

**UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE**

**FACTORS AFFECTING STUDENTS LEARNING OUTCOME IN  
MATHEMATICS AMONG SENIOR HIGH SCHOOLS IN THE TAMALE  
METROPOLIS**

**FUACHIE DANIEL**



**UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE  
FACULTY OF EDUCATION  
DEPARTMENT OF EDUCATIONAL FOUNDATIONS STUDIES**

**FACTORS AFFECTING STUDENTS LEARNING OUTCOME IN  
MATHEMATICS AMONG SENIOR HIGH SCHOOLS IN THE TAMALE  
METROPOLIS**

**BY**

**FUACHIE DANIEL  
(UDS/MME/0012/22)**

**THE THESIS SUBMITTED TO THE DEPARTMENT OF  
EDUCATIONAL  
FOUNDATIONS STUDIES, FACULTY OF EDUCATION, UNIVERSITY  
FOR  
DEVELOPMENT STUDIES IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF  
Master of Philosophy Degree in Measurement and Evaluation.**

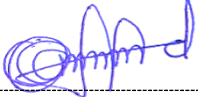
**2025**



## DECLARATION

I hereby declare that this thesis is the result of my original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Name: **FUACHIE DANIEL**

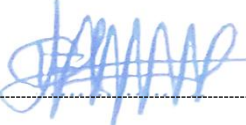
Signature:  .....

Date: 29<sup>TH</sup> JULY, 2025 .....

### Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised following the guidelines on supervision of the thesis laid down by the University for Development Studies.

Supervisor's Name: **DR. EDWARD ABASIMI**

Signature:  .....

Date: 29<sup>TH</sup> JULY, 2025 .....



## ABSTRACT

The purpose of this study was to investigate the factors affecting students' learning outcomes in mathematics among Senior High School (SHS) students in the Tamale Metropolis. The philosophy underpinning this study is the positivism. The descriptive survey design and quantitative approach were adopted for the study. The population consists of 385 students from selected public SHSs through a combination of stratified and simple random sampling techniques. An adapted and modified questionnaire was used for the data collection. Descriptive Statistics (Frequencies and Percentages, Mean and standard Deviation) were used to analyse the data. The findings revealed that high levels of test anxiety negatively impact students' ability to retain and apply mathematical knowledge. Peer relationships had both positive and negative effects, depending on the nature of peer interaction. A supportive classroom atmosphere, characterized by teacher motivation and effective classroom management, was found to enhance learning outcome. Furthermore, the study found that parental involvement, especially in terms of providing learning materials and maintaining strong relationships with teachers, positively influenced students' learning outcome. Based on these findings, it is recommended that schools implement support programs such as test anxiety reduction workshops, peer mentoring initiatives, and teacher professional development programs should emphasize inclusive teaching strategies, effective classroom management, and the creation of emotionally supportive learning spaces. Additionally, parents should be encouraged to take a more active role in supporting their children's academic life, regardless of their educational background.



## ACKNOWLEDGEMENTS

My profound gratitude goes to the Almighty God for seeing me through the entire work successfully and also to my supervisor Dr. Edward Abasimi for his patience, words of encouragement, useful suggestions, and corrections throughout the entire work. Am also thankful to my dear friend Antwi Adjei Derrick for his persistent support, sacrifices and encouragement during this study. My appreciation also goes to the authorities of the Senior High Schools in Tamale Metropolis who permitted me for the studies to be carried out. My last appreciation goes to my mentees Angiabisa Awenjaab Prosper and Awuntig Osman Mohammed for their massive support and love.



## DEDICATION

This work is a dedicated to my mother, Rosina Owusu, for her love and support.



**TABLE OF CONENT**

DECLARATION .....	i
ABSTRACT.....	ii
ACKNOWLEDGEMENTS .....	iii
DEDICATION .....	iv
TABLE OF CONENT .....	v
LIST OF TABLES .....	ix
LIST OF FIGURES .....	x
LIST OF ACRONYMS .....	xi
CHAPTER ONE .....	1
INTRODUCTION .....	1
1.0 Overview of the Study .....	1
1.1 Background to the Study.....	1
1.2 Statement of the Problem.....	4
1.3 Purpose of the Study .....	6
1.4 Objectives of the Study .....	6
1.5 Research Questions .....	7
1.6 Delimitations of the Study .....	7
1.7 Limitations of the Study.....	7
1.8 Significance of the Study .....	8
1.9 Operational Definition of Terms.....	8
1.10 Organization of the Study .....	9
CHAPTER TWO .....	10
LITERATURE REVIEW .....	10
2.0 INTRODUCTION .....	10





2.1 Theoretical Framework .....	10
2.1.1 Constructivist learning theory .....	10
2.1.2 Item Response Theory .....	15
2.1.2.1 Principles of Item Response Theory (IRT) .....	15
2.1.2.2 The Three-Parameter Logistic (3PL) models in Item Response Theory (IRT). .....	17
2.2 Conceptual Review .....	21
2.2.1 Concept of Learning Outcomes in Mathematics .....	21
2.2.2 Concept of Test Anxiety .....	24
2.2.3 Concepts of Peer Relationships .....	26
2.2.4 Concept of Classroom Atmosphere .....	29
2.2.5 Concept of Parental Support and Educational Outcomes .....	31
2.2.6 Interactions Among the Factors .....	33
2.3 Empirical Review .....	36
2.3.1 Test Anxiety and Learning Outcomes .....	36
2.3.2 Peer Relationships and Learning Outcomes in Mathematics .....	39
2.3.3 Classroom Atmosphere and Learning Outcomes .....	42
2.3.4 Parental Support and Learning Outcomes in Mathematics .....	45
2.4 Summary of Literature Review .....	48
CHAPTER THREE .....	51
METHODOLOGY .....	51
3.0 Overview .....	51
3.1 Research Approach .....	51
3.2 Research Design .....	52
3.3 Research Paradigm .....	53



3.4 Population .....	54
3.5 Sample.....	54
3.6 Sampling Techniques and Procedure.....	55
3.7 Research Instrument(s) .....	57
3.7.1 Pilot Testing.....	60
3.7.2 Validity and Reliability.....	61
3.8 Data Collection Procedure .....	62
3.8.1 Ethical Issues .....	63
3.9 Data Analysis .....	64
CHAPTER FOUR.....	66
RESULTS AND DISCUSSION .....	66
4.0 Introduction.....	66
4.1 Demographic Data of Responses .....	67
4.2 Discussion of Research Findings .....	78
4.2.1. The level of relationship between test anxiety and students’ learning outcomes in mathematics.....	78
4.2.2 How peer relationships affect students’ learning outcomes in mathematics .....	80
4.2.3 The level of effect the classroom atmosphere has on students’ learning outcomes in mathematics.....	82
4.2.4 How parental support influences students’ learning outcomes in mathematics. ....	85
4.3 Chapter Summary .....	86
CHAPTER FIVE .....	88
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS.....	88

5.1 Introduction.....	88
5.2 Overview of the study.....	88
5.3 Summary of Key Findings.....	89
5.4 Conclusions.....	90
5.5 Recommendations.....	91
5.6 Suggestions for Further Research.....	92
REFERENCES .....	94
APPENDIX A.....	123
INTRODUCTORY LETTERS.....	123
APPENDIX B.....	125
QUESTIONNAIRE .....	125



**LIST OF TABLES**

Table 1: Sample Size ..... 55

Table 2: Displays the details of the Respondents taken from each of the 6 schools..... 57

Table 3: Results of the Reliability coefficients of the 40 items ..... 61

Table 4: Represents the Gender Distribution of the Respondents in the Study. .... 67

Table 5: Distribution of respondents by level (N=385)..... 67

Table 6: Distribution of Respondents by Age (N=385)..... 68

Table 7: Result of Respondents’ Responses to the Relationship Between Test Anxiety and Learning Outcome in Mathematics (N=385) ..... 69

Table 8: Result of Respondents’ Responses to How Peer Relationships affect Students’ Learning Outcomes in Mathematics (N=385) ..... 71

Table 9: Result of Respondents’ Responses to the Effect of Classroom Atmosphere on Students’ Learning Outcome in Mathematics (N=385). ..... 74

Table 10: Responses of Respondents’ Responses to How Parental Support Affect Students' Learning Outcome in Mathematics (N=385). ..... 76



**LIST OF FIGURES**

Figure 1: Conceptual Framework..... 23



## LIST OF ACRONYMS

<b>Terms</b>	<b>Meaning</b>
TA	Test Anxiety
CA	Classroom Atmosphere
PS	Parental Support
PR	Peer Relationship
GES	Ghana Education Service
TL	Tamale
SPSS	Statistical Package for Social Science
IRT	Item Response Theory
GSS	Ghana Statistical Service
SHSs	Senior High Schools
NGO	Non-Governmental Organization
CTT	Classical Test Theory
3PL	Three-Parameter Logistic Model
DIF	Differential Item Functioning



## CHAPTER ONE

### INTRODUCTION

#### 1.0 Overview of the Study

This study investigates the factors affecting students' learning outcomes in mathematics among Senior High Schools (SHSs) within the Tamale Metropolis. This chapter outlines the background to the study, the problem statement, the purpose and objectives, research questions, delimitations and limitations, significance, definitions of key terms and the organization of the study.

#### 1.1 Background to the Study

Mathematics has long been recognized as a core subject in educational curricula globally and remains central to national development, economic progress, and technological advancement. It promotes logical reasoning, problem-solving, and analytical thinking skills important for scientific exploration and effective decision-making (Plummer et al., 2022). In Ghana, mathematics is a compulsory subject across all levels of education and a fundamental requirement for progress to higher education and employment opportunities.

Despite its importance, students' performance in mathematics remains a major challenge, especially in Senior High Schools (SHSs) within the Tamale Metropolis. Data from the West African Senior School Certificate Examination (WASSCE) have consistently revealed low pass rates in mathematics, raising concerns about the factors contributing to this trend (Efa, et al., 2024). Student learning outcomes refer to the measurable knowledge, skills, attitudes, and values that learners acquire through formal education (Goss, 2022). Learning outcomes may include conceptual understanding, procedural fluency, problem-solving abilities, and positive attitudes toward the subject. Therefore, it is



imperative to identify and understand the factors influencing students' mathematics outcomes.

Research has identified various variables that influence students' performance in mathematics. These include instructional methods, teacher qualifications, classroom environment, parental involvement, peer relationships, socio-economic background, and psychological factors such as test anxiety. Yang et al. (2023) found that high parental support correlates positively with academic achievement and student motivation. Similarly, Moliner and Alegre (2022) reported that students with positive peer interactions perform better academically. A study by Ramazan et al., (2023) also highlighted the influence of classroom climate, showing that a favourable classroom environment marked by supportive teacher-student relationships increased students' interest and involvement in mathematics learning. These insights confirm that learning outcomes in mathematics are not solely determined by innate cognitive abilities but are also mediated by emotional, social, and contextual elements.

In the Tamale Metropolis, several factors are believed to affect how students interact with and succeed in mathematics. Many schools face challenges such as inadequate qualified mathematics teachers, overcrowded classrooms, poor infrastructure, limited instructional time, and lack of learning materials (Bah, 2021). These challenges lead to teacher centred-teaching methods that fail to engage students in meaningful mathematical reasoning and problem-solving. Moreover, the cultural perceptions of mathematics as a difficult and abstract subject contribute to students' anxiety and negative attitudes, further hampering their learning outcomes (Hussein & Csikos, 2023). Differences in teacher training and pedagogical competence further complicate the issue. Many



mathematics teachers lack access to continuous professional development and rely on traditional methods that limit active student engagement (Niyibizi et al., 2024). The Ghana Education Service (GES) has introduced training programs to address these issues, but their impact remains inconsistent, particularly in Northern Ghana (Saaka, 2024).

Additionally, the socio-economic status of students and their families plays a crucial role in academic achievement. According to Bayat and Madyibi (2022), Students from low-income households often face challenges such as lack of access to textbooks, inadequate parental support due to illiteracy, and limited time for study due to household responsibilities. These conditions excessively affect students' ability to focus on academic tasks and persist in learning challenging subjects like mathematics. Furthermore, issues of language proficiency and comprehension also intersect with mathematics learning. Although mathematics is considered a universal language, the ability of students to understand and follow mathematical instructions is heavily influenced by their language proficiency, especially when English the medium of instruction is not their first language. Misinterpretation of questions, difficulties in understanding mathematical terminology, and weak literacy skills can significantly impair students' ability to perform well in mathematics assessments (Manfreda Kolar & Hodnik, 2021). Psychological dimensions such as mathematics anxiety and self-efficacy are also influential. Students with negative experiences in mathematics may develop fear and avoidance behaviours, which correlate with lower performance (Musa & Maat, 2021). Etherton et al., (2022) stated that students with high self-efficacy tend to exhibit resilience and better outcomes. Despite extensive research into these factors





globally, limited empirical studies have been conducted in the specific area of SHS students in the Tamale Metropolis. While national data may provide broad insights into student performance in mathematics, they often fail to capture the nuanced, location specific challenges and opportunities that shape student learning at the district level. This lack of localized research limits the ability of educators, policymakers, and school administrators to design and implement targeted interventions that are responsive to the unique conditions of the Tamale Metropolis.

Understanding the factors that influence mathematics learning outcomes is not only relevant for academic purposes but also for national development. Therefore, this study seeks to investigate the factors affecting students' learning outcomes in mathematics among Senior High Schools in the Tamale Metropolis. The study aims to identify and analyze the interplay of instructional, psychological, socio-economic, and institutional factors that shape how students learn mathematics and perform in it. The findings from this study are expected to provide critical insights for educators, school leaders, curriculum developers, and policymakers to improve mathematics instruction and learning in the region.

## **1.2 Statement of the Problem**

According to Nkansah (2021), mathematics education in Ghana remains vibrant for socio-economic development. However, persistent underperformance in mathematics, especially in the Tamale Metropolis, threatens educational and national development goals. According to WAEC (2020) data as cited by Asomah et al., (2024), many SHS students fail to meet basic mathematics competency requirements, limiting their access to tertiary education. According

to Oppong (2022), many studies focus on instructional quality and teacher competencies when there is increasing recognition of the importance of non-instructional variables such as peer influence, classroom climate, parental support, and test anxiety. However, these factors remain underexplored in Northern Ghana.

In Tamale, subjective evidence suggests that students face challenges beyond classroom instruction. These include inadequate home support, negative peer influences, and test anxiety during mathematics assessment. Adongo et al. (2022) looked at students in the Northern region of Ghana and found that peer influence, parental support, study behaviour, and self-efficacy have a major effect on their academic performance. Similarly, Codjoe et al., (2024) conducted a study in Oti Region, which established that classroom atmosphere, study attitudes, motivation, and locus of control importantly influenced students' academic success. Furthermore, Wang (2024) in the United States established that school environment influences students' sense of belonging and their behaviour in learning mathematics, while Research conducted in Western Nigeria by Ndubuisi et al., (2020) demonstrated that family involvement influences students' mathematics learning behaviour, and that the parents' level of education impacts both learning behaviour and academic achievement in mathematics.

A study by Amoah (2022) stated that heavily research relied on quantitative approaches typically using test scores and self-reported questionnaires without incorporating qualitative insights from students, teachers, or parents. This restricts a deeper understanding of how and why non-instructional factors influence mathematics outcomes, especially within context specific realities



like those of Tamale. Scott (2022) found that SHS Curriculum Framework have prioritized curriculum reform and teacher training, but largely overlook the psychosocial and environmental barriers that shape students' ability to succeed in mathematics. As a result, interventions developed under current policies may fail to address the underlying causes of persistent underperformance.

Given these gaps, this study seeks to investigate peer relationships, classroom atmosphere, parental support, and test anxiety as factors affecting mathematics learning outcomes in SHSs in the Tamale Metropolis.

### **1.3 Purpose of the Study**

The primary purpose of this study is to investigate the factors affecting students' learning outcomes in mathematics among Senior High Schools in the Tamale Metropolis.

### **1.4 Objectives of the Study**

The specific objectives of the study are to:

1. Examine the level of relationship between test anxiety and students' learning outcomes in mathematics.
2. Determine the influence of peer relationships on students' learning outcomes in mathematics.
3. Assess the level of effect the classroom atmosphere has on students' learning outcomes in mathematics.
4. Explore how parental support influences students' learning outcomes in mathematics.



### **1.5 Research Questions**

The following research questions were used to guide the study:

1. What is the level of the relationship between test anxiety and learning outcomes in mathematics?
2. How do peer relationships affect students' learning outcomes in mathematics?
3. What is the level of effect that the classroom atmosphere has on students' learning outcomes in mathematics?
4. How does parental support impact students' learning outcomes in mathematics?

### **1.6 Delimitations of the Study**

This study was limited to public Senior High Schools in the Tamale Metropolis, so its findings may not apply to other areas or private schools. It only included students, leaving out the views of parents, teachers, and administrators who could have added more insight. The focus was just on test anxiety, peer relationships, classroom atmosphere, and parental support, so other factors were not explored. Also, data were collected only through a questionnaire, without interviews or observations. Finally, only students who were available and willing to participate on the day of data collection were included, which means the opinions of absent students, who may have held differing views or experiences, were not captured.

### **1.7 Limitations of the Study**

The study relied on students' self-reported answers, which might include some bias or errors. It used a descriptive survey done at one point in time, so it could not track changes or prove cause and effect. Some students may have



misunderstood questions or answered carelessly. The study looked at students' own views of their learning, not their actual exam results. Finally, the findings might not fully apply to students in other regions or private schools.

### **1.8 Significance of the Study**

This study will help policymakers to gain insights into how emotional and social variables such as anxiety and peer influence affect students learning outcome. The Ghana Education Service (GES) and school administrators will benefit from data that inform classroom practices and teacher training.

Teachers will be able to adopt more student-centered strategies, while NGOs can develop programs that address identified gaps such as after-school support and parental involvement. Parents and community members will also gain awareness of their roles in enhancing students' learning experiences at home and in school.

### **1.9 Operational Definition of Terms**

**Learning outcomes:** The statements of the knowledge, skills and abilities individual students should possess and can demonstrate upon completion of a learning experience or sequence of learning experiences (Harefa et al., 2023).

**Test anxiety:** The emotional and physiological stress experienced by students before, during, and after tests, affecting performance (Heissel et al., 2021).

**Classroom atmosphere:** The emotional and psychological climate of a classroom shaped by teacher-student and student-student interactions (Luo & Derakhshan, 2024).

**Parental support:** Educational, emotional, and material assistance provided by parents to enhance their children's academic success (Sengonul, 2022).



**Peer relationships:** The social interactions and bonds students form with classmates that may influence learning behaviors and academic performance (Shao et al., 2024).

### **1.10 Organization of the Study**

The study is structured into five chapters. The first chapter provides an overview of the study, including the background, problem statement, purpose, objectives, research questions, delimitations and limitations, significance, definition of terms, and organization of the study. Chapter two focuses on the literature review, which encompasses the theoretical, conceptual and empirical review. Chapter three details the research methods employed in the study. This section covers the research approach, research design, Research Paradigm, population, sample, sampling techniques and procedure, research instrument, data collection instruments, and data analysis.

Chapter four presents the findings and interpretation of the study's data. The final chapter summarizes the study's key points, draws conclusions based on the findings, and offers recommendations for future research.



## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0 INTRODUCTION

Theoretical, conceptual and empirical frameworks are included in this chapter. The theoretical framework deals with the Constructivist Learning Theory and Item Response Theory. The concept of learning mathematics and its outcome on students is also covered in the conceptual review. Empirically, the following topics were also reviewed: Test Anxiety and Learning Outcome in mathematics, Effects Peer Relationships on Students' Learning Outcomes in mathematics, effect of classroom atmosphere on students' learning outcomes in mathematics. and how parental support influences students' learning outcomes in mathematics.

#### 2.1 Theoretical Framework

##### 2.1.1 Constructivist learning theory

The Constructivist Learning Theory, as pioneered by Piaget (1970), argues that learners actively construct new knowledge by building on their prior understanding through real-world interaction. Within mathematics education, this perspective emphasizes experiential learning, problem solving, and collaborative tasks that allow students to internalize mathematical concepts through active participation (Nishonov, 2024). Constructivism shifts the focus from rote memorization to conceptual understanding, critical thinking, and application.

This theoretical supporting offers a useful lens to assess the various psychosocial and other factors such as classroom climate, parental support, peer interaction, and test anxiety that influence student learning outcomes.



According to Mastul (2024), learners thrive when they are placed in a social and cognitive environment that fosters discovery and exploration. Similarly, McLeod, (2023) emphasized the importance of scaffolding and discovery learning in helping students grasp abstract concepts. Sanchez (2021) opposes that learning is socially situated and constructed through dialogue, making social interactions (e.g., teacher-student, peer-peer) central to learning. Hastings (2022) reinforces these views by advocating for learning environments that incorporate discussion, reasoning, and problem-solving as central strategies. Furthermore, Hattan (2024) highlighted that learners must make sense of content through personal interpretation and reflection, which is influenced by prior knowledge and environmental cues.

According to Khodadad (2023) an engaging and emotionally secure environment facilitates meaningful interactions and enhances learning. It plays a pivotal role in shaping students' engagement, focus, and success in mathematics. Frommelt et al., (2021) observed that students in supportive classrooms tend to show more enthusiasm and deeper understanding in math. Likewise, Niță (2023) concluded that respectful and emotionally safe classrooms lead to improved participation and risk-taking in problem-solving. In Tamale, however, factors like overcrowded classrooms, limited resources, and occurrence of teacher-centered teaching compromise this ideal learning environment (Ayantunji, 2022). Barksdale (2021) conducted a study and found that students' perceptions of their classroom environments significantly predict academic success. Wang (2023) demonstrated that emotional connection with the teacher fosters better learning behaviours. Also, Romano et al., (2021) found that emotional support in the classroom is critical for long-term academic



progress. Killen & Rutland (2022) also showed that a fair, inclusive classroom increases participation and motivation, while Lichtenfeld et al., (2023) emphasized that early emotional experiences in school shape long-term performance. Constructivism acknowledges that learning is deeply social, and that peer collaboration plays a critical role in cognitive development. Drawing from Vygotsky's (1978) Social Development Theory, the idea is that students achieve deeper learning through interaction and collaboration with more capable peers. Qureshi et al., (2023) noted that cooperative learning leads to greater conceptual understanding than traditional instruction.

Crichton et al., (2021) found that peer discussions allow for reflection and articulation of thought, which reinforces learning. However, negative peer interactions or isolation may hinder participation, reducing opportunities to build understanding. In Tamale, Adongo et al., (2022) confirmed that peer influence has a direct effect on students' academic behaviour and achievement. Additional support is found in the work of Aksu and Zengin (2022) who emphasized the value of structured collaborative learning in developing mathematical reasoning. Passion and Marcelo (2024) identified peer tutoring as a strong intervention for improving math performance. Bowden et al., (2021) found that students who feel accepted by peers show higher levels of academic engagement. Laursen and Veenstra (2021) argued that peer pressure and social norms shape students' effort and motivation in school. Arthur et al., (2022) demonstrated that peer-assisted learning strategies lead to statistically significant gains in mathematics achievement. Parental involvement significantly shapes educational outcomes and is supported by Constructivist theory, that learning continues beyond school and that home support reinforces



classroom instruction. Yang et al. (2023) demonstrated that students whose parents are involved in their education tend to be more motivated and achieve higher.

In economically underprivileged region like Tamale, Singh, (2022) observed that students often lack essential learning materials or quiet spaces, which adversely affects study habits. Chen et al., (2022) confirmed that students with educated and supportive parents typically outperform those from less literate homes. Complementary studies include Wilder (2023) reported a consistent, positive link between parental involvement and academic success. Jeynes (2024) found that high parental expectations correlate with better school performance, particularly in math. Stewart et al., (2022) emphasized that parental communication and home supervision are critical for fostering motivation. Research by Maldonado et al., (2022) argued that home-based support rather than school-based involvement has the most significant impact on student learning. Test anxiety remains one of the most common emotional barriers to academic performance, especially in high-stakes subjects like mathematics. According to Spalding, et al., (2021), anxiety affects working memory and impairs the ability to recall learned information during assessments. Musa and Maat (2021) observed that math anxiety results in avoidance behaviour, low confidence, and poor performance. Adefisayo (2024) emphasized that negative past experiences form a cycle of fear and underachievement. These dynamics are especially relevant in Tamale, where many students lack psychosocial support to cope with academic stress.

According to Ashcraft and Kirk (2001), anxiety restricts cognitive resources needed for math tasks. Barlow et al., (2022) linked negative emotions to





disengagement and lower outcomes. A study by Wong et al., (2024) found that self-doubt lowers resilience, while Zuo et al., (2024) connected performance pressure to anxiety and reduced math engagement. Constructivist classrooms emphasize formative assessment, which focuses on guiding students through learning rather than simply evaluating performance. Li and Yuan (2022) argued that high-quality feedback from teachers helps learners understand their progress and promotes metacognition. Menninga et al., (2021) highlighted that teacher-student interaction during assessment can enhance conceptual understanding. Also, a study by Howell (2021) stressed that reflective feedback fosters long-term learning. In Tamale, overburdened teachers may struggle to implement these practices effectively due to large class sizes and limited training (Adjei, 2023). Morris et al., (2021) conducted research and noted that formative feedback helps bridge the gap between current and desired performance. Tsai (2021) emphasized that feedback promotes learner autonomy. A study by Carless and Winstone (2023) argued that effective feedback addresses where the student is, where they are going, and how to get there. Hasan (2024) also stressed the need for timely and actionable feedback. Flournoy and Bauman (2021) promoted self-assessment as a tool for encouraging responsibility for learning. Effective feedback practices, when implemented, have the potential to transform students' learning outcomes in mathematics.

This review shows that mathematics learning outcomes are influenced by classroom environment, peer interaction, home support, and emotional factors which are supported by Constructivist Learning Theory.

## 2.1.2 Item Response Theory

Item Response Theory (IRT) has emerged as a powerful analytical framework in educational research, offering a more nuanced approach to understanding student learning outcomes than the traditional Classical Test Theory (CTT). IRT posits that the probability of a student answering a test item correctly depends not only on their overall ability but also on specific item characteristics such as difficulty, discrimination, and guessing (Stemler & Naples, 2021). This theory supports a probabilistic model that estimates a student's latent trait typically, ability or proficiency based on their pattern of responses. In mathematics education, IRT has been instrumental in revealing the deeper, often hidden, factors that shape students' cognitive engagement and response behaviour. This is particularly useful in areas such as Senior High Schools (SHSs) in the Tamale Metropolis, where learning outcomes are influenced by a blend of psychosocial, instructional, and background dynamics.

### 2.1.2.1 Principles of Item Response Theory (IRT)

The main principles of IRT include:

1. **Unidimensionality:** IRT assumes that a single latent trait (e.g., mathematics ability) underlies responses to items in a given test. This means the test measures one primary construct.
2. **Item Characteristic Curve (ICC):** Each test item has an ICC, which graphically represents the probability of a correct response as a function of a student's ability level ( $\theta$ ). The shape of the curve depends on item parameters.
3. **Item Parameters:**



- Difficulty (b): Indicates the level of ability at which a student has a 50% chance of answering the item correctly.
- Discrimination (a): Reflects how well an item distinguishes between students with abilities above and below the item's difficulty.
- Guessing (c): Represents the probability that a low-ability student could answer the item correctly by guessing (used in 3PL models).

4. Local Independence: Once the latent trait is controlled, the responses to different items are assumed to be statistically independent of one another.

5. Invariant Item and Person Parameters: Item parameters do not change across different samples of test-takers, and person ability estimates are independent of the specific set of test items, assuming proper model fit.

The application of IRT in educational assessment offers a significant advantage in analyzing how related and psychosocial factors affect students' mathematics learning outcomes. IRT's assumption of Unidimensionality aligns well with evaluating mathematics proficiency as a single latent construct, though it allows for extensions into multidimensional models when assessing the effects of multiple variables such as anxiety, peer interaction, or classroom environment. Stemler and Naples (2021) emphasize that IRT models provide a robust framework for understanding how latent traits like ability interact with item properties. The principle of item discrimination can reveal how well particular test items differentiate between high- and low-performing students, especially in settings with varying instructional quality.



### 2.1.2.2 The Three-Parameter Logistic (3PL) models in Item Response Theory (IRT).

It is designed to evaluate how individual test-takers respond to specific test items, especially in multiple-choice assessments. The 3PL model considers three key item parameters:

#### 1. Difficulty (b)

This parameter indicates the level of ability a student must have to have a 50% chance of answering the item correctly (excluding guessing).

- A higher b-value means the item is more difficult.
- A lower b-value means the item is easier.

#### 2. Discrimination (a)

This parameter shows how well an item distinguishes between students of high and low ability.

- A high a-value means the item is good at differentiating between strong and weak students.
- A low a-value means the item does not discriminate well (almost everyone gets it right or wrong).

#### 3. Guessing (c)

This parameter accounts for the likelihood that a student with very low ability can answer the item correctly just by guessing (typically in multiple-choice questions).

- A higher c-value suggests the item is more susceptible to correct guesses (e.g., if options are poorly constructed).
- This is especially relevant in low-stakes testing or when test anxiety leads to random guessing.



A study by Stemler and Naples (2021) explain that the 3PL model captures the nuances of test performance, especially where low-performing students might answer difficult items correctly due to random guessing, which traditional scoring systems fail to account for. The 3PL model is useful for identifying performance differences due to instructional gaps, test anxiety, and socio-economic constraints. Morris (2024) found that in low-income school settings, students often exhibit high guessing behaviour due to insufficient exposure to content and poor preparation, which increases the c-parameter in 3PL models. Similarly, Musa and Maat (2021) noted that students with high math anxiety displayed irregular item response patterns and higher guessing parameters, suggesting that anxiety negatively affects test-taking behaviour and masks true ability.

Several studies have reviewed that IRT has effects on students learning outcome in mathematics and for instance research has shown that classroom atmosphere significantly affects students' ability to respond accurately to test items. A supportive and engaging classroom environment has been associated with increased focus, motivation, and participation, which in turn improve item response consistency and discrimination parameters in IRT models (Ridho, 2024). These findings are critical when considering the realities of SHSs in Tamale, where factors such as overcrowded classrooms, lack of instructional materials, and rigid teacher-centered pedagogies often create unfavourable learning conditions (Bah, 2021). In such settings, IRT can reveal Differential Item Functioning (DIF), wherein students of similar abilities respond differently due to environmental limitations. Studies by Diallo (2022) underscore how collaborative and emotionally secure classrooms correlate with more consistent



response patterns in mathematics tasks. Furthermore, Chiu (2021) suggest that technology enhanced and autonomy supportive classroom environments enhance item level reliability and student engagement. Therefore, applying IRT in the analysis of student performance in mathematics in Tamale may offer deeper insights into how classroom climate mediates achievement beyond raw scores.

Parental support has also been widely documented as a key determinant of academic success and latent ability estimates in IRT modeling. Students whose parents are actively involved in their education buy them mathematics past questions and textbooks which tend to exhibit lower guessing parameters and better discrimination indices in 3PL IRT models, indicating stronger cognitive engagement and preparedness (Akanni, 2021). In low income or resource constrained households, such as those prevalent in Tamale, parental illiteracy and limited economic capacity can lead to elevated measurement error and reduced test validity. Zimmer-Gembeck et al., (2023) found that students with academically supportive parents were more accurate in item responses and exhibited fewer error response patterns. This is consistent with findings by Alan and Turkum (2024) who observed that students from needy backgrounds showed greater standard error in IRT estimates, particularly on items requiring abstract reasoning. Lerner et al., (2022) emphasized that parental involvement especially in homework, academic discussion, and motivational support shapes how students interact with test items. Nwaba et al., (2022) confirmed this pattern in Nigeria, noticing that students from literate homes performed better even when test content was controlled for ability.





Peer relationships also play a critical role in students' learning outcomes and subsequent test performance. Within IRT frameworks, peer influence affects latent traits such as self-efficacy, motivation, and anxiety, all of which shape response outcomes. Kos (2023) demonstrated that students with strong peer support tend to be more persistent in tackling difficult items and show fewer skipped or misread questions. Talaei et al., (2022) reinforced the view that peer collaboration fosters deeper conceptual understanding and more accurate responses. Haddow et al., (2021) further observed that positive peer environments mitigate the negative effects of anxiety, leading to more reliable IRT estimates. Test anxiety remains a pervasive challenge in mathematics education and has been shown to distort test outcomes significantly in the Tamale metropolis. Pickering et al., (2022) found that anxiety disrupts students' working memory and leads to poor navigation of complex item formats. In resource constrained and high-pressure environments like SHSs in Tamale, test anxiety may be worsened by fear of failure and limited academic support, leading to inflated guessing and lower ability estimates. Musa and Maat (2021) confirmed that mathematics anxiety is associated with reduced theta scores, even when students have comparable levels of cognitive ability. Naveed and Anwar (2021) further emphasized that anxiety introduces bias into item responses and affects the overall psychometric structure of assessments. Stokes (2023) found that anxious students respond erratically to high-difficulty items, leading to misinterpretation of their true ability.

Finally, assessment practices grounded in IRT provide actionable diagnostic feedback that goes beyond traditional grading. By mapping student proficiency along a latent continuum, IRT enables teachers to pinpoint specific knowledge

gaps and adjust instructional strategies accordingly. Clariana & Park (2021) argued that feedback based on precise item-level analysis improves learner reflection and growth. Khursheed and Alwi (2023) emphasized that formative assessment driven by IRT data empowers both students and teachers to focus on learning processes rather than mere test scores. Oladele and Ndlovu (2021) further suggested that adaptive testing using IRT algorithms could tailor assessments to students' ability levels, offering a more equitable testing environment. Given the challenges facing mathematics instruction in Tamale, the use of IRT as both an evaluative and formative tool presents a strategic advantage in improving learning outcomes and achieving fairer assessments. The literature strongly supports the use of Item Response Theory as a robust analytical framework for exploring the certain factors influencing mathematics learning outcomes. Whether addressing the influence of classroom atmosphere, parental support, peer relationships and test anxiety, IRT enables a more precise and equitable interpretation of student performance.

## **2.2 Conceptual Review**

### **2.2.1 Concept of Learning Outcomes in Mathematics**

Learning outcomes in mathematics refer to the specific knowledge, skills, attitudes, and values that students are expected to acquire as a result of formal instruction and engagement with mathematical content (Harefa (2023)). These outcomes are used as measurable indicators of what learners understand and can do after completing a lesson, course, or program. In mathematics, learning outcomes typically include conceptual understanding, procedural fluency, problem-solving ability, logical reasoning, and the ability to apply mathematical knowledge in real-world contexts. For instance, a student who has achieved a

good learning outcome in algebra should not only be able to solve equations but also explain the underlying concepts and apply them in unfamiliar situations. Learning outcomes are essential for both formative and summative assessments, curriculum development, and instructional planning. According to Ajai (2024), effective mathematics learning outcomes must reflect a balance between knowing facts and developing mathematical reasoning and communication skills.

Senior High Schools (SHS) in Ghana are often assessed through the West African Senior School Certificate Examination (WASSCE). However, persistent poor performance suggests that students may not be achieving the intended outcomes, which include not just test scores, but deeper learning indicators like confidence in problem-solving and mathematical thinking.

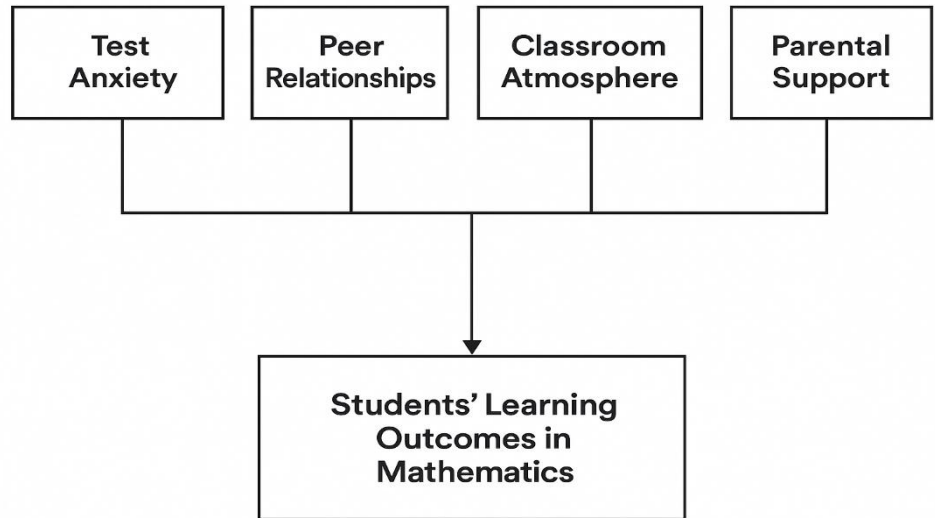
Furthermore, as outlined by Noushad (2024) learning outcomes in mathematics must align with cognitive domains ranging from basic recall (knowledge) to complex evaluation and creation. In low-resource settings, factors such as test anxiety, poor classroom atmosphere, limited parental support, and peer influences may hinder students from attaining these desired outcomes.

### **Conceptual Framework**

The diagram below presents the conceptual framework of the study, illustrating the relationship between the independent and dependent variables. The four independent variables test anxiety, peer relationships, classroom atmosphere, and parental support are shown with arrows pointing toward the dependent variable, students' learning outcomes in mathematics, to indicate the direction of influence.



**Figure 1**



Source: Authors' construct (2024)

From the diagram above, the dependent variable is students' learning outcomes in mathematics, which refers to the measurable academic performance or achievement. This outcome represents the key construct the study seeks to explain, assess, and improve. The independent variables influencing this outcome are identified as: test anxiety, peer relationships, classroom atmosphere, and parental support. Each of these factors plays a distinct role in shaping students' academic experiences and mathematical performance.

Test anxiety is expected to negatively influence learning outcomes. High levels of anxiety before or during assessments can impair concentration, reduce cognitive processing, and hinder memory retrieval, which collectively diminish students' ability to perform well in mathematics.

Peer relationships may have either a positive or negative influence on learning outcomes, depending on the nature of the peer interactions. Supportive peers who promote academic collaboration, motivation, and discipline can enhance



mathematics performance, while negative peer influence may lead to distractions and disengagement.

Classroom atmosphere refers to the general learning environment shaped by teacher-student interactions, classroom management, and instructional practices. A positive classroom atmosphere is believed to foster greater student engagement, motivation, and understanding, thereby improving mathematics learning outcomes. Parental support provides emotional encouragement, academic guidance, and material resources. When parents are actively involved in their children's learning, it often results in better preparedness, increased motivation, and improved academic performance in mathematics.

Collectively, these independent variables interact to shape students' cognitive, emotional, and behavioural responses toward learning mathematics, thereby influencing their academic outcomes.

### **2.2.2 Concept of Test Anxiety**

According to Udechukwu and Ofoke (2024), Test anxiety is defined as a psychological condition wherein individuals experience extreme stress, nervousness, or apprehension before or during an examination. It typically comprises two components: cognitive anxiety (worry and negative expectations) and emotionality (physiological arousal such as increased heart rate and sweating) (Spielberger, 1980). Test anxiety is one of the most frequently reported emotional barriers to academic success. According to Mahmood et al., (2024) test anxiety has been linked to negative self-perception, learned helplessness, and a cycle of underachievement. The complex nature of mathematics, involving abstract reasoning and problem-solving under time constraints, often intensifies anxiety, especially in high-stakes examination



environments such as the West African Senior School Certificate Examination (WASSCE), which determines tertiary progression for Ghanaian students. Musa and Maat (2021) examined senior high school students and discovered that mathematics anxiety was a significant predictor of poor academic performance. In the Tamale Metropolis, socio cultural perceptions of mathematics as a “difficult subject” further compound students’ anxiety, leading to avoidance behaviours, reduced classroom participation, and diminished confidence. According to Sulaiman (2024) the cognitive manifestations of test anxiety include intrusive thoughts, reduced concentration, and negative self-talk. Emotionally, students may exhibit increased irritability, fatigue, and helplessness. These manifestations contribute to a cycle of underachievement, where students with poor past performance in mathematics anticipate failure in future tasks, further reinforcing their anxiety.

Test anxiety does not occur in isolation; it is mediated by socio-cultural and institutional factors. Students in Northern Ghana may face familial pressure to succeed academically as a pathway out of poverty. Parental expectations, especially when paired with limited academic support at home, can exacerbate anxiety. Several intervention strategies have been proposed to mitigate test anxiety, especially in low-resource settings. Cognitive-behavioural techniques such as relaxation training, systematic desensitization, and self-instructional training have shown positive results in reducing anxiety (Espie, 2022). Metacognitive strategies like time management and self-testing help students prepare more effectively and approach tests with greater confidence. Integrating anxiety-reduction practices into classroom instruction can be beneficial. For example, frequent low-stakes testing, constructive feedback, and supportive



teacher-student relationships have been found to reduce students' emotional burden and enhance their readiness for high-stakes assessments (Ansong et al., (2024). The inclusion of test anxiety provides a comprehensive understanding of how emotional factors mediate cognitive performance in mathematics among SHS students in Tamale.

### **2.2.3 Concepts of Peer Relationships**

Peer relationships refer to the social interactions, emotional bonds, and academic connections that students form with one another within the school environment (Shao et al., 2024). These relationships are a fundamental part of adolescent development and play a pivotal role in shaping students' attitudes, behaviours, and academic outcomes.

As students transition into higher levels of education, particularly during adolescence, peers become an increasingly significant source of influence, sometimes rivalling or surpassing the influence of teachers and parents. In the mathematics classroom, peer relationships manifest in several ways, including collaborative learning, peer tutoring, informal study groups, and class discussions. These settings allow students to explain concepts to one another, ask questions freely, and engage in shared problem-solving. Vygotsky's social constructivist theory highlights the importance of social interaction in cognitive development, arguing that learning occurs most effectively when students engage with more knowledgeable peers within their zone of proximal development. In mathematics education, such interactions often help clarify difficult concepts and build confidence through mutual support.

The relevance of peer relationships in mathematics learning becomes especially evident in contexts where teaching resources are limited, as is often the case in





many public SHSs in Tamale. Overcrowded classrooms and teacher-centered pedagogies may limit the ability of instructors to attend to individual learning needs. In such settings, students often rely on one another for academic assistance. When peer relationships are positive, characterized by cooperation, empathy, and shared academic goals, students benefit from increased motivation, reduced anxiety, and enhanced problem-solving abilities (Amerstorfer et al., 2021). Peer collaboration fosters a sense of belonging and academic resilience, encouraging students to persist even when they encounter difficulties with mathematical content. However, not all peer relationships are beneficial. Negative peer influence manifested through distractions, mockery, competition, or discouragement can lead to reduced academic effort and low performance. Some students may avoid seeking help from their peers due to fear of judgment or ridicule, particularly in a subject like mathematics, which is often associated with feelings of inadequacy and low self-worth. In schools where academic culture is weak or where peer groups do not value scholastic achievement, students may be less inclined to engage seriously with learning activities. This is particularly concerning in the Tamale Metropolis, where subjective evidence and prior studies indicate that peer pressure can divert students' attention from academics to non-productive activities, such as absenteeism or social media use during instructional hours.

Hoferichter et al., (2022) found that students who reported higher levels of peer support were more likely to engage in classroom activities and perform better academically. Moliner and Alegre (2022) also confirmed that students who worked cooperatively with peers exhibited higher retention of mathematical concepts and greater enthusiasm for learning. These findings are echoed in

study area, where Adongo et al. (2022) observed that positive peer interactions in Northern Ghana significantly enhanced student motivation and academic performance. Their study emphasized that students who formed study groups or engaged in academic discussions with friends showed improved outcomes in core subjects, including mathematics.

The influence of peer relationships on learning outcomes can also be understood through the lens of assessment theory, particularly Item Response Theory (IRT). In peer rich environments where students are encouraged and supported, there is often more consistent and motivated response behaviour in mathematics assessments. Conversely, in environments where peer dynamics induce anxiety or competition, students may exhibit aberrant response patterns, particularly in high-stakes tests. For instance, test items that require open-ended reasoning or collaborative problem-solving might show lower discrimination values among students from unsupportive peer settings due to reduced engagement and confidence. Moreover, the impact of peer relationships extends beyond immediate academic support. It also shapes students' academic identities, influencing how they perceive their competence in mathematics and their willingness to engage with challenging tasks. Students who see their friends succeeding in mathematics may be more likely to believe in their own abilities, a phenomenon known as peer academic modelling. Conversely, those surrounded by peers who frequently express fear or hatred toward mathematics may internalize these sentiments, thereby developing math anxiety or self-doubt.



#### 2.2.4 Concept of Classroom Atmosphere

Classroom atmosphere, also referred to as classroom climate, embodies the emotional, instructional, and organizational tone within a learning environment, profoundly shaping students' motivation, engagement, and academic performance (Luo & Derakhshan, 2024). This concept includes factors such as teacher-student relationships, peer interactions within the classroom, teaching strategies, discipline procedures, classroom organization, and emotional safety all of which collectively influence how students perceive and engage with mathematics teaching. A positive classroom atmosphere is one in which students feel respected, supported, and motivated to participate actively in the learning process. In such environments, mathematics is presented as an accessible and meaningful subject rather than a rigid and abstract domain. When students perceive their learning environment to be supportive, they are more likely to develop self-confidence, reduce anxiety, and take academic risks essential for problem-solving and conceptual reasoning. Research by Hall et al., (2022). demonstrated that the psychosocial environment of the classroom significantly affects student outcomes, particularly in subjects like mathematics that require both cognitive effort and emotional resilience. In mathematics classrooms where the teacher fosters encouragement, respect, and inclusiveness, students tend to engage more deeply, which results in better comprehension and performance.

In classrooms characterized by fear of failure, lack of feedback, poor teacher-student interaction, and minimal peer cooperation, students often develop feelings of inadequacy and disengagement. These negative emotions can manifest in avoidance behaviours, reduced participation, and ultimately poor



performance. According to Hettinger et al., (2023) students in classrooms with poor climate are less likely to seek help, less engaged during instruction, and more likely to give up when faced with complex mathematical problems. In regions like Tamale, where overcrowding and limited resources often dominate SHS settings, maintaining a positive classroom atmosphere is particularly challenging. Many SHSs in the region grapple with large class sizes, teacher shortages, lack of instructional materials, and infrastructural deficits. These conditions tend to foster authoritarian teaching styles, where instruction is delivered in a top-down, lecture-based format with minimal student interaction. Teachers who employ student-centered strategies such as cooperative learning, project-based tasks, and inquiry-based instruction contribute to a more dynamic and supportive atmosphere. These practices resonate with the constructivist learning theory, which emphasizes active participation and social interaction as keys to knowledge construction. According to Thapa (2022), students exposed to learner-friendly environments, where teachers show empathy and adaptability, tend to demonstrate better mathematics performance. The role of emotional support in classrooms is vital, especially for students who already harbor negative attitudes or anxiety toward mathematics.

Furthermore, classroom atmosphere serves as a mediating factor between instructional quality and academic outcomes. For instance, two classrooms may utilize the same curriculum and instructional resources, yet produce vastly different student outcomes due to differences in classroom environment. In a study by Sökmen (2021), it was found that students' perceptions of their classroom environment significantly predicted their levels of academic efficacy and engagement, suggesting that fostering a positive atmosphere could





compensate for certain instructional or material deficiencies. This is particularly relevant in Tamale, where some schools may lack advanced teaching aids or spacious classrooms but could improve learning outcomes by nurturing better relational dynamics between teachers and students. According to Ahmad (2021), If students fear ridicule or punishment for incorrect answers, they are less likely to participate or attempt complex problems. Conversely, an emotionally safe environment promotes resilience and perseverance, traits essential for mathematics mastery. According to Sarwari and Kakar (2023) students who feel emotionally safe and respected are more likely to show persistence in solving difficult problems and demonstrate higher-order thinking skills.

Classroom atmosphere also impacts how assessment is perceived and responded to. In an environment where assessments are used primarily for grading and punishment, students may resort to memorization and surface learning. However, in a supportive climate where formative assessment and feedback are integral, students are more likely to reflect on their mistakes and view assessment as a learning tool. This aligns with findings from Rajapakse (2024), who emphasized that a classroom culture centered around continuous feedback and growth significantly enhances students' academic progress.

### **2.2.5 Concept of Parental Support and Educational Outcomes**

According to Bradley (2021), parental support is positively associated with student motivation, academic achievement, and school engagement. Children whose parents regularly engage in their academic lives tend to develop stronger learning habits, higher self-efficacy, and a more positive attitude toward school. In mathematics, this support is particularly critical because students frequently



encounter conceptual difficulties that require consistent practice and confidence to overcome. When students are supported at home, they are more likely to develop persistence and problem-solving skills, which are essential for success in mathematics. In Tamale, however, many parents face economic and educational limitations that hinder their ability to provide consistent academic support. A significant number of households in the region are characterized by low parental literacy levels, irregular income sources, and limited access to educational materials. According to Njuguna (2021), students from low-income families are less likely to receive academic assistance at home due to parental illiteracy or lack of time, as parents may be preoccupied with subsistence activities. This situation creates a gap between students from supportive home environments and those who lack such resources, reinforcing educational inequality. The challenge is particularly acute in mathematics, where success often depends on cumulative understanding and regular reinforcement of concepts, which disadvantaged students may lack outside the classroom.

The influence of parental support on mathematics achievement also extends beyond material provision. Emotional encouragement and the establishment of a home environment that values education can significantly shape a student's perception of learning. Research by Madeeha et al., (2024) emphasized that parental expectations and aspirations have a strong influence on students' academic attitudes. According to Lerner et al., (2022), if parents view mathematics as overly difficult or irrelevant to future success, they may be less inclined to motivate or assist their children in the subject, thereby indirectly contributing to poor academic outcomes. In addition, communication between parents and schools plays a vital role in ensuring consistent academic progress.



Parents who are informed about their children's academic challenges can collaborate with teachers to address them. However, in the Tamale Metropolis, structural barriers such as long travel distances to schools, limited opportunities for parent-teacher interactions, and lack of awareness about school policies hinder effective communication. As noted by Ndubuisi et al. (2020), students whose parents are actively engaged with school authorities perform better academically because schools can tailor interventions that complement home efforts. Without this partnership, students may fall through the cracks, especially in mathematics where timely remediation is crucial for mastering foundational concepts.

Furthermore, the role of cultural perceptions and gender norms cannot be ignored. In some households in Tamale, traditional expectations may limit the involvement of parents, particularly mothers, in their children's academic lives, especially if they themselves did not receive formal education. Girls may receive less encouragement in mathematics due to societal beliefs that associate mathematical competence with masculinity. This cultural bias, combined with lack of parental advocacy, can lead to underperformance among female students, thus reinforcing gender disparities in mathematics achievement. Supporting this, Agbenyo and Sarkpoh (2021) found that gender-based parental expectations had a measurable impact on students' mathematics outcomes in Northern Ghana.

### **2.2.6 Interactions Among the Factors**

The interaction among test anxiety, peer relationships, classroom atmosphere, and parental support plays a key role in shaping students' learning outcomes in mathematics. While each of these factors exerts a unique influence, their effects



are often intertwined, amplifying each other's impact on students' academic performance. Understanding the interconnected nature of these variables is crucial in diagnosing the root causes of persistent underachievement in mathematics and designing effective interventions. A key interaction exists between test anxiety and classroom atmosphere. When students experience high levels of anxiety related to assessments, their ability to recall and apply mathematical concepts is impaired. However, the emotional climate of the classroom can either exacerbate this anxiety. Supportive and engaging classroom environments marked by constructive feedback, patience, and mutual respect have been found to significantly reduce the negative cognitive effects of anxiety (Ramazan et al., 2023). In contrast, authoritarian teaching styles, rigid assessment procedures, or high-pressure environments can amplify anxiety, further distancing students from successful learning outcomes (Shah et al., (2024). This relationship is particularly relevant in many SHSs in Tamale, where traditional, teacher-centered instruction dominates, and students are often not encouraged to express confusion or ask for help.

The influence of peer relationships on both classroom atmosphere and test anxiety also cannot be overlooked. Students who are part of supportive peer links often show higher levels of classroom engagement, reduced fear of failure, and increased willingness to collaborate on mathematical tasks. Peer encouragement can serve as a buffer against test-related stress and foster a sense of academic belonging, which is vital for mathematics learning. Conversely, negative peer dynamics such as bullying, ridicule for mistakes, or social exclusion can heighten anxiety and reduce participation, particularly in subjects like mathematics that require active problem-solving and class interaction

(Moliner & Alegre, 2022). This is a significant concern in Tamale schools, where large class sizes and inadequate supervision may foster unproductive peer interactions. Parental support further interacts with both emotional and social classroom experiences. Parents who demonstrate interest in their children's education often instill a sense of value for learning, equipping students with the confidence to confront academic challenges. This parental involvement, when combined with a positive classroom atmosphere and peer reinforcement, creates a cohesive support system that promotes academic resilience. According to Yang et al. (2023), students who feel supported both at home and school tend to exhibit lower anxiety, better self-regulation, and stronger learning motivation. Students lacking such home reinforcement may feel isolated in the learning process, becoming more susceptible to anxiety and peer influence, particularly in high-stakes subjects like mathematics. Socioeconomic context further moderates these interactions. In Tamale, where many families face financial constraints and educational disadvantages, limited parental involvement is often coupled with under-resourced school environments. This can create a feedback loop in which poor classroom conditions increase anxiety and reduce student engagement, which is not counterbalanced by adequate home support or positive peer relationships. As a result, students may develop negative attitudes toward mathematics and disengage entirely. According to Luthar et al., (2020) stated that students from lower socioeconomic backgrounds are more likely to experience cumulative risk due to the convergence of weak parental support, supportive school environments, and social instability, leading to long-term learning deficits.



Overall, the complex interplay among test anxiety, peer relationships, classroom atmosphere, and parental support demonstrates that no single factor operates in isolation. These variables function within a dynamic educational ecosystem where the presence or absence of one condition influences the effectiveness of others. Addressing learning challenges in mathematics among SHS students in Tamale therefore requires an integrated approach that strengthens all four areas simultaneously. Educational stakeholders must recognize that improvements in instructional quality, emotional classroom climate, peer culture, and parental engagement must work hand in hand to yield meaningful changes in learning outcomes.

## **2.3 Empirical Review**

### **2.3.1 Test Anxiety and Learning Outcomes**

Studies conducted across various educational settings confirm that students at the senior high school level frequently experience moderate to high levels of anxiety when confronted with mathematics assessments. A survey by Khalid (2024) in Pakistan reported that over 60% of secondary school students exhibited moderate to severe anxiety during mathematics tests, a pattern also echoed in several African contexts where competitive examinations determine educational progression. The direct impact of test anxiety on mathematics learning outcomes has been extensively documented. A meta-analysis by von der Caviola et al., (2022) concluded that higher levels of test anxiety are consistently associated with lower academic performance, with mathematics showing the strongest correlation. This negative relationship is largely attributed to the cognitive interference theory, which posits that anxiety consumes working memory resources, impairs concentration, and obstructs



retrieval of previously learned content. Morse (2022) conducted research in south Africa and found that students who reported high anxiety before math tests scored significantly lower than their low-anxiety counterparts, even when prior knowledge was controlled. Similar patterns were observed by Yuan et al., (2023) in their cross-national study, which indicated that math anxiety was not only correlated with low performance but also with reduced effort and persistence in solving complex problems.

Gender and age differences have also emerged as critical scopes in the empirical literature on test anxiety. Multiple studies indicate that female students are more susceptible to test-related stress, particularly in mathematics. Roos et al., (2023) observed that girls often report higher levels of physiological and emotional symptoms of anxiety, which in turn affects their confidence and performance during tests. This trend has also been observed in parts of Sub-Saharan Africa, including Kenya and Nigeria, where female students in SHS exhibit greater apprehension towards mathematics assessments, partially due to sociocultural beliefs about gender and mathematical aptitude (Amoah, 2024). Age-wise, younger students in early high school grades tend to experience more test anxiety, which may gradually reduce with exposure and coping strategies as they advance through the academic system. This suggests a developmental path in test anxiety, influenced by both cognitive maturity and prior success in academic evaluations. Self-efficacy, defined as a student's belief in their ability to perform well, significantly moderates the effect of anxiety on mathematics performance. A study by Zhang and Wang (2020) showed that students with high mathematical self-efficacy reported lower anxiety and achieved higher scores, even under stressful conditions. Motivation also plays a central



mediating role. Rubach and Bonanati (2023) found that intrinsic motivation for learning math reduces the detrimental impact of anxiety by enhancing engagement and task persistence. According to Turgut and Uğurlu (2024) students who were internally motivated and believed in their academic abilities demonstrated more resilience during mathematics examinations, showing that self-perception of competence is crucial in moderating anxiety's effects.

Essuman et al., (2021) investigated the academic stressors of Ghanaian high school students and found that anxiety related to mathematics testing was among the top three challenges affecting their academic engagement and achievement. They also noted that schools in northern Ghana, including the Tamale Metropolis, were particularly affected due to larger class sizes, fewer individualized learning opportunities, and high expectations from national examinations such as WASSCE. Acheampong (2023) conducted a comparative study on students from Islamic and Christian mission senior high schools in the Ashanti Region and found that students from mission schools reported slightly lower levels of test anxiety, possibly due to structured routines, value-based education, and strong teacher-student rapport rooted in faith principles. Ottey (2024) also explored test-related stress in Adventist and Presbyterian schools in the Eastern Region, noting that schools that emphasized spiritual support and weekly devotions helped students develop coping strategies such as prayer and faith in divine support, which in turn reduced perceived anxiety during examination.

In a qualitative study, Mensah (2021) examined Muslim senior high school students in Northern Ghana and found that Islamic practices such as daily prayers and Qur'anic recitation served as psychological buffers against exam



anxiety. Students reported that spiritual preparation helped them mentally frame mathematics assessments as part of God's test of faith and discipline, leading to improved composure. Another study by Ampem (2023) focused on Catholic and Pentecostal schools in Greater Accra and observed that religious instruction, combined with moral guidance and pastoral counselling, had a significant influence on how students processed academic pressure. These schools often integrated messages of resilience and discipline into their religious curriculum, creating a protective effect against anxiety in challenging subjects like mathematics. Another study by Victor-Edema (2024) in Nigeria emphasized that mathematics-related test anxiety often results from insufficient preparation and rigid assessment practices, which create a sense of fear rather than learning enthusiasm among students. The accurate measurement of test anxiety is essential for effective empirical investigation. Several validated instruments have been employed to capture this multidimensional construct. Among the most widely used is the Mathematics Anxiety Rating Scale (MARS), which assesses both emotional and cognitive symptoms of anxiety specific to mathematics. In more localized contexts, researchers have adapted the Test Anxiety Inventory (TAI) to suit secondary school environments in Africa. For instance, Muhammad (2020) customized an anxiety scale to reflect culturally relevant stress triggers in Nigerian SHSs, achieving high reliability scores. Such tools allow researchers to quantify anxiety levels and analyze correlations with academic outcomes in a statistically robust manner.

### **2.3.2 Peer Relationships and Learning Outcomes in Mathematics**

Numerous studies have illustrated how peer relationship correlates with students' academic outcome and mathematics achievement. Hoferichter et al.,



(2022) established that students who felt accepted and supported by their classmates showed significantly higher levels of academic responsibility and were more likely to complete assignments and participate in classroom tasks. This is particularly relevant in mathematics, where collaborative problem-solving and confidence are essential. Similarly, a longitudinal study by Shao et al., (2024) demonstrated that middle and high school students who reported positive peer relationships were more engaged in mathematics learning and demonstrated greater academic resilience in the face of difficult tasks. Peer support also extends to structured academic interventions such as group work, peer tutoring, and collaborative learning, which have been empirically validated to enhance mathematics achievement. Pesout and Nietfeld (2021) conducted research of over 100 studies on cooperative learning and found that students in cooperative settings significantly outperformed those in individualistic or competitive learning environments, especially in mathematics. They argued that peer collaboration enhances understanding through shared cognitive processes, exposure to diverse problem-solving approaches, and social reinforcement of academic norms. In a quasi-experimental study conducted in Egypt by Price and Walker (2021) that students exposed to structured peer tutoring sessions in mathematics scored significantly higher on end-of-term tests than those in traditional classrooms. The researchers attributed this to peer tutors being able to explain concepts in more relatable ways and reduce the intimidation often associated with teacher-led instruction. Some empirical studies have found that peer groups can foster academic ambition, shared learning goals, and discipline. For instance, a study by Powell (2020) in the United Kingdom found that students in schools with strong peer collaboration and mutual academic support





outperformed their counterparts in traditional competitive classrooms. These students reported greater enjoyment of mathematics, higher problem-solving skills, and more positive attitudes toward school. However, the reverse is also evident in environments where peer influence leans toward delinquency or anti-academic behaviour. According to Korpershoek et al., (2020) students embedded in peer groups that diminish school achievement tend to exhibit lower academic motivation and poorer performance in mathematics, suggesting that social belonging can sometimes come at the cost of academic engagement. Agyeman (2020), in their study on peer influence among senior high school students in the Ashanti Region of Ghana, found that peer encouragement and shared study habits significantly predicted higher mathematics achievement scores. Students who formed peer study groups, discussed assignments, and practiced questions together performed better than their peers who studied alone or received minimal peer support. Similarly, Cevikbas and Kaiser (2022) investigated peer interactions and discovered that students with high levels of peer academic engagement were not only more confident in tackling mathematics problems but also demonstrated better test performance and class participation.

Further evidence from Panitz (2023) showed that collaborative learning in mathematics significantly increased student interest and reduced math anxiety. The study emphasized the importance of structured peer-led discussions and math clubs in improving outcomes, particularly in under-resourced schools. These peer-based strategies provided opportunities for feedback, error correction, and motivation, especially among students who were otherwise passive learners in traditional classrooms. However, peer relationships can also



hinder learning, especially when peer pressure promotes inattentiveness or indiscipline. A study by Lekola (2023) in Botswana revealed that students who were part of peer groups that prioritized non-academic activities such as truancy or socializing during class hours reported lower achievement in mathematics. Such peer norms discouraged academic focus and created classroom environments that distracted motivated students, leading to a drop in performance. Likewise, in a study conducted in Nigeria, Jorgenson (2023) found that toxic peer groups that stigmatized students who participated actively in mathematics classes discouraged classroom interaction and reduced learners' confidence. The mode and intensity of peer interaction also affect learning in different ways. Informal peer assistance such as helping each other during homework has a positive but limited impact, whereas formalized peer tutoring programs have shown stronger and more consistent benefits. In a study conducted Micari and Pazos (2021) found that schools that implemented peer tutoring programs in mathematics observed an average improvement of 12% in end-of-term test scores compared to control schools without such programs.

The empirical evidence suggests that the type and quality of peer relationships significantly influence learning outcomes in mathematics, particularly among SHS students. Supportive peer interactions foster academic engagement, reduce mathematics anxiety, and create a positive learning culture conducive to collaboration and growth.

### **2.3.3 Classroom Atmosphere and Learning Outcomes**

The nature and quality of teacher-student interactions within the classroom are critical determinants of student engagement, motivation, and ultimately, achievement. A study by Burgess et al., (2021) revealed that students who



experienced warm, respectful, and intellectually stimulating interactions with their teachers not only reported higher levels of interest in mathematics but also showed improved scores on standardized tests. This connection underscores how affective sizes of the classroom can enhance students' willingness to engage with complex mathematical tasks. Similarly, Li et al., (2020) in a longitudinal study, observed that adolescents who perceived their mathematics classroom atmosphere as emotionally supportive exhibited increased academic motivation, self-efficacy, and achievement. These findings reinforce the argument that beyond cognitive instruction, the emotional and relational dynamics within the classroom environment are crucial for sustained academic growth. Instructional strategies and classroom management also significantly contribute to the atmosphere and, by extension, learning outcomes. Kwan (2020), using the Constructivist Learning Environment Survey (CLES), found that classrooms designed around constructivist principles where students are encouraged to explore, question, and collaborate foster higher achievement in mathematics. His study across 14 countries revealed that supportive classroom climates characterized by student autonomy and low teacher dominance correlated positively with mathematics achievement, even when controlling for socioeconomic variables.

A study conducted by Appiah (2022) examined the relationship between classroom environment and student performance in core mathematics across 10 SHSs in the Northern Region. They found that classrooms with better ventilation, adequate lighting, and interactive teaching methods were associated with higher student achievement. However, they also reported widespread challenges, including overcrowded classrooms, inadequate furniture, and

minimal student-teacher interaction, which contributed to disengagement and low mathematics performance. Another relevant study by Assibey (2021) conducted a study in the Ashanti region and found out that students in overcrowded and poorly managed classrooms reported higher levels of mathematics anxiety and lower test scores. Conversely, in classrooms where teachers employed student-centered strategies and maintained a calm, orderly environment, students demonstrated greater confidence and better outcomes. A study by Li et al., (2022) stated that, the quality of teacher-student relationships ranked among the most influential factors affecting learning outcomes. His work affirmed that students who feel respected and cared for by their teachers are more likely to exert effort, persist in problem-solving, and perform better in assessments. This is especially relevant in mathematics, where students often face emotional barriers to learning and need continuous support and encouragement from their instructors.

In Nigeria, Özdaş (2022) explored how classroom atmosphere affected students' participation and achievement in science and mathematics. Their findings indicated that students in classrooms with high levels of teacher immediacy such as eye contact, movement around the class, and verbal encouragement demonstrated higher retention and application of mathematical concepts. Similar findings were echoed by Niu et al., (2022), who observed that a conducive classroom atmosphere significantly predicts students' problem-solving abilities in mathematics. A study by Ayikue (2022) identified that the lack of professional development for mathematics teachers in Hohoe contributes to their overreliance on lecture-based instruction, which limits student engagement. Furthermore, their research noted that in many classrooms,



teachers adopt authoritarian management styles, discouraging student inquiry and participation two vital aspects of a healthy classroom climate. Alorki et al., (2024) using a mixed-methods design in Tamale revealed that students who described their classroom environment as interactive, respectful, and emotionally supportive scored significantly higher in end-of-term mathematics assessments. They also noted that girls, in particular, benefited more from positive classroom atmospheres, suggesting a gendered size that teachers must consider in improving outcomes.

#### **2.3.4 Parental Support and Learning Outcomes in Mathematics**

Parental involvement ranging from helping with homework, attending school meetings, providing learning materials, to engaging in school-community activities has been linked to students' academic achievement across various settings. Fiskerstrand (2022) asserted that parental engagement, particularly in the form of academic socialization (communicating expectations, discussing school activities, and helping with decision-making), had the most robust impact on student outcomes in mathematics. Research by Kang et al., (2024) found a significant and positive correlation between parental involvement and students' academic achievement, with mathematics showing substantial gains where parents regularly supported their children's academic pursuits. Several studies have identified that the educational level of parents plays a critical role in determining the kind of academic support they can provide. According to Daucourt (2021), parents with higher educational attainment were more likely to create intellectually stimulating home environments, which translated into higher mathematics achievement in children. Moreover, their children typically had access to educational resources such as textbooks, internet access, and quiet



study environments factors that collectively contributed to better performance. Similarly, Abimanyu et al., (2023) found that parental income level significantly predicted not only access to learning materials but also the time and energy parents could dedicate to supervising their children's schoolwork. A study by Idris (2020) found a strong relationship between parental education and student performance in core subjects, especially mathematics and science. The study showed that students whose parents had at least secondary education certificate outperformed their peers from households with lower educational backgrounds. This disparity was partly attributed to educated parents' ability to assist with homework and communicate the importance of mathematics for future opportunities. Likewise, local data from the Ghana Education Service (GES) indicate that parental attendance at Parent-Teacher Association (PTA) meetings is often linked to improved student attendance and academic monitoring, reinforcing the role of parental presence in school-related matters (Buntugu, 2023).

A study by Bartoli et al., (2022) examining educational participation in rural Northern Ghana found that socioeconomic hardship and low parental literacy were major barriers to effective parental involvement. Children in such backgrounds often had to assist with farming or petty trading after school, reducing their time for academic engagement. This was verified by Amagnya (2020) whose study on SHS students in Northern Ghana revealed that students from households with high economic dependency ratios had significantly lower performance in mathematics, largely due to limited parental support and insufficient access to learning materials. Parental aspirations and motivation have also emerged as key drivers of student success. A study by Yan and Gai



(2022) found that students whose parents held high aspirations for their academic future showed stronger academic resilience, even in challenging learning environments. These students were more likely to persist in problem-solving and develop a growth mindset, both of which are critical in mastering mathematics. Chen et al., (2022) confirmed that parental aspirations had a strong predictive value for student outcomes in mathematics. Students whose parents communicated clear expectations about tertiary education and professional careers were more engaged and performed better than peers whose parents' showed apathy or discouraged academic ambition.

Ntiamoah Ntim (2021) found that the most effective forms of involvement included routine checks on homework, frequent discussions about school progress, and provision of study materials. The study concluded that even in low-income households, consistent parental encouragement and monitoring significantly contributed to improved mathematics grades. This highlights the importance of not only material support but also emotional and motivational backing in academic achievement. A study by Alimatu et al., (2024) focused on low-income communities in Tamale and reported that targeted interventions, such as parent education workshops and home learning toolkits, enhanced parents' ability to support their children in mathematics. Their findings suggest that schools and educational stakeholders can bridge the parental involvement gap by equipping parents with the skills and confidence needed to contribute to their children's academic development.

The empirical evidence clearly establishes that parental support in its many forms positively influences students' academic outcomes in mathematics. Whether through direct academic assistance, motivational encouragement, or



resource provision, engaged parents contribute to creating an environment conducive to learning.

## 2.4 Summary of Literature Review

The chapter dealt with the review of literature related to factors affecting students learning outcome in mathematics. The review of literature for this study was grounded in two core theoretical frameworks: Constructivist Learning Theory and Item Response Theory (IRT). These frameworks collectively underpin the investigation into how test anxiety, peer relationships, classroom atmosphere, and parental support influence students' mathematics learning outcomes in senior high schools in the Tamale Metropolis. Constructivist Learning Theory, as developed by Piaget (1970) and expanded by Vygotsky, posits that learners actively construct knowledge through experiences and social interactions. In mathematics education, this theory emphasizes hands-on engagement, collaborative problem-solving, and real-world application as vital to meaningful learning (Huang et al., 2024). These theoretical insights directly relate to the study's focus on how social and environmental factors like classroom atmosphere and peer collaboration shape cognitive and affective learning outcomes.

Item Response Theory (IRT) provides a statistical framework to evaluate how students' latent traits such as ability or anxiety relate to performance on individual test items. IRT's three-parameter logistic model (3PL) captures item difficulty, discrimination, and guessing behaviour, allowing for a nuanced understanding of how psychological or contextual factors can distort test performance (Adetutu, 2022). IRT is thus particularly useful for identifying Differential Item Functioning (DIF), a condition where students with similar





ability levels perform differently due to external influences like anxiety or poor classroom conditions (Diallo, 2022). Empirical literature supports the significance of test anxiety as a major barrier to mathematics achievement. High levels of anxiety have been shown to impair working memory, reduce concentration, and increase avoidance behaviour, all of which hinder mathematics performance (Petronzi et al., (2021). Research by Musa and Maat (2021) emphasizes that repeated negative experiences in mathematics exacerbate this anxiety, forming a cycle of underachievement. In Ghana and other Sub-Saharan African contexts, this is a particular concern due to the high stakes associated with mathematics examinations and limited psychological support in schools. Peer relationships also play a crucial role in shaping students' engagement and academic outcomes. Studies reveal that supportive peer interactions foster positive attitudes toward learning and improve mathematics comprehension through collaborative problem-solving (Hewitt, 2023). Conversely, toxic peer environments can result in social withdrawal and reduced academic focus. Research in Northern Ghana by Adongo et al. (2022) confirms that positive peer influence enhances academic achievement, especially in resource-constrained environments where formal support may be lacking.

The influence of classroom atmosphere has been extensively documented in the literature. Effective teacher-student interactions, emotionally safe learning spaces, and participatory instructional strategies are associated with improved academic performance (Ahmeda et al., (2020). Ramazan et al. (2023) found that classrooms with mutual respect and student-centered approaches promote mathematical reasoning and engagement. However, studies from Ghana,

including Bah (2021), highlight challenges such as overcrowded classrooms, inadequate instructional resources, and authoritarian teaching styles, which contribute to disengagement and poor performance in mathematics. Parental support is another critical factor influencing students' academic behaviour. Yang et al. (2023) and Hooper et al. (2013) found that students whose parents actively monitor their academic progress and assist with learning tasks tend to exhibit higher academic motivation and better mathematics performance. Luthar et al., (2020) further noted that children from low-income households or illiterate families often face compounded disadvantages due to lack of learning resources and cognitive stimulation at home. Ndubuisi et al. (2020) confirmed that even after controlling for ability, students with more educated parents performed significantly better on language-intensive mathematics items. The academic literature provides sufficient evidence that students' mathematics outcomes are influenced by psychological, social, and institutional factors. The integration of Constructivist Learning Theory helps illuminate the role of learning environments and social interactions, while IRT provides a robust framework for understanding how these factors affect assessment outcomes at a granular level. These insights provide a strong foundation for this study's focus on test anxiety, peer relationships, classroom atmosphere, and parental support in the Tamale Metropolis.



## CHAPTER THREE

### METHODOLOGY

#### 3.0 Overview

In this chapter, the research methodology employed in the study is explained in detail. It highlights the study population, the group of people involved in the study, and the process of selecting Respondents. Additionally, this section provides information about the tool used to gather data, the procedure for collecting data, and the approach used to analyse the collected data.

#### 3.1 Research Approach

This study adopted a quantitative research approach to systematically investigate the factors affecting students' learning outcomes in mathematics among Senior High Schools in the Tamale Metropolis. The choice of a quantitative approach was guided by the nature of the research questions, which aimed to examine the relationships and effects among measurable variables such as test anxiety, peer relationships, classroom atmosphere, parental support, and students' learning outcomes in mathematics. The quantitative approach is appropriate because it allows for the collection of numerical data that can be analysed statistically to determine the strength and direction of relationships between variables (Ghanad, 2023). This approach facilitates objective measurement and quantification of variables, enabling the researcher to generalize findings to the larger population within the study area.

The four main research questions, which sought to quantify the level of association and effect between the independent variables (test anxiety, peer relationships, classroom atmosphere, and parental support) and the dependent



variable (learning outcomes in mathematics), were best answered through this approach.

### **3.2 Research Design**

The study employed a descriptive research design. Holmes et al., (2024) defines descriptive study design as a methodology that covers the processes of measurement, classification, analysis, comparison, and interpretation. The system captures three categories of data: the current state of affairs, the comparison between the existing state and the ideal state, and the strategies to attain objectives. Despite being regarded as primitive, the descriptive research design is capable of offering valuable information for problem-solving purposes and occasionally serves as the foundation for further research. The utilization of a descriptive research design entails focusing on past events that are connected to present occurrences. It provides an unaltered representation of a situation in its original context, without any form of alteration (Cheong, (2023).

The researcher's choice of a descriptive survey strategy is justified since it aligns precisely with the focus of this investigation. The researcher gathered data from individuals within the population and assessed the present condition of that group of people with one or more variables. According to Rassel et al., (2020) descriptive survey research provides an overview of a certain situation or population. Assessing the situation is an essential step in all forms of research, serving as a necessary condition for making inferences and generalizations.

Descriptive research designs have certain limitations. Firstly, the results obtained from the analysis do not provide strong evidence for establishing a cause-and-effect relationship between variables. Secondly, these designs do not provide a detailed description of the phenomenon being studied, as pointed out



by Remler & Van Ryzin (2021). The study's approach facilitated the identification of the factors that influence students' learning outcome in mathematics among selected Junior High Schools within the Tamale Municipality.

### **3.3 Research Paradigm**

This study is grounded in the positivist philosophical paradigm, which asserts a deterministic worldview where causes predictably influence effects or outcomes (Ali, 2024). Positivism emphasizes the identification, measurement, and analysis of variables that affect observable phenomena, making it particularly suited for research seeking to explain relationships between factors and outcomes. Given that this study aims to investigate the factors influencing students' learning outcomes in mathematics, the positivist paradigm provides a coherent and appropriate philosophical foundation. Positivists argue that knowledge is derived from empirical observation and objective measurement, independent of individual perceptions or interpretations (Park et al., 2020). This paradigm values the collection of quantifiable data and the use of statistical tools to analyze relationships among the variables. Moreover, positivism holds that theories about human behaviour and educational phenomena must be rigorously tested, validated, and refined through empirical evidence. This aligns with the primary objective of the study: to empirically establish how specific factors positively or negatively influence students' learning outcome and academic performance in mathematics. By adopting this paradigm, the research follows a systematic scientific process of theory formulation, data collection, hypothesis testing, and refinement (Harefa, 2023).



The use of structured questionnaires and surveys in this study reflects the positivist methodology, as these instruments enable the systematic collection of reliable and valid numerical data. This quantitative data provides a basis for objective analysis, supporting or refuting theoretical propositions about the influence of various psychosocial and contextual factors on learning outcomes. A fundamental tenet of positivism is objectivity, requiring researchers to minimize bias by critically examining assumptions and ensuring the reliability and validity of their findings (Ali, 2024).

### **3.4 Population**

In Willie (2024) study, a target population is defined as a group of individuals, objects, or events that meet specific criteria and are the main focus of the researcher's purpose to generalize the findings. The study's population comprised six (6) public Senior High Schools situated in the Tamale Metropolis. The population comprised 8,378 students, including students from St. Charles Senior High, Business Senior High, Anbariya Senior High, Ghana Senior High, Vittin Senior High, and Tamale Girls Senior High School. According to Asassfeh (2020), the population is made up of all the components that satisfy the requirements to be included in a study and on which the results can be used.

### **3.5 Sample**

According to Casteel and Bridier (2021), a sample refers to a selected subset of a population that is studied to make generalizations about the entire group. The sample for this study consisted of 385 students selected from six Senior High Schools (SHSs) in the Tamale Metropolis. These schools included: St. Charles Senior High School, Business Senior High School, Ghana Senior High School, Vitting Senior High School, Anbariya Senior High School, and Tamale Girls



Senior High School. The total population from which the sample was drawn was 8,378 students across these schools. To ensure proportional representation, the sample was distributed according to the size of each school's student population. Table 1 presents the number of students sampled from each school.

### Sample Distribution

**Table 1: Sample Size**

School	Population	Sample Size
St. Charles Senior High	1200	55
Business Senior High, Tamale	1500	69
Anbariya Senior High, Tamale	850	39
Ghana Senior High	1800	83
Vittin Senior High	1700	78
Tamale Girls Senior High School	1328	61
Total	8,378	385

From the table above, the Yamane (1967) formula was used to calculate a total sample size of 382 from the overall population of 8,378. The sample size for each school was then determined using proportional allocation to ensure that each school's share reflected its student population. Specifically, each school's sample size was obtained by dividing the population of that school by the total population and multiplying the result by the total sample size.

### 3.6 Sampling Techniques and Procedure

Sampling refers to the process of selecting a portion of a population that accurately represents the entire group for the purpose of conducting research (Giri, 2024). In this study, a total sample of 385 students was selected from six





Senior High Schools (SHSs) within the Tamale Metropolis to represent the target population of 8,378 students. To ensure representativeness and reduce sampling bias, a stratified random sampling technique was employed. Stratified sampling was used to divide the SHSs into distinct subgroups or strata based on school type, single-sex schools (all-boys and all-girls) and mixed-sex schools. This method was appropriate because the population consisted of heterogeneous groups that could influence the variables under study, particularly those related to learning outcomes in mathematics. According to Sharma (2023), stratified sampling ensures that specific sub-groups are adequately represented within the sample, enabling valid comparisons between them.

From this stratification, six schools were randomly selected: one boys' school, one girls' school, and four mixed schools. Within each selected school, only SHS1 and SHS3 students were considered due to the operational constraints of the double-track system, which had SHS2 students off-campus during the study period. This ensured consistency and accessibility in data collection. A simple random sampling technique with the lottery method was then applied within each stratum to select individual Respondents. This technique provided each student within the eligible groups an equal and independent chance of being selected. A table of random numbers was used to guide the selection process. To avoid duplication, once a student number was selected, any repeated entry was skipped by moving horizontally to the next unique number. This method enhanced the randomness and fairness of the sampling process while ensuring that the desired sample size was met accurately across all six schools.

The distribution of the sample was proportional to each school's population size to maintain balance and fairness. The distribution of the sample size was proportional to each school's population, as shown in Table 1 above.

**Table 2: Displays the details of the Respondents taken from each of the 6 schools.**

**Table 2. Sample Size**

School	Population	Sample Size
St. Charles Senior High	1200	55
Business Senior High, Tamale	1500	69
Anbariya Senior High, Tamale	850	39
Ghana Senior High	1800	83
Vittin Senior High	1700	78
Tamale Girls Senior High School	1328	61
Total	8,378	385

### 3.7 Research Instrument(s)

This study employed adapted questionnaire as the primary data collection instrument to assess the factors influencing students' learning outcomes in mathematics among senior high school students in the Tamale Metropolis. The choice of a questionnaire was consistent with the study's quantitative research design and positivist paradigm, which emphasize the objective measurement of variables and the statistical analysis of relationships through empirical data (Mohajan, 2020). The questionnaire was divided into five main sections. The first section collected demographic data such as gender, age, school name, and class level. The subsequent four sections measured the independent variables under investigation test anxiety, classroom atmosphere, parental support, and



peer relationships all assumed to influence students' learning outcomes in mathematics. Each of these variables was measured using a 4-point Likert scale, adapted from the original Amuaful (2011) instrument which had used a 5-point scale. In the modified version, the Likert scale ranged from Strongly Disagree (1) to Strongly Agree (4). The "Undecided" option was removed to reduce neutral responses and encourage Respondents to take a clear position, thereby enhancing data quality and interpretability.

The Test Anxiety Scale was designed to measure students' cognitive and emotional responses to examination situations and how these affect their academic engagement. Originally comprising 10 items, the scale was refined to align with the study's objectives. Items were revised for clarity and contextual appropriateness. For example, the statement "Thoughts of doing poorly in examination interfere with my learning" was modified to "The presence of negative thoughts towards my performance in mathematics tests affects my ability to learn maths." Likewise, "I forget facts I really know during examination because I get nervous" was revised to "During examination, I experience a state of anxiety that causes me to forget things that I am already familiar with." Other items were either refined or replaced based on pilot feedback and theoretical alignment with the construct of test anxiety.

The Classroom Atmosphere Scale assessed the instructional environment, teacher-student relationships, and overall emotional climate in mathematics classrooms. Based on the original 10-item scale, several items were updated for relevance and focus. For example, "Teachers value my contribution in class which motivates me to learn hard" was reformulated as "Teachers appreciate how I participate in class, which serves as a source of motivation for me to study



hard in mathematics and other subjects." Another revised item was "Mutual respect and good rapport between teachers and students affects my learning," now framed as "My learning quality is directly influenced by the mutual respect and rapport between me and my math teachers." These changes were informed by recent literature that emphasizes the role of emotional and instructional support in fostering mathematical learning.

The Parental Support Scale explored the extent to which parental involvement, availability of resources, and family background contribute to students' learning outcome in mathematics. This 10-item scale was converted to a 4-point format and tailored for specificity. For instance, "My parents provide enough incentives for good academic performance from time to time determines my learning" was changed to "My parents supply virtually all the necessary mathematics learning materials I need for the studies." Similarly, "My parents are well educated so they guide me in terms of learning" was revised to "As a result of my parents' high level of education, they're able to assist me in my maths studies." These refinements ensured that the scale captured not only material support but also the cognitive and motivational dimensions of parental influence.

The Peer Relationship Scale measured the impact of peer dynamics on students' learning engagement, motivation, and academic outcomes in mathematics. The scale was revised to capture both supportive and disruptive peer influences. For example, "My classmates who are academically good inspire me to learn hard" was changed to "My classmates motivate me to learn, which positively affects my studies." Another item, "My friends help me to obtain most of the materials I learn," was revised to "I frequently spend too much time with my friend, which



affects my performance in math," thereby capturing the dual role of peers as both facilitators and distractors in learning.

All four subscales Test Anxiety, Classroom Atmosphere, Parental Support, and Peer Relationship were designed to generate quantitative data amenable to descriptive analysis.

### **3.7.1 Pilot Testing**

To further refine the questionnaire, a pilot test was conducted at Tamale Senior High School, which was not part of the schools included in the main study. This approach helped the researcher to evaluate the practicality, clarity, and effectiveness of the questionnaire items. According to Muasya and Mulwa (2023), pilot testing helps identify issues such as unclear instructions, confusing questions, and formatting errors that may impact the quality of data collected in the actual study. During the pilot phase, respondents were asked to complete the questionnaire and then provide verbal or written feedback on the ease of understanding, interpretation of items, and overall experience. This process helped to detect confusing terms, redundant items, and gaps in the coverage of each construct. The responses from the pilot also provided a preliminary indication of the questionnaire's time demands and logistical feasibility.

As part of the pilot evaluation, the researcher assessed comprehension and item difficulty, ensuring that the final instrument would be user-friendly and effective for the SHS student population. Based on findings from the pilot test, modifications were made to improve clarity and ensure that each item aligned with the research objectives and was easily understood by respondents. After these adjustments, the questionnaire was deemed ready for full-scale deployment across the selected schools in the Tamale Metropolis.



### 3.7.2 Validity and Reliability

To ensure that the questionnaire accurately captured the constructs under investigation, both content validity and face validity were established. The adapted items were reviewed by the researcher's supervisor and two educational measurement experts. These reviewers evaluated whether the items sufficiently represented the theoretical constructs and whether the language, format, and logical structure of the questionnaire were appropriate for the target population. Based on their feedback, several items were reworded for clarity, redundancies were eliminated, and ambiguous expressions were refined to improve the quality of the instrument.

For reliability, the study employed Cronbach's Alpha to measure internal consistency. According to Kennedy (2022), reliability refers to the extent to which an instrument produces stable and consistent results over repeated applications. Cronbach's Alpha values above 0.70 are generally considered acceptable indicators of reliability (Ahmad et al., 2024). After pilot testing, the reliability coefficients for the various subscales (test anxiety, peer relationships, classroom atmosphere, and parental support) all exceeded this threshold, indicating strong internal consistency. This confirmed that the instrument was reliable and appropriate for use in the main study.

**Table 3: Results of the Reliability coefficients of the 40 items**

#### Reliability Statistics

Cronbach's Alpha	Number of Items
.852	40



### 3.8 Data Collection Procedure

The data collection process was systematically carried out following ethical protocols and administrative procedures suitable for educational research involving human Respondents. To initiate the process, the researcher sought official approval from relevant authorities. A formal letter of introduction was obtained from the Department of Educational Foundations at the University for Development Studies and was presented to the Tamale Metro Directorate of the Ghana Education Service (GES). This letter served as the basis for requesting permission from the headmasters of the six selected senior high schools in the Tamale Metropolis.

Upon obtaining authorization, the respective headmasters referred the researcher to the heads of mathematics departments to assist in coordinating the administration of the questionnaires. A preliminary visit was made to each school to familiarize both the staff and potential respondents with the study's goals and to schedule convenient times for questionnaire administration, ensuring minimal disruption to regular academic activities. During the actual data collection time, the researcher made a conscious effort to establish rapport with the Respondents, creating a comfortable and respectful atmosphere. The objectives and importance of the study were clearly explained to the respondents in simple, understandable language. The voluntary nature of participation was emphasized, and students were encouraged to respond honestly without fear of judgment or reprisal. The researcher ensured that all questionnaires were completed in a single session and collected immediately after completion, resulting in a 100% response rate, thus minimizing the risk of data loss or tampering.



The researcher remained present during the completion of the questionnaires to clarify any issues or questions that arose without influencing the responses. This approach ensured the accuracy and completeness of the data while also fostering participant engagement. All responses were reviewed on-site for completeness before students were dismissed, ensuring high-quality data ready for statistical analysis. It took two weeks for all the selected schools to complete their questionnaires.

### **3.8.1 Ethical Issues**

Prior to data collection, Respondents were given a clear and comprehensive explanation of the study's objectives, expected benefits, and any potential risks associated with their participation. Informed consent was obtained from each participant, with the assurance that they could withdraw at any point without penalty or consequence. Students were made aware that their participation was entirely voluntary and that declining to participate would not affect their academic standing or relationship with their school. To uphold the principle of anonymity, no personally identifiable information such as names, admission numbers, or school Ids was recorded on the questionnaire forms. This measure was vital in reducing response bias and protecting respondents from any form of victimization or psychological discomfort arising from their participation. Additionally, confidentiality was rigorously maintained throughout the research process. All completed questionnaires were stored securely, and the data was accessible only to the researcher and the academic supervisors overseeing the study.



### 3.9 Data Analysis

The dataset was thoroughly checked for entry errors and inconsistencies before analysis. The study employed descriptive statistics such as frequencies, percentages, means, and standard deviations to analyse the responses. These tools were used to examine patterns and levels of agreement related to each research question. Below is a summary of how each research question was analysed:

**Research Question One:** What is the level of the relationship between test anxiety and learning outcomes in mathematics?

The data collection instrument for this aspect is presented in Section B (page 109) and consists of ten items. Descriptive statistics (mean and standard deviation) were used to analyse students' responses to ten items measuring test anxiety. These statistics helped determine the overall intensity of test anxiety and its potential relationship with mathematics learning outcomes. The use of the mean provided a central value for the level of anxiety, while the standard deviation indicated variability across students' responses.

**Research Question Two:** How do peer relationships affect students' learning outcomes in mathematics?

Responses to ten items related to peer influence were analysed using descriptive statistics (means and standard deviations) and the data collection instrument for this aspect is presented in Section B (page 110). These measures were appropriate as they quantified the extent of perceived peer support or distraction and its influence on mathematics performance. This approach enabled comparison of patterns in how students viewed the role of peer relationships in shaping their academic outcome.



**Research Question Three:** What is the level of effect that the classroom atmosphere has on students' learning outcomes in mathematics?

The data collection instrument for this aspect is presented in Section B (page 111) and consists of ten items. Descriptive statistics (means and standard deviations) were applied to analyse the ten items that measured students' perceptions of classroom atmosphere. This statistical method was appropriate for identifying general trends in students' experiences regarding classroom support, teacher-student rapport, and instructional methods. It also helped in determining whether the classroom environment facilitated or hindered mathematics learning.

**Research Question Four:** How does parental support impact students' learning outcomes in mathematics?

This research questions consists of ten items and is presented in Section B (page 112) to assessed students' perceptions of parental involvement and support. Descriptive statistics (means and standard deviations) were computed to evaluate the level and influence of this support on learning outcomes. The use of these statistics was suitable for determining the general degree of parental involvement and its perceived effectiveness in supporting mathematics education. The statistical tools provided clear, interpretable summaries of responses across the study's variables.



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.0 Introduction

This chapter presents the analysis and interpretation of the findings from the study, which explored the factors influencing students' learning outcomes in mathematics among Senior High School students in the Tamale Metropolis. The analysis was guided by the study's research questions, with data collected from a total of 385 students who successfully completed the questionnaires. The return rate of the questionnaires was 100% because the researcher was present during their completion and collected them directly from the Respondents. The chapter begins with an analysis of the demographic characteristics of the respondents, using frequencies and percentages to summarize data on gender, age, and class level. The subsequent section presented the research findings based on the research questions stated for the study.

The main section of the analysis focuses on the research questions and the variables under investigation. Section A of the questionnaire gathered demographic information, while Section B was structured into four sub-sections representing the key independent variables: test anxiety, classroom atmosphere, peer relationships, and parental support. Each sub-section consisted of ten items designed to measure students' perceptions and experiences related to each factor. Respondents' responses were rated on a scale from 1 to 4, where 4 represented the highest level of agreement and 1 represented the lowest level of agreement with the statements.



#### 4.1 Demographic Data of Responses

The study used a sample of 385 respondents selected from six schools in the Tamale Metropolis of the Northern Region of Ghana.

**Table 4: Represents the Gender Distribution of the Respondents in the Study.**

**Table 4: Distribution of Respondents by Gender (N=385)**

Items	Frequency	%
Female	217	56.4
Male	168	43.6
Total	385	100.0

As shown in Table 4; 217 students identified as females, accounting for 217 (56.4%) of the total respondents, whereas 168 (43.6%) students identified as males. The researcher further focused on the distribution of respondents according to their levels.

**Table 5: Distribution of respondents by level (N=385)**

Items	Frequency	%
SHS 1	176	45.7
SHS 3	209	54.3
Total	385	100.0

Table 5 indicates that 176 (45.7%) of the total, were in SHS 1 and 209 (54.3%) were in SHS 3.



**Table 6: Distribution of Respondents by Age (N=385)**

Age	Frequency	%
14-16	106	27.5
17-19	247	64.2
20 – above	32	8.3
Total	385	100.0

Table 6 reveals that around 27.5% of the respondents belonged into the age range of 14 to 16 years, 64.2% were aged between 17 and 19 years, whereas 8.3% were in the age range of 20 years and above. The data indicates that the majority of the respondents, specifically 64.2%, belong to the age range of 17 to 19 years, which corresponds to the adolescent demographic.

### **Research Question One**

#### **What is the level of the relationship between test anxiety and learning outcomes in mathematics?**

This research question aimed to find out the relationship between test anxiety and learning outcome in mathematics. The Respondents' responses were examined using a set of 10 statements, and the activities were evaluated on a Four-Point Likert scale, with options ranging from Strongly Agree (4) to Strongly Disagree (1). According to Frimpong and Osei (2021), the criterion value for the scale is set at 2.50, which was calculated by adding the values of all four scales on the Likert scale ( $4+3+2+1=10$ ) and dividing it by 4 ( $10/4=2.50$ ) if the Likert scale has four scales. A mean value below 2.5 indicates disagreement with the statement, while a mean value above 2.5 indicates agreement. This criterion value was utilized to determine whether Respondents'



responses fell within the range of agreement or disagreement with the statements presented.

**Table 7:** Result of Respondents' Responses to the Relationship Between Test Anxiety and Learning Outcome in Mathematics (N=385)

Items	N	Mean	Std. Deviation
1. The presence of negative thoughts toward my performance in mathematics tests affects my ability to learn.	385	2.70	1.008
2. During examination, I experience a state of anxiety that causes me to forget things that I am already familiar with.	385	2.93	.851
3. I have severe fear when presented with the thought of taking mathematics examination which affects my learning.	385	2.68	.966
4. Math examination bring severe anxiety and worry, affecting my ability to concentrate on my studies afterwards.	385	2.32	.979
5. I wish math examination didn't stress me out so much, so I could relax and concentrate on learning other subjects without anxiety	385	2.89	1.004
6. Before a math exam, I usually stay up late studying objective test questions because the complex format makes it difficult for me to identify the correct answers.	385	2.81	.990
7. The thought of taking a math exam causes me to feel afraid, making it difficult for me to study	385	2.18	1.016
8. There is always tension when I am completing math questions because the time given is very short.	385	2.82	.930



---

9. I find it difficult to cope with the tension and anxiety related to math examination, which affects my success in my math studies	385	2.61	.901
10. I often struggle to finish my math examination due to tension	385	2.87	.934

---

Based on the data presented in Table 7, Items 1, 2, 3, 5, 6, 8, 9, and 10 have mean scores above 2.5, suggesting that respondents generally agreed with the statements and Items 4 and 7 have the least mean score below 2.5, suggesting that respondents generally disagreed with the statements. These statements indicate a significant level of anxiety, fear, tension, and difficulty coping with mathematics examination, which affect learning. It is evident that among these factors affecting students' learning behaviour in mathematics, the most predominant one reported by respondents due to test anxiety is "During examination, I experience a state of anxiety that causes me to forget things that I am already familiar with." with (M=2.93, SD= .851). The second most frequently reported factor related to test anxiety, as disclosed by the respondents is " I wish math examination didn't stress me out so much, so I could relax and concentrate on learning other subjects without anxiety (M = 2.89, SD = 1.004). The third most predominant reported factor related to test anxiety, as disclosed by the respondents, is " I often struggle to finish my math examination due to tension." (M = 2.87, SD = .934). Lastly, the lowest value among the predominant statements on test anxiety is "The thought of taking a math exam causes me to feel afraid, making it difficult for me to study (M=2.18, SD=1.016) was reported by students as a factor affecting their learning.



## Research Question 2

### How do peer relationships affect students' learning outcomes in mathematics?

The study also examined the effect of peer relationships on student's learning behaviour in mathematics. The Respondents' responses were analysed using a set of 10 statements, and the activities were assessed on a Four-Point Likert scale, with options ranging from Strongly Agree (4) to Strongly Disagree (1). According to Frimpong and Osei (2021), the criterion value for the scale is set at 2.50, which was calculated by adding the values of all four scales on the Likert scale ( $4+3+2+1=10$ ) and dividing it by 4 ( $10/4=2.50$ ) if the Likert scale has four scales. If the mean value is below 2.5, it indicates that respondents disagreed with the statement; however, if the mean value is above 2.5, it indicates that participants agreed with the statement. This criterion was used to determine if Respondents' responses agreed or disagreed with the statements presented. The results are shown in Table 7

**Table 8:** Result of Respondents' Responses to How Peer Relationships affect Students' Learning Outcomes in Mathematics (N=385)

Items	N	Mean	Std. Deviation
1. Peer teaching among my friends influences my learning	385	2.92	.991
2. My friends place a high value on their academic work, which positively influences my studies.	385	2.38	.939
3. I frequently spend too much time with my friend, which affects my performance in math	385	2.69	.983



4. My friends provide me with most of the materials I learn, which contributes to my studies	385	2.75	.999
5. My friends' interruptions make it hard for me to focus and learn.	385	2.82	.956
6. The distractions from my friends make it difficult for me to concentrate while solving math questions.	385	2.96	.933
7. I have group studies with my friends, which influence my learning	385	2.85	.943
8. I often solve math past questions with my friends, which positively affects my learning	385	2.69	.997
9. I often have difficulties choosing appropriate times to spend with my friends, and this has a negative effect on my academic performance	385	2.48	.976
10. My classmates motivate me to learn, which positively affects my studies	385	2.67	1.110

As shown in Table 8, Participant indicated that peer relationship affects their learning outcome in mathematics. This was professed that eight (8) of the results were above the cut-off value (2.50) and two (2) of the results were below the cut-off value (2.50). The major items are that were above the cut-off value are: (1) “Peer teaching among my friends influences my learning” with (M=2.92, SD=.991), (3) “I frequently spend too much time with my friend, which affects my performance in math” (M=2.69, SD=.983), (4) ‘My friends provide me with most of the materials I learn, which contributes to my studies’ (M=2.75, SD=.999) (5) “My friends' interruptions make it hard for me to focus and learn.” (M=2.82, SD=.956), (6) “The distractions from my friends make it difficult for me to concentrate while solving math questions.” (M=2.96,



SD=.933), (7) “I have group studies with my friends, which influence my learning” (M=2.85, SD=.947), (8) “I often solve math past questions with my friends, which positively affects my learning” (M=2.69, SD=9.997), (10) “My classmates motivate me to learn, which positively affects my studies” (M=2.67, SD=1.110).

The other two (2) items that are below the cut-off value are: (9) “I often have difficulties choosing appropriate times to spend with my friends, and this has a negative effect on my academic performance” with (M=2.48, SD=.976), and (2) “My friends place a high value on their academic work, which in turn affects my learning.” With (M=2.38, SD=.939).

### **Research Question Three**

#### **What is the level of effect that the classroom atmosphere has on students' learning outcomes in mathematics?**

This research question was to examine the effect classroom atmosphere has on students' learning behaviour in mathematics. It focused on aspects such as teachers' competence, the importance they placed on student input, and monitoring of students' academic progress. For this discussion, a mean value of 2.50 or above indicated agreement with a statement, while a value below 2.50 signified disagreement.

A summary of this result is presented in Table 8. This value was obtained by summing the scores of all four scales on the Likert scale (4+3+2+1=10) and dividing it by 4 (10/4=2.50), as the Likert scale consists of four scales (Frimpong & Osei (2021). This criterion was used to determine if Respondents' responses agreed or disagreed with the statements. The Results are shown in table 8



**Table 9:** Result of Respondents' Responses to the Effect of Classroom Atmosphere on Students' Learning Outcome in Mathematics (N=385).

Items	N	Mean	Std. Deviation
1. Teachers appreciate how I participate in class, which serves as a source of motivation for me to study hard in math and other subjects	385	3.21	.876
2. I regularly solve math problems to improve my problem-solving skills	385	3.21	.767
3. The way teachers teach math affects how well I learn and understand the topic.	385	2.53	1.041
4. The effectiveness of the teacher in managing classroom activities significantly affects my academic performance.	385	2.78	.931
5. My learning quality is directly influenced by the mutual respect and rapport between me and my math teachers	385	2.23	1.032
6. I have difficulties concentrating in class due to the distracting from of some of my classmates	385	3.06	.938
7. Regular feedback and support from teachers, along with their encouragement and guidance in the classroom, motivate me to take my learning seriously	385	3.46	.746
8. My learning in math is influenced by how students in my class interact with and impact the academic performance of students of a different sex	385	2.73	.961
9. The classroom environment that involves math competitions impacts my learning behaviour	385	3.06	.865
10. The distracting noise level in the classroom hinders my ability to learn	385	2.99	.991

In Table 9 Items 1, 2, 3, 4, 6, 7, 8, 9, and 10 have mean values above 2.5, indicating that respondents generally agreed with these statements. In contrast, Item 5 has a mean value below 2.5, suggesting that respondents generally disagreed with it. The overall mean (M) of 3.21 and standard deviation (SD) of 0.876 demonstrate that the majority of respondents believe that teachers in the



metropolis appreciate students' participation in class, which serves as a motivation for them to study hard in math and other subjects. A significant number of students believe that regular feedback and support from teachers, along with their encouragement and guidance in the classroom, motivate them to take maths lessons seriously. This belief is supported by a mean (M) of 3.46 and a standard deviation (SD) of 0.746. Many students strongly disagreed with the statement that mutual respect and rapport between themselves and their math teachers has a no impact on their learning, Mean of 2.23 and a standard deviation of 1.032. This significantly means that this particular statement did not significantly influence their learning experience.

#### **Research Question Four**

#### **How does parental support impact students' learning outcomes in mathematics?**

This study aims to examine how parental support affects students' learning behavior in mathematics. To examine this relationship, a criterion value of 2.50 on the Likert scale was established as a benchmark for analysis. According to Frimpong and Osei (2021), The criterion is derived by summing the scores of all four scales ( $4+3+2+1=10$ ) and dividing the sum by the number of scales ( $10/4=2.50$ ). In the presented Table 9, a mean value above 2.50 indicates agreement with a statement, while a value below 2.50 signifies disagreement. This analysis helps determine whether respondents' responses agree or disagree with the given statements related to parental support and its influence on students' learning behaviour in mathematics. The results are presented in Table

9



**Table 10:** Respondents' Responses to How Parental Support Affect Students' Learning Outcome in Mathematics (N=385).

Items	N	Mean	Std. Deviation
1. Both my parents are employed on a full-time basis and do not have enough time to supervise my studies	385	2.32	.979
2. The presence of siblings at home affects my studies as I am entitled to assist in taking care of them	385	2.36	1.025
3. I have sufficient amenities, such as a library and computers, that assist me in my studies	385	2.30	1.088
4. As a result of my parent's high level of education, they assist me in my studies	385	2.74	1.027
5. The occasional provision of sufficient incentives by my parents has had a significant effect on my academic success	385	2.72	.949
6. My parents supply virtually all the necessary learning materials I need for my studies	385	2.92	.950
7. My learning is influenced by my parent's incapacity to address my educational requirements	385	2.66	.995
8. The relationship between my parents and my teachers serves as an inspiration for my motivation to study hard	385	3.03	.960
9. The extent of my learning is affected by the support and motivation given to me by my parents	385	2.74	1.036
10. My parents rely on me to take care for my younger siblings, which makes it challenging for me to focus on my own learning and academic responsibilities	385	2.28	1.015

From the data presented in Table 10, it is clear that the respondents agreed with the statement, "The relationship between my parents and my teachers serves as an inspiration for my motivation to study hard," with a mean (M) of 3.03 and a standard deviation (SD) of 0.960. This finding indicates that the interaction



between students, their parents, and teachers plays a crucial role in determining academic achievements. Specifically, the mean score was 2.92, with a standard deviation of 0.950. The result revealed that a significant proportion of students in Senior High Schools (SHS) within the Tamale Metropolis reported that their parents provided most of the necessary learning materials for their studies. This suggests that many students in the Tamale Metropolis are highly driven to learn, likely due to the support and encouragement they receive from their parents in pursuing their academic goals.

Students agreed with a Mean of 2.74 and Standard Deviation of 1.036 on the statement, "The extent of my learning is affected by the support and motivation given to me by my parents." This implies that a majority of the students concurred with this idea, suggesting that they believe their learning is influenced by their parent's ability to meet their educational needs.

The results further show that "As a result of my parent's high level of education, they assist me in my studies" with a Mean of 2.74 and SD of 1.027 which explains that students whose parents have a higher level of education affected their studies. In responding to the statement (1) "Both of my parents are employed on a full-time basis and do not have enough time to supervise my studies" with (M=2.32, SD=.979), (2) "The presence of siblings at home affects my studies as I am entitled to assist in taking care of them" with (M=2.346, SD=1.025), (3) "I have sufficient amenities, such as a library and computers, that assist me in my studies" with (M=2.30, SD=1.088) and (10) "My parents rely on me to take care for my younger siblings, which makes it challenging for me to focus on my own learning and academic responsibilities" with (M=2.28, SD=1.015) Respondents disagreed with those statements.



## 4.2 Discussion of Research Findings

This section sought to discuss the findings of the research questions concerning:

1. The level of relationship between test anxiety and students' learning outcomes in mathematics.
2. How peer relationships affect students' learning outcomes in mathematics
3. The level of effect the classroom atmosphere has on students' learning outcomes in mathematics.
4. How parental support influences students' learning outcomes in mathematics.

### 4.2.1. The level of relationship between test anxiety and students' learning outcomes in mathematics.

The findings from the study reveal that test anxiety is a significant factor affecting students' learning outcomes in mathematics among Senior High School students in the Tamale Metropolis. The students generally reported experiencing a high level of anxiety, fear, and tension related to mathematics examinations, which undermines their ability to effectively engage with mathematical content and perform optimally in assessments. Most notably, a considerable number of students acknowledged that anxiety during examination causes them to forget information they already know, indicating the cognitive disruption that test-related stress can inflict on learning and recall. These results are consistent with prior studies that emphasize the detrimental effects of test anxiety on academic performance, particularly in mathematics. For example, studies by Caviola et al., (2022) suggest that high levels of anxiety impair the encoding, storage, and retrieval processes required for successful academic



performance. Their research concluded that test anxious students tend to exhibit decreased working memory functioning, which directly interferes with problem-solving and logical reasoning tasks commonly found in mathematics examinations.

Similarly, Morse (2022) found that test anxiety, particularly the cognitive dimension (worry and negative thoughts), significantly predicted lower achievement in high stakes tests. Students often anticipate failure, which disrupts their study habits and leads to underperformance. The responses in the current study mirror this pattern, as students disclosed that negative thoughts towards math performance reduced their ability to concentrate and study effectively. Furthermore, the observation that students wish for less stressful math examination so they could focus better supports the findings of Jaradat (2024), who reported that students with high test anxiety are more likely to avoid studying or procrastinate as a coping mechanism. This aligns with the tendency of students in the current study to express a desire for stress free examination environments, suggesting that their learning outcome is influenced not only during the test but also before and after. A study by (Amoah, 2024) also confirms these results, asserting that mathematics is one of the most anxiety inducing subjects for secondary school students and that emotional responses such as worry, fear, and helplessness can significantly interfere with academic performance. These emotions lead to physiological responses like restlessness and mental fatigue, ultimately reducing a student's ability to think clearly during examinations. In the current study, students described struggling to cope with tension during examination and often failing to complete math tasks on time, reflecting these symptoms.





The finding that students are affected by the structure and time constraints of math examination is also consistent with the research of Acheampong (2023) who found that timed mathematics tests increased anxiety levels and that students often associated performance with perceived failure, further exacerbating avoidance behaviors and reducing their willingness to engage with the subject. The observation that some students do not feel particularly afraid about taking math examination, although less common, suggests that test anxiety does not affect all students uniformly. This reflects the conclusions of Tan and Pang (2023) who, in a meta-analysis of anxiety and academic achievement, noted that while test anxiety is generally detrimental, its intensity and impact vary among students based on personal, contextual, and academic variables. Amuaful (2011) found that high school students frequently report significant emotional and psychological distress during mathematics assessments, which correlates with lower academic achievement in the subject. The present study confirms this local finding, reinforcing the idea that test anxiety is not only a global educational issue but also a pressing concern within the Ghanaian secondary school system.

In conclusion, the findings of the study testify that test anxiety adversely impacts students' learning behaviour and academic outcomes in mathematics.

#### **4.2.2 How peer relationships affect students' learning outcomes in mathematics**

The analysis of data affirm that peer relationships significantly influence students' learning outcomes in mathematics. A majority of the Respondents acknowledged both the positive and negative roles played by their peers in shaping their academic engagement and achievement in mathematics. The data

suggests that peer relationship, such as peer teaching, shared learning materials, group studies, and even distractions, contribute substantially to students' academic performance in mathematics either by enhancing motivation and support or by reducing focus and study time. According to Mulaudzi (2023), peer relationships serve as a key motivational milieu for learning. When students are surrounded by peers who actively engage in academic activities, it tends to foster a culture of shared responsibility, encouragement, and goal setting, all of which contribute positively to academic success. The students in the current study who reported engaging in group studies and solving past questions with friends likely benefited from this shared motivation, which supports collaborative learning models as essential tools for enhancing mathematics performance.

Additionally, Thurston et al., (2020), which posits that learning occurs through social interaction, is validated by the findings. Peer tutoring and group learning are highlighted in this study as beneficial influences on students' mathematics outcomes. These findings resonate with the work of Hidayat et al., (2023), who found that structured peer collaboration, such as cooperative learning and peer tutoring, leads to improved cognitive and metacognitive skills, particularly in problem solving subjects like mathematics. However, the study also exposes the negative side of peer influence. A substantial number of students admitted that frequent socialization and distractions from friends often disrupted their focus and study routines. This duality in peer influence is consistent with the findings of Shao et al., (2024), who indicated that while supportive peer relationships enhance school engagement, peer distraction, especially when unregulated, can lead to a decline in academic performance. The students' struggle with balancing



friendship and academics is thus a critical issue, particularly in environments where peer culture does not always prioritize academic excellence. The relatively low score reported for the item regarding friends placing a high value on academics indicates that not all peer groups contribute positively. This finding reflects the results of a study by Zhao and Zhao (2022), who reported that peer norms significantly impact students' academic behaviour. When academic achievement is not valued within a student's peer group, the student may experience reduced motivation and lower performance.

Moreover, Saha et al., (2024), emphasized that peer led distractions and a lack of time regulation skills can diminish students' capacity to dedicate adequate time for academic preparation, particularly in difficult subjects like mathematics. According to Amuaful (2011), peer influence significantly contributes to students' study patterns and academic success, noting that students who engage with academically inclined peers are more likely to develop positive learning outcome. This is consistent with students in this study who reported being motivated and supported academically by their classmates.

#### **4.2.3 The level of effect the classroom atmosphere has on students' learning outcomes in mathematics.**

Results from the analysed data revealed that classroom atmosphere plays an essential role in shaping students' learning outcomes in mathematics within Senior High Schools in the Tamale Metropolis. Respondents' responses shows that various sizes of classroom climate including teacher support, instructional practices, classroom management, peer interaction, and environmental factors significantly influenced their learning outcome. The positive effect of teachers' appreciation for student participation, as reported by the respondents, highlights



the motivational impact of teacher-student interaction. This finding is supported by Frommelt et al., (2021) who emphasized that students' perception of teacher support and encouragement in the classroom enhances their motivation to learn, particularly in challenging subjects like mathematics. According to Rich et al., (2021) when students feel acknowledged and valued by their teachers, they develop greater self-efficacy and persistence in academic tasks.

Moreover, the role of teacher feedback and guidance in the learning process was strongly acknowledged by Respondents, reinforcing earlier studies by Liu et al., (2023), who identified that consistent feedback and emotional support from teachers correlate positively with students' learning outcome. Respondents also noted the effect of classroom management and peer distractions on their concentration. These observations align with the findings of Wilkins et al., (2023), who found that effective classroom management, including minimizing disruptions and fostering an orderly environment, significantly improves students' focus and academic outcomes. In particular, when students experience a calm, structured, and respectful learning environment, their ability to engage with complex mathematical content increases. According to Islam et al., (2024), who observed that interactive and student-centered teaching strategies in mathematics classes, such as real-life application and cooperative learning, enhance understanding and rouse greater learner involvement.

Interestingly, a large number of respondents reported that classroom activities like math competitions and peer-based academic interactions had a meaningful impact on their learning outcome. This supports the study of McLeod (2024) which posits that learning is enhanced through social interaction and scaffolding within a learner's zone of proximal development. Math competitions, peer



tutoring, and collaborative tasks stimulate a sense of achievement, healthy competition, and shared responsibility, all of which promote deeper learning in mathematics. On the other hand, the one area that students did not strongly support was the statement concerning mutual respect and rapport with their math teachers. While the item scored below the cut-off for agreement, this finding may reflect either an inconsistency in how respect and rapport are interpreted by students or a potential gap in relational dynamics between some teachers and students. However, this contrasts with studies by Wang (2023), who found that a respectful, empathetic, and supportive teacher-student relationship is consistently linked with positive academic and social outcomes. This discrepancy may signal a related difference or suggest that more effort is needed in strengthening affective teacher-student interactions in the studied schools.

A study by, Amuaful (2011) established that the emotional climate of the classroom and the interpersonal behaviour of teachers greatly influence students' academic attitudes and outcomes in mathematics. Blazar (2021) also highlighted that, schools with well-organized, inclusive, and engaging classroom environments often report better student performance in core subjects like mathematics. Their study showed that classroom spaces that foster participation, regular monitoring, and teacher feedback create a culture of academic seriousness among students.



#### **4.2.4 How parental support influences students' learning outcomes in mathematics.**

The study revealed that parental support significantly influences students' learning outcomes in mathematics in Senior High Schools within the Tamale Metropolis. The responses from students suggest that various forms of parental involvement both material and emotional contribute positively to their academic motivation, focus, and performance. Conspicuously, students agreed that when parents provide essential learning materials and incentives, it encourages them to study more seriously. This observation is consistent with findings by Yang et al., (2022), who emphasized that parental provision of academic resources and emotional support enhances students' cognitive engagement and learning outcomes. When students are equipped with the necessary tools for learning such as textbooks, stationery, and a supportive home environment they are more likely to be attentive and invested in their academic responsibilities.

The study also revealed that students value the relationship between their parents and teachers, considering it a source of motivation. This supports the work of Amin et al., (2021), who found that parental communication with school personnel has a direct positive impact on students' learning outcome. When parents engage with teachers, it creates a supportive network that reinforces student accountability and fosters a sense of importance around schooling. In addition, the educational level of parents was found to be an influential factor. Students with more educated parents reported receiving academic assistance at home, which contributes to improved learning. This is corroborated by findings from Mensah et al., (2024), who argued that parental education level is a strong predictor of student academic success, particularly



because educated parents are more likely to engage in enriching learning activities and provide academic guidance at home.

On the contrary, students expressed disagreement with statements suggesting that household responsibilities and the absence of academic amenities significantly hindered their academic pursuits. While these factors can generally pose barriers to effective learning, their limited influence may be due to strong parental strategies that mitigate their impact.

This finding contrasts somewhat with studies like that of Kong and Yasmin (2022), which identified that excessive home responsibilities and limited parental supervision could negatively affect academic performance.

### **4.3 Chapter Summary**

This chapter presented and discussed the findings of the study, which examined factors affecting students' learning outcomes in mathematics among Senior High Schools in the Tamale Metropolis. The analysis revealed that test anxiety significantly impacts students' learning outcome. Many students admitted to experiencing nervousness, fear, and mental blocks during examination, which negatively affected their ability to learn and recall information. Also, the findings about how peer relationships affect the student's learning outcome in mathematics revealed that peer relationships affect the learning outcome of students in the Tamale metropolis. These results indicate that peers can either reinforce academic goals or introduce counterproductive outcomes depending on the nature of the relationship.

The influence of classroom atmosphere reviewed that students identified teacher support, class participation, effective instructional strategies, and a conducive classroom environment as strong motivators for learning. This is



consistent with prior research that emphasized the role of supportive classroom dynamics in fostering student engagement and performance.

Finally, the findings on parental support showed that students whose parents provided learning materials, motivation, and communicated with teachers experienced better academic outcomes. Parental education levels and involvement were seen as critical, while lack of supervision and home responsibilities had a relatively lesser effect.



## CHAPTER FIVE

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter deals with the summary of the research findings, the conclusion, and the recommendations. This chapter also suggests areas for further research.

#### 5.2 Overview of the study

The study aims to examine the factors affecting students learning outcome in mathematics among senior high schools in the Tamale Metropolis. The research employs a descriptive survey design with a quantitative approach, utilizing the stratified random sample technique to categorize the schools into two strata: single-sex (all-boys and all-girls) and co-educational (mixed) and simple random sampling technique with the lottery method was employed to select the six schools, which comprised a total of 385 students who participated in the study by filling out questionnaires. The findings of this study shed light on how senior high school students are affected by some learning outcome in mathematics. Key variables, such as test anxiety, classroom atmosphere, parental support, peer relationships, and the relationship between learning outcome and gender, school type, and class level, were identified. To achieve the study's objectives, a modified version of an existing questionnaire was used as the primary data collection tool. The data obtained were primarily analysed through the use of frequencies, mean, and standard deviation to address the research question. These analytical techniques were employed to derive meaningful conclusions from the gathered data.



### 5.3 Summary of Key Findings

The following are the key findings of the analysed data:

The first research question revealed the finding that test anxiety significantly affects learning outcomes in mathematics among Senior High Schools students in the Tamale Metropolis. A majority of the Respondents agreed that feelings of anxiety, fear, and negative thoughts before or during mathematics examinations interfered with their ability to concentrate, recall information, and perform well. Most students indicated that exam related anxiety often led to forgetting previously studied material and caused tension that hindered learning. This implies that test anxiety is a major psychological barrier to effective learning in mathematics. The results of the second research question showed that peer relationships play a dual role in students' learning outcome. Generally, students agreed that group studies, discussions, and encouragement positively contributed to their understanding of mathematics. However, the findings also disclosed that distractions and poor time management with peers negatively impacted learning. This suggests that while peers can be academic motivators, they may also serve as sources of disruption depending on how those relationships are managed.

The findings of the study on classroom atmosphere indicated that the teaching style, student-teacher interactions, and the learning environment significantly influence mathematics learning. Most students reported that teacher appreciation, regular feedback, classroom orderliness, and healthy competition such as math quizzes motivated them to take mathematics seriously. It was also revealed that students who received consistent guidance and felt valued by their teachers demonstrated better engagement and performance in mathematics.



It further disclosed that parental support influences students' learning outcomes both directly and indirectly. Generally, students agreed that access to learning materials, parental motivation, and a strong parent-teacher relationship positively affected their learning outcome in mathematics. However, it was also noted that limited parental supervision due to work commitments, sibling care responsibilities, and lack of amenities at home were identified as minor hindrances. Despite these, the supportive roles of educated and involved parents were seen as crucial to student success.

#### **5.4 Conclusions**

The results of the study provide valuable insights into the key factors influencing students' learning outcomes in mathematics among Senior High Schools in the Tamale Metropolis. The research identified key variables such as test anxiety, peer relationships, classroom atmosphere, and parental support as significant contributors to students' academic performance.

The study findings revealed generally that students experience anxiety during examination, which can impact their performance and lead to physiological symptoms. Peer relationships were found to positively influence students' learning outcome in mathematics, Furthermore, parental involvement and provision of learning resources were found to play a vital role in student success. Additionally, a positive classroom atmosphere, including teacher-student relationships, was found to encourage students to study hard and excel academically.



## 5.5 Recommendations

Based on the findings of the study and conclusions drawn from them, the following recommendations are made.

1. The Ministry of Education should incorporate mental health and test anxiety reduction strategies into teacher training curricula and secondary school programs. By embedding these components within the broader educational policy framework, schools can proactively support students facing psychological barriers to mathematics achievement.
2. The Ghana Education Service and school administrators should prioritize the provision of basic learning materials for students from low-income families, particularly in mathematics, to bridge the resource gap and enhance equity.
3. Given the role of classroom atmosphere in shaping learning outcomes, teacher professional development programs should emphasize inclusive teaching strategies, effective classroom management, and the creation of emotionally supportive learning spaces.
4. Educational institutions should promote cooperative learning, peer mentoring, and group based problem-solving activities. These approaches can harness the power of peer relationships to boost motivation and reduce academic isolation in mathematics.
5. Schools must actively engage parents through regular communication, PTA meetings, and community forums that educate them on their role in supporting their children's learning, even if they have limited formal education themselves.



6. Non-Governmental Organizations (NGOs) working in education should invest in programs that foster peer mentoring, after-school mathematics clubs, and parent education workshops within the Tamale Metropolis. These initiatives can strengthen home-school linkages, offer academic support beyond the classroom, and mitigate the effects of peer pressure and parental unavailability.

### **5.6 Suggestions for Further Research**

Based on the findings of the study the following are recommended for further research.

1. This study concentrated on public Senior High Schools in the Tamale metropolis; therefore, the results may not be generally applicable worldwide. A replication of this study would be helpful in all senior high schools in the Tamale metropolis and other districts in Ghana to confirm its findings and conclusions and promote their implications at the national level.
2. I suggest that further research should be conducted using both quantitative and qualitative research methods, such as interviews and focus groups, which can provide a deeper understanding of students' experiences, perceptions, and attitudes towards learning mathematics.
3. Besides the present study, which concentrated on mathematics, I suggest that future research should be carried out in various subject areas. This would help identify the factors that influence students' overall academic performance in the Tamale Metropolis and beyond.



4. Further studies should explore how teachers' attitudes, qualifications, and instructional strategies directly influence classroom atmosphere and student performance in mathematics.



## REFERENCES

- Abimanyu, M. A., Ismaya, E. A., & Setiawan, D. (2023). The Role of Parents Based on Their Type of Work: How to Motivate Children's Learning. *Journal of Innovation and Research in Primary Education*, 2(2), 37-44.
- Acheampong, R. I. C. H. A. R. D. (2023). Junior high school integrated science teachers and students' perceptions of classroom assessment practices and students' academic performance.
- Adefisayo, A. J. (2024). Perceived Influence Of Gender, Increased Responsibility, Fear Of Failure And Social Comparison As Predictor For After-School Achievement Anxiety Among Fuoye Undergraduates. *Increased Responsibility, Fear Of Failure And Social Comparison As Predictor For After-School Achievement Anxiety Among Fuoye Undergraduates (July 20, 2024)*.
- Adetutu, O. M. (2022). *Item Response Modelling of Items' Properties and Respondents' Abilities in Multiple Choice Options* (Doctoral dissertation, Kwara State University (Nigeria)).
- Adjei, J. O. S. H. U. A. (2023). Communicative language teaching approach by esl teachers in shs the case of tamale metropolis.
- Adongo, A. A., Dapaah, J. M., & Wireko, D. (2022). The influence of family size on academic performance of high school students in Ghana. *SN Social Sciences*, 2(9), 179.
- Agbenyo, F., & Sarkpoh, F. (2021). EXAMINING GENDER-BASED INCLUSIVE EDUCATIONAL INTERVENTIONS IN THE KADJEBI



DISTRICT, GHANA. *UDS International Journal of Development*, 8(2), 637-655.

Agyeman, E. P. (2020). *Gender, self-esteem and self-efficacy as predictors of academic achievement among college of education students in Mampong Municipality, Ashanti Region, Ghana* (Doctoral dissertation, University of Cape Coast).

Ahmad, C. V. (2021). Causes of students' reluctance to participate in classroom discussions. *ASEAN Journal of Science and Engineering Education*, 1(1), 47-62.

Ahmad, N., Alias, F. A., Hamat, M., & Mohamed, S. A. (2024). Reliability Analysis: Application of Cronbach's Alpha in Research Instruments. *Pioneering the Future: Delving Into E-Learning's Landscape*, 114-119.

Ahmeda, I., Hamzah, A., & Abdullah, M. N. (2020). Effect of emotionally positive classroom atmosphere on student social-emotional competence. *International Journal of Innovation, Creativity and Change*, 8(12), 320-339.

Ajai, J. T. (2024). The Crucial Role of Assessment and Evaluation in Science and Mathematics Education. *Contemporary Issues in Education*, 2(1), 12-24.

Akanni, O. O. (2021). Evaluation of Item Response Theory in the Development and Validation of Multiple Choice Tests in Mathematics among Adolescents in Lagos Metropolis. *A Publication of Faculty of Education, Kampala International University in Tanzania*, 141.



- Aksu, N., & Zengin, Y. (2022). Disclosure of students' mathematical reasoning through collaborative technology-enhanced learning environment. *Education and Information Technologies*, 27(2), 1609-1634.
- Alan, S., & Turkum, B. (2024). Abstract reasoning, theory of mind and character development in the school. *Journal of Economic Behavior & Organization*, 221, 307-326.
- Ali, I. M. (2024). A guide for positivist research paradigm: From philosophy to methodology. *Idealogy Journal*, 9(2).
- Alimatu, I. C., Alhassan, M., & Sadik, A. A. (2024). Exploring the Effects of Parental Engagement on Special Needs Students' Learning within Tamale Metropolis Inclusive Schools. *American Journal of Multidisciplinary Research & Development (AJMRD)*, 6(11), 01-10.
- Alorki, I., Tahiru, A. W., & Tahiru, R. (2024). Exploring impact of student attitude, parental involvement, and teacher competence on mathematics performance in selected schools in Northern Ghana. *Journal of Mathematics and Science Teacher*, 4(1).
- Amagnya, M. A. (2020). Factors affecting education in the Builsa District of Northern Ghana. *Africa Education Review*, 17(2), 104-121.
- Amerstorfer, C. M., & Freiin von Münster-Kistner, C. (2021). Student perceptions of academic engagement and student-teacher relationships in problem-based learning. *Frontiers in psychology*, 12, 713057.
- Amin, A., Alimni, A., Kurniawan, D. A., Azzahra, M. Z., & Septi, S. E. (2021). Parental communication increases student learning motivation in



elementary schools. *International Journal of Elementary Education*, 5(4), 622-630.

Amoah, C. H. A. R. L. E. S. (2022). *An investigation of the factors influencing the attitudes of students towards the study of mathematics in Asokore DA Trinity Junior High School in the Sekyere East District–Ashanti Region* (Doctoral dissertation, University of Education, Winneba).

Amoah, E. K. (2024). Gender and Other Significant Factors Causing Disparities in Senior High School Students' Mathematics Performance. *Turkish Journal of Computer and Mathematics Education*, 15(1), 26-33.

Ampem, I. O. (2023). *Teachers' Knowledge and use of Indoctrinatory Practices in Teaching Christian Religious Studies: A Study of Mission Schools in Central Region* (Doctoral dissertation, University of Cape Coast).

Amuaful, G. A. (2011). *Determinants of students' learning behaviour in selected public senior high schools in the Cape Coast Metropolis* (Doctoral dissertation, University of Cape Coast).

Ansong, D., Okumu, M., Amoako, E. O., Appiah-Kubi, J., Ampomah, A. O., Koomson, I., & Hamilton, E. (2024). The role of teacher support in students' academic performance in low-and high-stakes assessments. *Learning and Individual Differences*, 109, 102396.

Appiah, S. N. B. (2022). *The effect of think-pair-share on students performance on circle theorem-plane geometry II the case of Asankrangwa Senior High School* (Doctoral dissertation, University of Education Winneba).

Arthur, Y. D., Dogbe, C. S. K., & Asiedu-Addo, S. K. (2022). Enhancing performance in mathematics through motivation, peer assisted learning, and teaching quality: The mediating role of student interest. *Eurasia*



*Journal of Mathematics, Science and Technology Education*, 18(2), em2072.

Asomah, R. K., Narh-Kert, M., Abdul-Malik, S., Enu, J., & Koomson, A. (2024). Evaluation of students' performance in elective mathematics: The effect of high school students' perceived difficulty of the subject. *International Journal of Educational Innovation and Research*, 3(2), 241-258.

Assibey, K. (2021). *Effects of Teacher Classroom Management Techniques On Junior High School Students' Academic Performance In the Asokwa Municipality in Ashanti Region, Ghana* (Doctoral dissertation, University of Cape Coast).

AYANTUNJI, M. M. (2022). Environmental Factors and Aged Abuse in Ibadan, Nigeria. *Journal of Capital Development in Behavioural Sciences Vol, 10(2)*.

Ayikue, A. K. (2022). *Employing mobile pedagogy as a model for instruction and assessment A case study at St. Francis College of Education, Hohoe, Ghana* (Doctoral dissertation, University of Education Winneba).

Bah, Y. M. (2021). Poor performance in mathematics among senior secondary school students: Lessons for education planners and parents. *International Journal of Advance Research in Education & Literature*, 7(11), 10-19.

Barksdale, C., Peters, M. L., & Corrales, A. (2021). Middle school students' perceptions of classroom climate and its relationship to achievement. *Educational Studies*, 47(1), 84-107.



- Barlow, M. A., Wrosch, C., Hamm, J., Sacher, T., Miller, G. E., & Kunzmann, U. (2022). Discrete negative emotions and goal disengagement in older adulthood: Context effects and associations with emotional well-being. *Emotion, 22*(7), 1583.
- Bartoli, B., Joshi, C., & Wolf, S. (2022). Parental engagement in Ghanaian pre-primary schools: A mixed-methods study. *International Journal of Educational Research, 112*, 101926.
- Bayat, A., & Madyibi, S. (2022). The home environment and parental involvement of preschoolers in Philippi, a low-income area: Do they hinder or support early learning?. *South African Journal of Childhood Education, 12*(1), 1055.
- Blazar, D. (2021). Teachers of Color, Culturally Responsive Teaching, and Student Outcomes: Experimental Evidence from the Random Assignment of Teachers to Classes. EdWorkingPaper No. 21-501. *Annenberg Institute for School Reform at Brown University*.
- Bowden, J. L. H., Tickle, L., & Naumann, K. (2021). The four pillars of tertiary student engagement and success: a holistic measurement approach. *Studies in Higher Education, 46*(6), 1207-1224.
- Bradley, G. L., Ferguson, S., & Zimmer-Gembeck, M. J. (2021). Parental support, peer support and school connectedness as foundations for student engagement and academic achievement in Australian youth. *Handbook of positive youth development: Advancing research, policy, and practice in global contexts, 219-236*.



- Buntugu, P. A. (2023). *Impact of parental support on pre-school students' learning outcomes in the Kasena Nankana Municipality* (Doctoral dissertation, University of Education Winneba).
- Burgess, S., Rawal, S., & Taylor, E. S. (2021). Teacher peer observation and student test scores: Evidence from a field experiment in English secondary schools. *Journal of Labor Economics*, 39(4), 1155-1186.
- Carless, D., & Winstone, N. (2023). Teacher feedback literacy and its interplay with student feedback literacy. *Teaching in higher education*, 28(1), 150-163.
- Casteel, A., & Bridier, N. L. (2021). Describing populations and samples in doctoral student research. *International journal of doctoral studies*, 16(1).
- Caviola, S., Toffalini, E., Giofrè, D., Ruiz, J. M., Szűcs, D., & Mammarella, I. C. (2022). Math performance and academic anxiety forms, from sociodemographic to cognitive aspects: A meta-analysis on 906,311 Respondents. *Educational Psychology Review*, 1-37.
- Cevikbas, M., & Kaiser, G. (2022). Student engagement in a flipped secondary mathematics classroom. *International Journal of Science and Mathematics Education*, 20(7), 1455-1480.
- Chen, S., Chen, C., & Wen, P. (2022). Parental anxiety, endorsement of literacy learning, and home literacy practices among Chinese parents of young children. *Reading and Writing*, 35(4), 825-852.
- Chen, Y., Chiu, S. W. K., Zhu, J., & So, W. W. M. (2022). Maintaining secondary school students' STEM career aspirations: The role of



perceived parental expectations, self-efficacy, and cultural capital. *International Journal of Science Education*, 44(3), 434-462.

Cheong, H. I., Lyons, A., Houghton, R., & Majumdar, A. (2023). Secondary qualitative research methodology using online data within the context of social sciences. *International Journal of Qualitative Methods*, 22, 16094069231180160.

Chiu, T. K. (2021). Digital support for student engagement in blended learning based on self-determination theory. *Computers in Human Behavior*, 124, 106909.

Clariana, R. B., & Park, E. (2021). Item-level monitoring, response style stability, and the hard-easy effect. *Educational Technology Research and Development*, 69(2), 693-710.

Codjoe, R. N., Amoah, L. A. O., & Amoah, S. K. (2024). School environmental factors, students' characteristics, and academic performance: The case of junior high school students of the Krachi West District of Ghana. *Heliyon*, 10(15), e15778.

Crichton, H., Valdera Gil, F., & Hadfield, C. (2021). Reflections on peer micro-teaching: raising questions about theory informed practice. *Reflective Practice*, 22(3), 345-362.

Daucourt, M. C., Napoli, A. R., Quinn, J. M., Wood, S. G., & Hart, S. A. (2021). The home math environment and math achievement: A meta-analysis. *Psychological bulletin*, 147(6), 565.

Diallo, R. (2022). *Dialogical Pedagogy and Critical Reflection: Their Role and Possibilities in Postcolonial Malian Teacher Education* (Master's thesis, Indiana University of Pennsylvania).



- Efa, Y., Baiden, D. S., Mensah, K. O., & Kwakye, D. O. (2024). Trend Analysis of Gender Enrolment and Performance in the West African Senior School Certificate Examination (WASSCE) Elective Mathematics. *Enhancing Equity and Excellence in Education*, 4.
- Espie, C. A. (2022). Standard CBT-I Protocol for the Treatment of Insomnia Disorder. *Cognitive-Behavioural Therapy For Insomnia (CBT-I) Across The Life Span: Guidelines and Clinical Protocols for Health Professionals*, 17-41.
- Essuman, S. A., Nyarko, J., & Frimpong, K. (2021). Impact of mathematics anxiety on the academic performance of junior high school students in the Bongo District of Ghana. *International Journal of Social Sciences and Humanities Invention*, 8(9), 6562-6569.
- Etherton, K., Steele-Johnson, D., Salvano, K., & Kovacs, N. (2022). Resilience effects on student performance and well-being: the role of self-efficacy, self-set goals, and anxiety. *The Journal of general psychology*, 149(3), 279-298.
- Fiskerstrand, A. (2022). Literature review–Parent involvement and mathematic outcome. *Educational Research Review*, 37, 100458.
- Flournoy, E. L., & Bauman, L. C. (2021). Collaborative Assessment: Using Self-Assessment and Reflection for Student Learning and Program Development. *Canadian journal for the scholarship of teaching and learning*, 12(1), n1.
- Frimpong, S. O., & Osei, D. (2021). Knowledge and practice of assessment: Empirical evidence from early childhood teachers in the Kumasi



Metropolis, Ghana. *European Journal of Humanities and Social Sciences*, 1(1), 10-18.

Frommelt, M., Schiefele, U., & Lazarides, R. (2021). Teacher enthusiasm, supportive instructional practices, and student motivation in mathematics classrooms. *Interdisciplinary Education and Psychology*, 2(3), 1-5.

Ghanad, A. (2023). An overview of quantitative research methods. *International journal of multidisciplinary research and analysis*, 6(08), 3794-3803.

Giri, O. P. (2024). Choosing Sampling Techniques and Calculating Sample Size. *Indonesian Journal of Teaching in Science*, 4(2), 165-176.

Goss, H. (2022). Student learning outcomes assessment in higher education and in academic libraries: A review of the literature. *The Journal of Academic Librarianship*, 48(2), 102485.

Haddow, S., Taylor, E. P., & Schwannauer, M. (2021). Positive peer relationships, coping and resilience in young people in alternative care: A systematic review. *Children and Youth Services Review*, 122, 105861.

Hall, S. S., McGill, R. M., Puttick, S., & Maltby, J. (2022). Resilience, science, technology, engineering, and mathematics (STEM), and anger: A linguistic inquiry into the psychological processes associated with resilience in secondary school STEM learning. *British Journal of Educational Psychology*, 92(3), 1215-1238.

Harefa, D. (2023). THE RELATIONSHIP BETWEEN STUDENTS'INTEREST IN LEARNING AND MATHEMATICS



LEARNING OUTCOMES. *Afore: Jurnal Pendidikan Matematika*, 2(2), 1-11.

Harefa, D., Sarumaha, M., Telaumbanua, K., Telaumbanua, T., Laia, B., & Hulu, F. (2023). Relationship student learning interest to the learning outcomes of natural sciences. *International Journal of Educational Research & Amp*, 240-246.

Hasan, A. M. (2024). Teachers' feedback and its impact on students' performance in education. *International Journal of Academic Pedagogical Research*, 8(3), 21-31.

Hastings, K. R. (2022). *Current School District Administrators' and Math Teachers' Perspectives of Teacher Buy-In for Problem-Based Learning in Middle School Math* (Doctoral dissertation, Walden University).

Hattan, C., Alexander, P. A., & Lupo, S. M. (2024). Leveraging what students know to make sense of texts: What the research says about prior knowledge activation. *Review of Educational Research*, 94(1), 73-111.

Heissel, J. A., Adam, E. K., Doleac, J. L., Figlio, D. N., & Meer, J. (2021). Testing, stress, and performance: How students respond physiologically to high-stakes testing.

Hettinger, K., Lazarides, R., & Schiefele, U. (2023). Motivational climate in mathematics classrooms: Teacher self-efficacy for student engagement, student-and teacher-reported emotional support and student interest. *ZDM–Mathematics Education*, 55(2), 413-426.

Hewitt, L. C. C. (2023). *Collaborative learning strategies to build critical thinking and collaboration in the mathematics classroom: A qualitative case study* (Doctoral dissertation, Northcentral University).



- Hidayat, R., Nasir, N., Fadzli, S. A. M., Rusli, N. S., Kamaruzzaman, N. N., Yii Zi Sheng, V., ... & Shukeri, A. S. (2023). Peer Tutoring Learning Strategies in Mathematics Subjects: Systematic Literature Review. *European Journal of Educational Research*, 12(3).
- Hoferichter, F., Kulakow, S., & Raufelder, D. (2022). How teacher and classmate support relate to students' stress and academic achievement. *Frontiers in psychology*, 13, 992497.
- Holmes, C. E., Guliford, M. K., Mendoza-Davé, M. A. S., & Jurkovich, M. (2024). A case for description. *PS: Political Science & Politics*, 57(1), 51-56.
- Howell, R. A. (2021). Engaging students in education for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies. *Journal of Cleaner Production*, 325, 129318.
- Huang, Y. M., Wang, W. S., Lee, H. Y., Lin, C. J., & Wu, T. T. (2024). Empowering virtual reality with feedback and reflection in hands-on learning: Effect of learning engagement and higher-order thinking. *Journal of Computer Assisted Learning*, 40(4), 1413-1427.
- Hussein, Y., & Csíkos, C. (2023). The effect of teaching conceptual knowledge on students' achievement, anxiety about, and attitude toward mathematics. *Eurasia journal of mathematics science and technology education*, 19(2).
- Idris, M., Hussain, S., & Ahmad, N. (2020). Relationship between parents' education and their children's academic achievement. *Journal of Arts & Social Sciences*, 7(2), 82-92.



- Islam, M. S., Sarker, M. S., Abir, S. S., Kamal, F., & Roy, B. K. (2024). Effect of Student-Centered Teaching Approach on Academic Performance in Mathematics at the Secondary School Level. *IJORER: International Journal of Recent Educational Research*, 5(6), 1492-1505.
- Jaradat, A. K. M. (2024). Strategies Used by Procrastinators and Non-Procrastinators to Cope with Test Anxiety. *The New Educational Review*, (76), 206-216.
- Jeynes, W. H. (2024). A meta-analysis: The relationship between the parental expectations component of parental involvement with students' academic achievement. *Urban education*, 59(1), 63-95.
- Jorgenson, R. H. (2023). *Engagement in Secondary Mathematics Group Work: A Student Perspective* (Master's thesis, Brigham Young University).
- Kang, L., Li, C., Chen, D., & Bao, X. (2024). Parental involvement, academic self-efficacy, and depression on academic performance among Chinese students during COVID-19 pandemic. *Psychology research and behavior management*, 201-216.
- Kennedy, I. (2022). Sample size determination in test-retest and Cronbach alpha reliability estimates. *British Journal of Contemporary Education*, 2(1), 17-29.
- Khalid, M. B. (2024). Examination anxiety on students' academic achievement: A study in the Pakistani context. In *5th International Artemis Congress on Humanities and Social Sciences Proceedings* (pp. 428-435).
- Khodadad, D. (2023). Creating a supportive and effective learning environment for engineering students: Pedagogical strategies, engagement, and



enhanced outcomes. *International Journal of Engineering Pedagogy*, 13(8), 33-50.

Khursheed, S., & Alwi, S. K. K. (2023). EVALUATION OF FORMATIVE ASSESSMENT STRATEGIES IN ENHANCING STUDENT ACHIEVEMENTS AND LEARNING MOTIVATION IN HIGHER SECONDARY SCHOOLS. *Pakistan Journal of Educational Research*, 6(2).

Killen, M., & Rutland, A. (2022). Promoting fair and just school environments: Developing inclusive youth. *Policy insights from the behavioral and brain sciences*, 9(1), 81-89.

Kong, C., & Yasmin, F. (2022). Impact of parenting style on early childhood learning: mediating role of parental self-efficacy. *Frontiers in Psychology*, 13, 928629.

Korpershoek, H., Canrinus, E. T., Fokkens-Bruinsma, M., & De Boer, H. (2020). The relationships between school belonging and students' motivational, social-emotional, behavioural, and academic outcomes in secondary education: A meta-analytic review. *Research papers in education*, 35(6), 641-680.

Kos, T. (2023). Exploring peer support among young learners during regular EFL classroom lessons. *International Journal of Applied Linguistics*, 33(2), 169-189.

Kwan, Y. W. (2020). Psychometric properties of a Chinese version of the constructivist learning environment survey among secondary-school students in Hong Kong. *Learning Environments Research*, 23(2), 167-184.



- Laursen, B., & Veenstra, R. (2021). Toward understanding the functions of peer influence: A summary and synthesis of recent empirical research. *Journal of Research on Adolescence*, 31(4), 889-907.
- Lekola, R. (2023). *Investigating mitigating strategies that SMT could use to enhance learners' academic performance in their final year of LGCSE* (Master's thesis, National University of Lesotho).
- Lerner, R. E., Grolnick, W. S., Caruso, A. J., & Levitt, M. R. (2022). Parental involvement and children's academics: The roles of autonomy support and parents' motivation for involvement. *Contemporary Educational Psychology*, 68, 102039.
- Li, L., Peng, Z., Lu, L., Liao, H., & Li, H. (2020). Peer relationships, self-efficacy, academic motivation, and mathematics achievement in Zhuang adolescents: A moderated mediation model. *Children and Youth Services Review*, 118, 105358.
- Li, M., & Yuan, R. (2022). Enhancing students' metacognitive development in higher education: A classroom-based inquiry. *International Journal of Educational Research*, 112, 101947.
- Li, X., Bergin, C., & Olsen, A. A. (2022). Positive teacher-student relationships may lead to better teaching. *Learning and Instruction*, 80, 101581.
- Lichtenfeld, S., Pekrun, R., Marsh, H. W., Nett, U. E., & Reiss, K. (2023). Achievement emotions and elementary school children's academic performance: Longitudinal models of developmental ordering. *Journal of Educational Psychology*, 115(4), 552.



- Liu, Q., Du, X., & Lu, H. (2023). Teacher support and learning engagement of EFL learners: The mediating role of self-efficacy and achievement goal orientation. *Current Psychology*, 42(4), 2619-2635.
- Luo, T., & Derakhshan, A. (2024). Examining the role of classroom climate and teacher-student relationships in EFL students' perceived learning outcomes: A self-determination theory perspective. *Learning and Motivation*, 88, 102062.
- Luthar, S. S., Kumar, N. L., & Zillmer, N. (2020). High-achieving schools connote risks for adolescents: Problems documented, processes implicated, and directions for interventions. *American Psychologist*, 75(7), 983.
- Madeeha, M., Khattab, N., Samara, M., Modood, T., & Barham, A. (2024). Explaining the educational aspirations-expectations mismatch among middle school students: The role of parental expectations, attitudinal and demographic factors. *Educational Studies*, 50(6), 1389-1405.
- Mahmood, S., Mumtaz, H. S. N., Sana, M., Iqbal, M. N., & Sharif, T. (2024). ANALYSIS OF STUDENTS' PERCEIVED SCIENCE TEST ANXIETY AT ELEMENTARY LEVEL. *Jahan-e-Tahqeeq*, 7(2), 120-128.
- Maldonado, J. E., De Witte, K., & Van Campenhout, G. (2022). Should Parents Get Homework? On Stimulating Home-Based Parental Involvement in Students' Learning.
- Manfreda Kolar, V., & Hodnik, T. (2021). Mathematical literacy from the perspective of solving contextual problems. *European Journal of Educational Research*, 10(1), 467-483.



- Mastul, A. R. H. (2024). The Crucial Role of Teachers in Fostering Creativity, Critical Thinking, and Motivation in Students. *Jurnal Praktik Baik Pembelajaran Sekolah dan Pesantren*, 3(02), 54-59.
- McLeod, S. (2023). Jerome Bruner's theory of learning and cognitive development. *Simply Psychology*.
- McLeod, S. (2024). Vygotsky's Zone of Proximal Development. *Simply Psychology*. <https://www.simplypsychology.org/zone-of-proximal-development.html>.
- Menninga, A., Van Geert, P., Van Vondel, S., Steenbeek, H., & Van Dijk, M. (2021). Teacher-student interaction patterns change during an early science teaching intervention. *Research in Science Education*, 1-27.
- Mensah, A. (2021). *Students' Attitude Towards the Study of Islam in Ghanaian Basic Schools: A Survey* (Doctoral dissertation, University of Cape Coast).
- Mensah, R. O., Acquah, A., & Mensah, D. Y. (2024). Investigating the impact of home factors on junior high school girls' academic performance in peri-urban areas: a case study of Dome cluster of schools. *Cogent Education*, 11(1), 2329416.
- Micari, M., & Pazos, P. (2021). Beyond grades: improving college students' social-cognitive outcomes in STEM through a collaborative learning environment. *Learning Environments Research*, 24(1), 123-136.
- Mohajan, H. K. (2020). Quantitative research: A successful investigation in natural and social sciences. *Journal of economic development, environment and people*, 9(4), 50-79.



- Moliner, L., & Alegre, F. (2022). Peer tutoring in middle school mathematics: Academic and psychological effects and moderators. *Educational Psychology, 42*(8), 1027-1044.
- Morris, A. M. (2024). *Exploring the Impact of Culturally-Relevant Assessment Material on Black Students' Reading Comprehension* (Master's thesis, University of Georgia).
- Morris, R., Perry, T., & Wardle, L. (2021). Formative assessment and feedback for learning in higher education: A systematic review. *Review of Education, 9*(3), e3292.
- Morse, K. (2022). Closing the mathematics achievement gap: Exploring the applicability of growth mindset in South Africa.
- Muasya, J. N., & Mulwa, P. M. (2023). Pilot Study, a Neglected Part of Qualitative and Quantitative Research Process: Evidence from Selected PhD Thesis and Dissertations. *Higher Education Research, 8*(4), 115-123.
- Muhammad, T. (2020). *Development of a Module to Address Interest and Anxiety in Learning Science for Female Secondary Students in Nigeria* (Doctoral dissertation, University of Malaya (Malaysia)).
- Mulaudzi, I. C. (2023). Factors affecting students' academic performance: a case study of the university context. *Journal of Social Science for Policy Implications, 11*(1), 18-26.
- Musa, N. H., & Maat, S. M. (2021). Mathematics anxiety: A case study of students' learning experiences through cognitive, environment and behaviour. *International Journal of Academic Research in Business and Social Sciences, 11*(3), 932-956.



- Naveed, M. A., & Anwar, M. A. (2021). Evidence on psychometric properties of scales assessing information related anxieties: A systematic review. *Library Philosophy and Practice*, 4470.
- Nishonov, F. (2024). EXPLORING THE IMPACT OF EXPERIENTIAL LEARNING STRATEGIES ON THE DEVELOPMENT OF MATHEMATICAL INTERESTS AND INDIVIDUAL LEARNING PATHWAYS IN EDUCATION. *Science and innovation*, 3(B2), 655-659.
- Niță, G. (2023). PSYCHOLOGICAL SAFETY IN SCHOOLS. *Journal of Communication and Behavioural Sciences*, 4(1), 51-61.
- Niu, W., Cheng, L., Duan, D., & Zhang, Q. (2022). Impact of perceived supportive learning environment on mathematical achievement: The mediating roles of autonomous self-regulation and creative thinking. *Frontiers in Psychology*, 12, 781594.
- Niyibizi, O., Uwitatse, M. C., & Mutarutinya, V. (2024). Teachers' Perceptions of Continuous Professional Development in Innovative Mathematics and Science Teaching. *Journal of Instructional Mathematics*, 5(2), 95-107.
- Njuguna, N. R. (2021). Influence of socio-economic factors on academic performance in public primary schools in Murang'a south sub county, Kenya. *Journal of Education*, 4(6), 16-27.
- Nkansah, J. N. (2021). The future of education in Ghana: critical education for socio-economic development. *Journal of Interdisciplinary Studies in Education*, 10(SI), 57-78.



- Noushad, P. P. (2024). Aligning Learning Outcomes and Knowledge. In *Designing and Implementing the Outcome-Based Education Framework* (pp. 109-138). Springer, Singapore.
- Ntiamoah Ntim, W. (2021). *Knowledge and use of formative assessment among senior high school teachers in the Kumasi metropolis* (Doctoral dissertation, UCC).
- Nwaba, A., Su, M., Rajamanickam, V., Mezu-Nnabue, K., Ubani, U., Ikonne, E. U., & Mezu-Ndubuisi, O. (2022). Community preventive health education intervention for pediatric iron-deficiency anemia in rural Southeast Nigeria. *Annals of Global Health*, 88(1), 105.
- Oladele, J. I., & Ndlovu, M. (2021). A review of standardised assessment development procedure and algorithms for computer adaptive testing: applications and relevance for Fourth Industrial Revolution. *International Journal of Learning, Teaching and Educational Research*, 20(5), 1-17.
- Opong, R. A. (2022). *Investigating demand for senior high school mathematics teachers and their preparedness to implement an inclusive education mathematics curriculum* (Doctoral dissertation, University of Education, Winneba).
- Ottey, H. (2024). *The Impact of Seventh-day Adventist Beliefs, Values, and Practices relative to Physical Activity* (Doctoral dissertation, Staffordshire University).
- Özdaş, F. (2022). Teachers' immediacy behaviors and academic achievement: A relational analysis. *SAGE Open*, 12(2), 21582440221091722.



- Panitz, T. (2023). Cooperative learning structures help college students reduce math anxiety and succeed in developmental courses. In *Cooperative learning in higher education* (pp. 57-68). Routledge.
- Park, Y. S., Konge, L., & Artino Jr, A. R. (2020). The positivism paradigm of research. *Academic medicine*, 95(5), 690-694.
- Passion, O. V., & Marcelo, P. (2024). Benefits of Peer Tutoring in Enhancing Students' Academic Performance in Mathematics. *International Journal of Advanced Multidisciplinary Studies*. Retrieved from <https://www.ijams-bbp.net/wp-content/uploads/2024/06/5-IJAMS-MAY-2024-754-765.pdf>.
- Pesout, O., & Nietfeld, J. (2021). The impact of cooperation and competition on metacognitive monitoring in classroom context. *The Journal of Experimental Education*, 89(2), 237-258.
- Petronzi, D., Hunt, T. E., & Sheffield, D. (2021). Interventions to address mathematics anxiety: An overview and recommendations. *Current Studies in Educational Disciplines*, 169, 169-194.
- Piaget, J. (1970). *Science of education and the psychology of the child* (D. Coltman, Trans.). New York: Orion Press.
- Pickering, H. E., Parsons, C., & Crewther, S. G. (2022). The effect of anxiety on working memory and language abilities in elementary schoolchildren with and without Additional Health and Developmental Needs. *Frontiers in Psychology*, 13, 1061212.
- Plummer, K. J., Kebritchi, M., Leary, H. M., & Halverson, D. M. (2022). Enhancing critical thinking skills through decision-based learning. *Innovative Higher Education*, 47(4), 711-734.



- Powell, J. J. (2020). Comparative education in an age of competition and collaboration. *Comparative Education*, 56(1), 57-78.
- Price, C., & Walker, M. (2021). Improving the accessibility of foundation statistics for undergraduate business and management students using a flipped classroom. *Studies in Higher Education*, 46(2), 245-257.
- Quintero, M., & Wang, Z. (2023). Achievement trajectories in low-achieving students as a function of perceived classroom goal structures and socioeconomic backgrounds. *Social Psychology of Education*, 26(5), 1341-1367.
- Qureshi, M. A., Khaskheli, A., Qureshi, J. A., Raza, S. A., & Yousufi, S. Q. (2023). Factors affecting students' learning performance through collaborative learning and engagement. *Interactive Learning Environments*, 31(4), 2371-2391.
- Rajapakse, R. (2024). The Impact of Feedback on the Progress of Teaching Learning Process and the Overall Student Performance. *Available at SSRN 4869045*.
- Ramazan, O., Danielson, R. W., Rougee, A., Ardasheva, Y., & Austin, B. W. (2023). Effects of classroom and school climate on language minority students' PISA mathematics self-concept and achievement scores. *Large-scale Assessments in Education*, 11(1), 11.
- Rassel, G., Leland, S., Mohr, Z., & O'Sullivan, E. (2020). *Research methods for public administrators*. Routledge.
- Remler, D. K., & Van Ryzin, G. G. (2021). *Research methods in practice: Strategies for description and causation*. Sage Publications.



- Rich, P. J., Mason, S. L., & O'Leary, J. (2021). Measuring the effect of continuous professional development on elementary teachers' self-efficacy to teach coding and computational thinking. *Computers & Education, 168*, 104196.
- RIDHO, A. (2024). MULTIDIMENSIONALITY OF STUDENT ENGAGEMENT CONSTRUCT: THE EXPLORATORY AND CONFIRMATORY ITEM RESPONSE MODEL. *TPM: Testing, Psychometrics, Methodology in Applied Psychology, 31*(2).
- Romano, L., Angelini, G., Consiglio, P., & Fiorilli, C. (2021). Academic resilience and engagement in high school students: The mediating role of perceived teacher emotional support. *European journal of investigation in health, psychology and education, 11*(2), 334-344.
- Roos, A. L., Goetz, T., Krannich, M., Donker, M., Bieleke, M., Caltabiano, A., & Mainhard, T. (2023). Control, anxiety and test performance: Self-reported and physiological indicators of anxiety as mediators. *British Journal of Educational Psychology, 93*, 72-89.
- Rubach, C., & Bonanati, S. (2023). The impact of parents' home-and school-based involvement on adolescents' intrinsic motivation and anxiety in math. *Psychology in the Schools, 60*(6), 1615-1635.
- Saaka, S. S. (2024). Resisting change: Explaining education policy reforms in Ghana. *Politics & Policy, 52*(2), 384-402.
- Saha, M., Islam, S., Akhi, A. A., & Saha, G. (2024). Factors affecting success and failure in higher education mathematics: Students' and teachers' perspectives. *Heliyon, 10*(7).



- Sanchez, A. M. P. (2021). *Peer Interaction in the Adult English as a Foreign Language Classroom: Using Social Discourse to Establish Peer Relationships*. Lancaster University (United Kingdom).
- Sarwari, K., & Kakar, A. F. (2023). Developing students' critical thinking skills through contextual teaching and learning. *Journal of Cognition, Emotion & Education, 1*(1), 29-42.
- Scott, L. (2022). *Perceptions and lived experience: exploring factors that affect student retention in mathematics* (Doctoral dissertation, Stellenbosch: Stellenbosch University, 2022.).
- Sengonul, T. (2022). A Review of the Relationship between Parental Involvement and Children's Academic Achievement and the Role of Family Socioeconomic Status in This Relationship. *Pegem Journal of Education and Instruction, 12*(2), 32-57.
- Shah, R. K., Paneru, N. R., & Bohora, B. B. (2024). Essence from within: Unveiling the voices of Nepalese master's degree students in English and biology education on internal assessments within the semester system. *Edelweiss Applied Science and Technology, 8*(6), 8986-9005.
- Shao, Y., Kang, S., Lu, Q., Zhang, C., & Li, R. (2024). How peer relationships affect academic achievement among junior high school students: The chain mediating roles of learning motivation and learning engagement. *BMC psychology, 12*(1), 278.
- Sharma, L. R. (2023). Choosing appropriate probability sampling designs in research. *Health, 2*, 4-21.



- Singh, A. (2022). *Exploring Learning Support Amongst Parents and Teachers of Grade 1 Learners in A Low-Income School* (Master's thesis, University of Pretoria (South Africa)).
- Sökmen, Y. (2021). The role of self-efficacy in the relationship between the learning environment and student engagement. *Educational Studies*, 47(1), 19-37.
- Spalding, D. M., Obonsawin, M., Eynon, C., Glass, A., Holton, L., McGibbon, M., ... & Nicholls, L. A. B. (2021). Impacts of trait anxiety on visual working memory, as a function of task demand and situational stress. *Cognition and Emotion*, 35(1), 30-49.
- Spielberger, C. D. (1980). *Test anxiety inventory: Preliminary professional manual*. Palo Alto, CA: Consulting Psychologists Press.
- Stemler, S. E., & Naples, A. (2021). Rasch measurement v. item response theory: Knowing when to cross the line. *Practical Assessment, Research & Evaluation*, 26, 11.
- Stewart, K., Brodowsky, G., & Sciglimpaglia, D. (2022). Parental supervision and control of adolescents' problematic internet use: understanding and predicting adoption of parental control software. *Young Consumers*, 23(2), 213-232.
- Stokes, E. A. (2023). *An Advanced Scale Analysis of the Full-Length Autism Spectrum Rating Scales (ASRS)* (Doctoral dissertation, Adler University).
- Sulaiman, Z. D. (2024). *Effectiveness of Cognitive Restructuring on Primary School Students' Examination Anxiety and Fear of Public Speaking in*



*Kwara State, Nigeria* (Master's thesis, Kwara State University (Nigeria)).

Talae, E., Mohammadi, A., & Bararpour, G. (2022). Exploring the Nature and Effects of Cross–Age Peer Tutoring on Primary School Students' Reading Competence and Self-esteem. *Studies on Education, Science, and Technology* 2022, 75.

Tan, S. H., & Pang, J. S. (2023). Test anxiety: An integration of the test anxiety and achievement motivation research traditions. *Educational Psychology Review*, 35(1), 13.

Thapa, S. (2022). *MAKING MATHEMATICS PEDAGOGY LEARNERS-FRIENDLY: A NARRATIVE INQUIRY* (Doctoral dissertation, Kathmandu University School of Education).

Thurston, A., Roseth, C., Chiang, T. H., Burns, V., & Topping, K. J. (2020). The influence of social relationships on outcomes in mathematics when using peer tutoring in elementary school. *International Journal of Educational Research Open*, 1, 100004.

Tsai, Y. R. (2021). Promotion of learner autonomy within the framework of a flipped EFL instructional model: Perception and perspectives. *Computer Assisted Language Learning*, 34(7), 979-1011.

Turgut, S., & Uğurlu, M. (2024). A moderated mediation analysis on the relationship between metacognition and mathematical resilience of gifted students. *Psychology in the Schools*, 61(5), 1848-1867.

Udechukwu, D. C., & Ofoke, S. M. (2024). COPING WITH TEST ANXIETY. *Nigerian Journal of Social Psychology*, 7(2).



- Victor-Edema, U. A. (2024). EXPLORING THE ROLE OF MATHEMATICS ANXIETY IN STUDENTS' COMMITMENT TO SCIENCE EDUCATION IN THE NIGER DELTA. *International Journal of Functional Research in Arts and Humanities (IJFRAH)*, 3(2).
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. & Trans.). Cambridge, MA: Harvard University Press.
- Wang, X. (2023). Exploring positive teacher-student relationships: The synergy of teacher mindfulness and emotional intelligence. *Frontiers in Psychology*, 14, 1301786.
- Wang, Y. (2024). Examining the role of sense of belonging and formative assessment in reducing the negative impact of learning anxiety in mathematics. *European Journal of Psychology of Education*, 39(1), 431–453
- Wilder, S. (2023). Effects of parental involvement on academic achievement: a meta-synthesis. In *Mapping the field* (pp. 137-157). Routledge.
- Wilkins, N. J., Verlenden, J. M., Szucs, L. E., & Johns, M. M. (2023). Classroom management and facilitation approaches that promote school connectedness. *Journal of School Health*, 93(7), 582-593.
- Willie, M. M. (2024). Population and target population in research methodology. *Golden Ratio of Social Science and Education*, 4(1), 75-79.
- Wilson, R. O. S. E. M. O. N. D. (2022). Factors influencing senior high school students' performance in core mathematics s in the Greater Accra region of Ghana.



- Wong, W. P., Peh, K. S., & Tan, C. S. (2024). Effects of a Character Strengths Intervention on Emerging Adults' Identity Formation, Self-Efficacy, and Self-Doubt. *Makara Human Behavior Studies in Asia*, 28(1), 1-15.
- Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). New York: Harper & Row.
- Yan, Y., & Gai, X. (2022). High achievers from low family socioeconomic status families: Protective factors for academically resilient students. *International Journal of Environmental Research and Public Health*, 19(23), 15882.
- Yang, D., Chen, P., Wang, K., Li, Z., Zhang, C., & Huang, R. (2023). Parental involvement and student engagement: a review of the literature. *Sustainability*, 15(7), 5859.
- Yang, Y., Li, G., Song, F., & Yuan, Y. (2023). Teacher support and student engagement in mathematics: The chain mediating role of academic self-efficacy and achievement goal orientation. *Journal of Psychology in Africa*, 33(5), 488-495.
- Yang, Y., Liu, K., Li, M., & Li, S. (2022). Students' affective engagement, parental involvement, and teacher support in emergency remote teaching during the COVID-19 pandemic: Evidence from a cross-sectional survey in China. *Journal of Research on Technology in Education*, 54(sup1), S148-S164.
- Yuan, Z., Tan, J., & Ye, R. (2023). A cross-national study of mathematics anxiety. *The Asia-Pacific Education Researcher*, 32(3), 295-306.
- Zhang, D., & Wang, C. (2020). The relationship between mathematics interest and mathematics achievement: mediating roles of self-efficacy and



mathematics anxiety. *International Journal of Educational Research*, 104, 101648.

Zhao, L., & Zhao, W. (2022). Impacts of family environment on adolescents' academic achievement: The role of peer interaction quality and educational expectation gap. *Frontiers in psychology*, 13, 911959.

Zimmer-Gembeck, M. J., Skinner, E. A., Scott, R. A., Ryan, K. M., Hawes, T., Gardner, A. A., & Duffy, A. L. (2023). Parental support and adolescents' coping with academic stressors: A longitudinal study of parents' influence beyond academic pressure and achievement. *Journal of youth and adolescence*, 52(12), 2464-2479.

Zuo, S., Huang, Q., & Qi, C. (2024). The relationship between cognitive activation and mathematics achievement: mediating roles of self-efficacy and mathematics anxiety. *Current Psychology*, 43(39), 30794-30805.




APPENDIX A

INTRODUCTORY LETTERS

INTRODUCTORY LETTER FROM THE DEPARTMENT OF  
EDUCATIONAL FOUNDATIONS STUDIES

**UNIVERSITY FOR DEVELOPMENT STUDIES**  
FACULTY OF EDUCATION  
DEPARTMENT OF EDUCATIONAL FOUNDATIONS STUDIES

TEL: +233-024-497-0564  
E-Mail: asiimon@uds.edu.gh  
Website: www.uds.edu.gh/FoE



P. O. Box TL1350  
Tamale  
Northern Region  
Ghana, West Africa

Our Ref:.....  
Your Ref:

DATE: 11/01/2024

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

**INTRODUCTORY LETTER**

The student whose details appear below is a member of the Department of Educational Foundations Studies, pursuing Master of Philosophy (MPhil) in Measurement and Evaluation.

He requires your kind assistance to enable him collect information (data) for his research entitled "Factors affecting students' learning behaviour in Mathematics among Senior High schools in the Tamale Metropolis"

I should therefore be very grateful if you could kindly offer him the needed assistance.

Name: Fuachie Daniel

Index Number: UDS/MME/0012/22

Thank you

Yours faithfully,

HEAD OF DEPARTMENT  
EDUCATIONAL FOUNDATION-  
STUDIES, FACULTY OF EDUC.  
UDS, TAMALE

Dr Simon Alhassan Iddrisu  
(HoD, Educational Foundations)



**INTRODUCTORY LETTER FROM THE TAMALE EDUCATION  
OFFICE**

**GHANA EDUCATION SERVICE**

*In case of reply the date and  
reference number of this letter  
should be quoted*

Our Ref: GES/NR/MEO/MC  
Your Ref: .....



REPUBLIC OF GHANA

Metropolitan Education Office  
P. O. Box 6, E/R  
Tamale, Northern Region  
Tel: 037-2022090

Date: January 30, 2024

Email: tmetroedu@gmail.com

**LETTER OF INTRODUCTION**

This is to introduce to you Mr. Fuachie Daniel, a Master of Philosophy (MPhil) student studying at the department of Education Foundation Studies at the University For Development Studies (UDS). He requires some information (data) from school to write his thesis titled: "Factors affecting student learning behavior in mathematics among schools in the Tamale Metro."

Kindly give him the necessary assistance he requires to enable him gather the information he needs for the research.

I count on your usual co-operation.

Thank you.

(DOMBAWEL K. MOSES)  
DEPUTY DIRECTOR – (H.R.M.D.)  
for: METROPOLITAN DIRECTOR OF EDUCATION  
TAMALE

THE HEADTEACHERS CONCERN  
TAMALE METROPOLIS

\*HARR\*



**APPENDIX B**

**QUESTIONNAIRE**

**UNIVERSITY FOR DEVELOPMENT STUDIES**

**FACULTY OF EDUCATION**

**DEPARTMENT OF EDUCATIONAL FOUNDATION STUDIES**

**MPHIL MEASUREMENT AND EVALUATION**

**QUESTIONNAIRE FOR SELECTED SENIOR HIGH SCHOOLS ON  
FACTORS AFFECTING STUDENTS LEARNING OUTCOME IN  
MATHEMATICS**

Greetings, I am a student from the University for Development Studies currently engaged in research. The objective of this study is to gather evidence regarding the factors affecting students' learning outcome in mathematics. Hence, I kindly request your collaboration and agreement to partake in this research. Your responses will be kept secret. There are no correct or incorrect answers, so please feel free to select (if applicable) the ones that reflect your opinions.

Your name is not needed in any section of the question.



Please indicate your choice by ticking (✓) or writing your response where necessary

**DEMOGRAPHIC DATA**

**Instruction:** Please specify your response by placing a checkmark [ ✓ ] in the box

**Sex:** Female [    ]                      Male [    ]

**School Type:** Mixed School [    ]                      Single sex School [    ]

**Form:** SHS 1 [    ]                      SHS 3 [    ]

**Age** 14 – 16 [    ]                      17 – 19 [    ]                      20 – above [    ]



**SECTION B**

**How much do you think the following statement on test anxiety affects your learning outcome in mathematics?**

**Instruction:** Indicate your level of agreement with each statement in the tables below by placing a tick [ $\surd$ ] in the box to the right of each statement.

SN	Item	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
TA1	The presence of negative thoughts toward my performance in mathematics tests affects my ability to learn.				
TA2	During examination, I experience a state of anxiety that causes me to forget things that I am already familiar with.				
TA3	I have severe fear when presented with the thought of taking mathematics examination which affects my learning.				
TA4	Math examination bring severe anxiety and worry, affecting my ability to concentrate on my studies afterwards.				
TA5	I wish math examination didn't stress me out so much, so I could relax and concentrate on learning other				





	subjects without anxiety				
<b>TA6</b>	Before a math exam, I usually stay up late studying objective test questions because the complex format makes it difficult for me to identify the correct answers				
<b>TA7</b>	The thought of taking a math exam causes me to feel afraid, making it difficult for me to study				
<b>TA8</b>	There is always tension when I am completing math questions because the time given is very short				
<b>TA9</b>	I find it difficult to cope with the tension and anxiety related to math examination, which affects my success in my math studies				
<b>TA10</b>	I often struggle to finish my math examination due to tension				

**How much do you think the following statement on peer relationship affects your learning outcome in Mathematics?**

**Instruction:** Indicate your level of agreement with each statement in the tables below by placing a tick [ $\surd$ ] in the box to the right of each statement.

SN	Item	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
PR11	Peer teaching among my friends influences my learning				
PR12	My friends place a high value on their academic work, which in turn affects my learning				
PR13	I frequently spend too much time with my friend, which affects my performance in math				
PR14	My friends provide me with most of the materials I learn, which contributes to my studies				
PR15	My friends' interruptions make it hard for me to focus and learn.				
PR16	The distractions from my friends make it difficult for me to concentrate while solving math questions.				
PR17	I have group studies with my friends, which influence my learning				
PR18	I often solve math past questions with my friends, which				





	positively affects my learning				
<b>PR19</b>	I often have difficulties choosing appropriate times to spend with my friends, and this has a negative effect on my academic performance				
<b>PR20</b>	My classmates motivate me to learn, which positively affects my studies				

**How much do you think the following statement on classroom atmosphere affects your learning outcome in mathematics?**

**Instruction:** Indicate your level of agreement with each statement in the tables below by placing a tick [√] in the box to the right of each statement.

SN	Item	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
<b>CA21</b>	Teachers appreciate how I participate in class, which serves as a source of motivation for me to study hard in mathematics and other subjects.				
<b>CA22</b>	I learn regularly in order to answer maths questions in class.				
<b>CA23</b>	The way teachers handle mathematics lessons in the class affects my learning.				
<b>CA24</b>	The competence of the teachers in handling classroom activities determines my learning.				
<b>CA25</b>	Mutual respect and good relationship between students and				



	mathematics teachers affect my learning.				
<b>CA26</b>	I have difficulties concentrating in class due to the distracting behavior of some of my classmates				
<b>CA27</b>	Regular feedback and support from teachers, along with their encouragement and guidance in the classroom, motivate me to take my learning seriously				
<b>CA28</b>	My learning in mathematics is influenced by how students in my class interact with and impact the academic performance of students of a different sex.				
<b>CA29</b>	The classroom environment that involves mathematics competitions impacts my learning behaviour.				
<b>CA30</b>	The distracting noise level in the classroom hinders my ability to learn.				

**How much do you think the following statement on parental support affects your learning outcome in mathematics?**

**Instruction:** Indicate your level of agreement with each statement in the tables below by placing a tick [√] in the box to the right of each statement.

SN	Item	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
PS31	Both my parents are employed on a full-time basis and do not have enough time to supervise my studies				
PS32	The presence of siblings at home affects my studies as I am entitled to assist in taking care of them				
PS33	I have sufficient amenities, such as a library and computers, that assist me in my studies				
PS34	As a result of my parent's high level of education, they assist me in my studies				
PS35	The occasional provision of sufficient incentives by my parents has had a significant effect on my academic success				
PS36	My parents supply virtually all the necessary learning materials I need for my studies				
PS37	My learning is influenced by my parent's incapacity to				



	address my educational requirements				
<b>PS38</b>	The relationship between my parents and my teachers serves as an inspiration for my motivation to study hard				
<b>PS39</b>	The extent of my learning is affected by the support and motivation given to me by my parents				
<b>PS40</b>	My parents rely on me to take care for my younger siblings, which makes it challenging for me to focus on my own learning and academic responsibilities				

