and teacher preparation programs—particularly in settings with similar developmental or educational constraints.

Beyond the practical implications, this study offers important contributions to both mathematics education theory and research methodology. Theoretically, the study advances the application of the Theory of Planned Behaviour (TPB) within the context of mathematics education in sub-Saharan Africa, particularly by integrating it with constructs from the Fennema-Sherman Mathematics Attitude Scales (FSMAS) and Kiwanuka's model of student attitudes. By mapping confidence, learned helplessness, enjoyment, and perseverance onto TPB's core dimensions—attitude toward behaviour, subjective norms, and perceived behavioural control—this research provides a culturally responsive framework for understanding how affective variables shape students' engagement and achievement in mathematics.

This theoretical integration demonstrates that affective constructs are not only significant in high-performing contexts like Singapore or the U.S. but also operate meaningfully within under-resourced and exam-oriented systems such as Ghana's. The findings reinforce the global applicability of TPB and FSMAS, while showing how these models can be adapted to reveal context-specific dynamics such as the impact of learned helplessness and the nuanced role of perseverance in classroom cultures characterised by limited learner autonomy.

Methodologically, this study contributes by adapting a well-established instrument (FSMAS) to suit a Ghanaian senior high school context. The rigorous process of cultural and contextual validation—including the removal of outdated gender and social influence items—demonstrates how instruments can be modified to maintain psychometric integrity while improving relevance. This approach provides a model for researchers working in similar educational contexts who seek to adapt Western-based frameworks without compromising measurement quality.

In sum, the study contributes to theoretical discourse by expanding the explanatory power of existing models in new cultural settings and to methodological practice by exemplifying responsible and context-aware adaptation of research instruments. These contributions enhance the field's understanding of how student attitudes shape mathematics learning in diverse global contexts and lay the groundwork for future research on affective constructs in African mathematics classrooms.

4.3 Conclusion

This study provides robust evidence that students' attitudes significantly influence mathematics achievement in Ghanaian senior high schools. Among the four attitudinal sub-constructs examined—confidence, enjoyment, learned helplessness, and perseverance—confidence emerged as the strongest positive predictor of achievement, while learned helplessness had a pronounced negative effect. Enjoyment also contributed positively, though to a lesser extent. Perseverance, although theoretically relevant, did not significantly predict achievement in the final model. These findings affirm the applicability of the Theory of Planned Behaviour and the Fennema-Sherman Mathematics Attitude Scales in the Ghanaian context and underscore the urgent need to integrate affective considerations into mathematics instruction. Given that affective dispositions are shaped by pedagogical practices, the study calls for teaching approaches that nurture confidence, reduce feelings of helplessness, and foster enjoyment. The findings not only contribute to the global discourse on affect and achievement but also highlight the need for culturally responsive strategies to improve mathematics learning outcomes in under-resourced settings.

4.4 Implications for Practice

The results of this study carry important implications for mathematics educators, curriculum developers, and educational policymakers. First, the strong predictive power of confidence suggests that teachers must intentionally cultivate students' belief in their ability to succeed in mathematics. This could be achieved through differentiated instruction, formative feedback, and the creation of low-anxiety environments that allow students to experience success incrementally. Second, the negative influence of learned helplessness signals the urgent need for teaching strategies that empower students and counteract the belief that success in mathematics is based solely on innate ability. Instructional approaches that incorporate growth mindset messages, allow for productive struggle, and reward effort over perfection may be particularly effective.

Third, enjoyment emerged as a positive contributor to achievement, implying that student engagement in mathematics can be enhanced when instruction is relevant, interactive, and enjoyable. The use of real-world problems, cooperative learning, and technology-based tools may make mathematics more meaningful and relatable. Finally, the findings call for curriculum and assessment reforms that place greater emphasis on students' attitudes, motivations, and emotional well-being alongside traditional content knowledge. Education authorities might consider embedding affective learning outcomes in national syllabi and promoting teacher professional development that addresses both pedagogical content knowledge and socio-emotional instructional strategies.

4.5 Limitations of the Study

While this study provides valuable insights into the role of attitudes in mathematics performance, several limitations should be noted. The research adopted a cross-sectional design, which restricts the ability to draw causal conclusions. As such, although significant relationships were found between attitudes and achievement, it is not possible to determine the directionality or long-term impact of these relationships. Additionally, the study relied on self-report data to measure student attitudes, which may be subject to social desirability bias or inaccuracies in students' self-perceptions.

Moreover, the study focused exclusively on affective factors, excluding other potentially influential variables such as prior academic achievement, teacher quality, instructional methods, or home environment. The findings, therefore, represent only a portion of the complex set of factors that affect students' mathematics outcomes. Finally, while the sample was relatively large and diverse, it was limited to one geographical region in Ghana. Generalisations to other regions or education systems should be made with caution.

4.6 Suggestions for Future Research

Future investigations could extend the current study in several meaningful directions. Longitudinal studies would allow researchers to trace the evolution of student attitudes over time and assess their long-term impact on achievement trajectories. Additionally, mixed-methods research could provide a richer, more holistic understanding of how attitudes manifest in classroom contexts by integrating student voice, teacher perspectives, and classroom observations.

Experimental or quasi-experimental studies could also be employed to test specific interventions designed to boost confidence, reduce learned helplessness, or enhance enjoyment in mathematics. For instance, programs incorporating peer mentoring, gamification, or real-life problem solving could be examined for their effectiveness. Comparative studies across different school types, regions, or countries would also help identify contextual factors that mediate the relationship between attitudes and performance. Furthermore, future studies could explore how these affective constructs interact with cognitive strategies, teacher behaviours, and school climate to produce academic outcomes.

4.7 Ethical Clearance

At the time this study was conducted, formal ethical clearance was not a mandatory institutional requirement at the university, as this research formed part of a doctoral thesis. However, all ethical principles relevant to educational research involving human participants were carefully observed. The researcher obtained a letter of introduction from the Department of Mathematics and ICT Education, of the University of Cape Coast, Ghana, which was presented to the heads of the participating schools to formally request permission to conduct the study. Approval was subsequently granted by school authorities before any data collection began. All student participants were fully informed about the purpose and scope of the research and were assured that their participation was entirely voluntary. Confidentiality and anonymity were maintained throughout the study, and no personally identifiable information was collected. Students were also informed of their right to withdraw from the study at any point without any negative consequences. Data were securely stored and used solely for academic and research purposes. The study adhered to the ethical principles of respect for persons, beneficence, and academic integrity throughout the research process.

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Conflict of Interest

The author states that there is no conflict of interest.

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