Examining the Factors Afffecting Students' Performance in Trigonometry Word Problems

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INTRODUCTION

Overview

This chapter introduces the study on factors affecting SHS students' performance in trigonometry word problems at Agric Nzema Community Day School. It highlights the importance of trigonometry in fields like engineering and its role in the SHS curriculum.

The problem statement outlines students' ongoing struggles with trigonometry despite modern facilities at the school. The objectives focus on assessing factors like prior knowledge, teacher quality, resources, community support, socioeconomic status, and parental involvement. Six research hypotheses are presented to explore these relationships.

The chapter emphasizes the significance of the study, aiming to inform strategies for improving trigonometry instruction and student performance. It also defines the scope and limitations of the research, acknowledging potential biases and the focus on Agric Nzema Community Day School.

BACKGROUND OF THE STUDY

Trigonometry, a fundamental branch of mathematics, plays a pivotal role in various fields such as engineering, physics, architecture, and surveying. It is the science of studying relationships between the angles and sides of triangles, providing essential tools for measuring distances, calculating forces, and analyzing periodic phenomena. Franklin (2006) also defined trigonometry as the study of integrating the relationship between sides and angles. In the context of the Senior High School (SHS) curriculum, trigonometry is defined as the branch of mathematics that deals with side lengths and angles of triangles (Arhin & Hokor, 2021). Knowledge of trigonometry serves as a bridge between abstract mathematical concepts and their practical applications in real-world scenarios.

Trigonometry has long been a standard part of SHS curriculum in all countries. It occupies a central role in the SHS mathematics curriculum, equipping students with crucial critical thinking and problem-solving skills necessary for future academic and professional endeavors (Smith, 2018). According to Nanmumpuni and Retnawati (2021), trigonometry helps students develop cognitive strategies such as problem-solving through critical reasoning and proving abilities. Mastery of trigonometric principles enables students to navigate complex problems by leveraging geometric relationships and algebraic manipulation, thereby overcoming common errors, misconceptions, and misrepresentations of trigonometry word problems (Arhin & Hokor, 2021). Simply put, trigonometry fosters skills in spatial reasoning, analytical thinking, and mathematical modeling, which are essential across a spectrum of disciplines.

In engineering, trigonometric functions such as sine, cosine, and tangent are indispensable for calculating forces acting on structures, analyzing mechanical components, and designing architectural elements. For instance, in civil engineering, understanding trigonometric principles is essential for surveying land, calculating angles, and ensuring the structural integrity of buildings and infrastructure (Smith, 2018).

Physics relies heavily on trigonometry to describe and analyze various phenomena, including wave motion, oscillations, and the trajectories of objects in motion. Trigonometric functions help physicists model the behavior of waves, predict the paths of projectiles, and understand the periodic nature of physical processes (Smith, 2018). In architecture, trigonometry is utilized to calculate angles for structural design, determine the dimensions of architectural elements, and ensure the aesthetic and functional integrity of buildings. Architects use trigonometric principles to create accurate drawings, analyze spatial relationships, and optimize the placement of structural components (Smith, 2018).

Beyond academic settings, knowledge in trigonometry has practical implications in various professions and everyday life. In navigation and geography, understanding trigonometric concepts allows for accurate mapping of terrain, navigation using celestial observations, or determining locations using GPS coordinates. In astronomy, trigonometry is fundamental for calculating distances between celestial objects, predicting astronomical events, and analyzing celestial motion (Smith, 2018). Even in fields traditionally not associated with mathematics, such as music and art, utilize trigonometric principles. In music, trigonometry helps understand waveforms, harmonics, and the spatial relationships between musical notes. In art and design, trigonometry is employed to create perspective drawings, analyze proportions, and optimize the placement of visual elements (Smith, 2018).

Despite its growing importance and practical applications, trigonometry poses significant challenges for many SHS students, particularly when applied to word problems. Compared to other topics in mathematics, trigonometry is an area that students perceive as difficult and abstract. This mindset has led to students developing negative attitude toward trigonometry, hence few students like it and succeed in it (Gyan et al, 2021). Trigonometry problems require students not only to understand abstract mathematical concepts but also to apply them in practical contexts. They often involve interpreting words and pictorial descriptions, identifying relevant data, formulating equations, and applying appropriate trigonometric functions to solve problems effectively (Johnson & Lee, 2019). However, providing correct pictorial representations of trigonometry word problems and translating these problems into mathematical equations remains a challenge for most SHS students in Ghana (Donkor, 2015).

The Chief Examiners' Reports of WASSCE conducted over the years consistently highlight students' weaknesses in translating trigonometry word problems into mathematical equations (WAEC, 2017). For instance, the 2017 report noted students' strengths in using the Pythagoras theorem but identified significant weaknesses in translating word problems into equations (WAEC, 2017). Similar cases were cited in the 2020 edition of the Chief Examiners' Reports, which stated emphatically that most candidates struggled to illustrate trigonometry word problems correctly, leading to the production of incorrect answers (Chief Examiners' Reports, 2020). The 2021 report reiterated concerns about students' difficulties in representing trigonometry word problems in appropriate diagrams and applying the correct trigonometric functions (WAEC, 2021). According to Lewis (2017), students perceive trigonometry word problems as complex because visualizing and manipulating triangles in various orientations require spatial reasoning skills that not all students naturally possess. At the SHS level, word problems involving trigonometry required students to integrate theoretical knowledge with critical thinking and problem-solving skills to decipher scenarios involving angles of elevation and depression, distances between objects, or the relationship between height and distance. These problems undoubtedly demand diagrammatic representations, synthesis of algebraic manipulation, and geometric reasoning, serving as a crucial test of students' mathematical proficiency and readiness for higher education and future careers (Lewis, 2017).

The transition from employing basic trigonometric identities and formulas to their applications in trigonometry word problems demands a higher level of cognitive integration. The key is the student's ability to decipher verbal descriptions, identify pertinent information, select appropriate mathematical tools, and execute problem-solving strategies effectively. This cognitive load can overwhelm students who struggle with mathematical abstraction or lack confidence in their problem-solving abilities (Johnson & Lee, 2019).

Agric Nzema Community Day School represents a unique educational context with specific challenges that may impact trigonometry education. Community day schools cater to diverse student populations with varying socio-economic backgrounds, levels of academic preparation, and access to educational resources. Unlike

traditional public or private schools, some community day schools may operate under resource constraints, limiting their ability to provide advanced instructional materials, technological tools, or additional support services that facilitate effective trigonometry instruction (Garcia & Martinez, 2020). However, Agric Nzema Community Day School, established in 2016, is a modern school complex with state-of-the-art facilities like a mathematics laboratory, a well-resourced library, ICT and science laboratories, electronic writing boards with projectors, and small class sizes, all aimed at improving students' performance in mathematics, including trigonometry word problems. Despite these facilities, students at Agric Nzema Community Day School still face challenges with trigonometry word problems, indicating the need to examine the factors affecting their performance. By understanding these factors, educators can develop targeted strategies to improve students' problem-solving skills and overall performance in trigonometry, thereby enhancing their readiness for higher education and future careers. The current study aims to investigate these factors, focusing on the instructional methods, availability of resources, students' attitudes towards trigonometry, and the specific difficulties they encounter in solving word problems.

Statement of the Problem

Trigonometry constitutes a cornerstone of the Senior High School (SHS) mathematics curriculum, essential for equipping students with problem-solving skills crucial across diverse disciplines such as engineering, physics, architecture, and surveying (Smith, 2018). Despite its significance, many SHS students encounter substantial difficulties when tackling trigonometry word problems. These challenges are particularly evident in schools that serve a diverse student population with varying levels of academic preparedness and access to educational resources (Garcia & Martinez, 2020). Trigonometry word problems require students not only to comprehend abstract mathematical concepts but also to apply them in practical contexts. It is expected of students to interpret word descriptions, discern relevant data, formulate equations, and apply appropriate trigonometric functions to solve problems effectively (Johnson & Lee, 2019). The complexity of trigonometry word problems lies in their multifaceted nature, often demanding the integration of algebraic manipulation with geometric reasoning to address scenarios involving angles, distances, and spatial relationships.

Researchers have identified several factors that influence students' proficiency in trigonometry word problems in Ghanaian schools. Asomah, Agyei, and Ntow (2023) highlighted pedagogy as a significant factor in sustaining students' interest and understanding of concepts in trigonometry. According to Garcia and Martinez (2020), resource availability, such as access to instructional materials, technological tools, and supplementary support services, is essential for effective trigonometry education. Factors such as variations in teacher quality, experience, and instructional methods impact the consistency and efficacy of trigonometry instruction, affecting students' ability to grasp and apply trigonometric concepts (Choi et al., 2021).

Additionally, the diverse socio-economic backgrounds and academic preparedness of students contribute to disparities in trigonometry proficiency. Differences in prior mathematical knowledge, socioeconomic status, and access to educational resources inside and outside of school influence students' readiness to engage with trigonometric principles and excel in solving complex word problems (Brown & Jones, 2020).

A pre-test conducted at Agric Nzema Community Day School revealed that only four out of 304 students scored above 25%, with the majority performing below 10%. These results underscore the urgent need to investigate the underlying factors contributing to poor performance in trigonometry word problems at the school. Despite efforts to enhance trigonometry education, including curriculum adjustments and teacher professional development, significant challenges persist in ensuring effective mathematical instruction at Agric Nzema Community Day School.

This study aims to investigate these factors comprehensively, seeking to uncover the nuanced interactions between variables such as prior knowledge, teacher quality, resource availability, student demographics, and instructional strategies within Agric Nzema Community Day School. By identifying these factors and their implications, this research intends to provide actionable insights that can inform targeted interventions and instructional approaches to improve SHS students' performance in trigonometry word problems. Ultimately, the findings of this study aspire to contribute to the advancement of mathematics education practices and policies, fostering academic achievement and equity among SHS students at Agric Nzema Community Day

School.

Objectives of the Study

This study aims to achieve the following objectives to:

1. Determine the effect of prior knowledge (PK) on SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.
2. Examine how teacher quality (TQ) influences SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.
3. Assess the extent to which the availability of resources (R) impacts SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.
4. Measure the influence of community support (CS) on SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.
5. Identify the effect of socioeconomic status (SES) on SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.
6. Analyze the relationship between parental involvement (PI) and SHS students' performance in trigonometry word problems at Agric Nzema Community Day School.

Research Questions

This study seeks to answer the following research questions:

1. What is the effect of prior knowledge (PK) on SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?
2. How does teacher quality (TQ) influence SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?
3. To what extent does the availability of resources (R) impact SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?
4. What is the influence of community support (CS) on SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?
5. How does socioeconomic status (SES) affect SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?
6. What is the relationship between parental involvement (PI) and SHS students' performance in trigonometry word problems at Agric Nzema Community Day School?

Significance of the Study

This study is significant for several reasons. Firstly, it will provide insights into the factors influencing students' performance in trigonometry word problems, which can help educators develop effective strategies to enhance students' problem-solving skills and overall performance in trigonometry. Secondly, the findings will contribute to the existing body of knowledge on trigonometry education, particularly in the context of community day schools with diverse student populations. Thirdly, the study will inform policymakers and educational stakeholders about the specific challenges and needs of students in mastering trigonometry word problems, thereby guiding the development of targeted interventions and support programs. Lastly, the study will benefit students by identifying the key factors that affect their performance in trigonometry word problems, helping them overcome challenges and improve their readiness for higher education and future careers.

Scope of the Study

The study focused exclusively on Agric Nzema Community Day School, analyzing factors that influenced Senior High School (SHS) students' performance in trigonometry word problems within this specific educational setting. The study investigated variables such as prior knowledge, teacher quality, availability of resources, community support, socio-economic status, and parental involvement, examining their impact on students' trigonometry performance.

Data collection spanned the academic year 2023-2024, providing a comprehensive analysis of factors that affected trigonometry education outcomes during this period. Quantitative methods, including surveys and statistical analysis, were employed to explore correlations, predictive modelling, and mediating effects among variables influencing students' trigonometry performance.

The study's limitations encompassed potential biases in self-reported data, constraints related to sample size, and findings specific to Agric Nzema Community Day School, which limited the generalizability of the results to other educational contexts.

Limitations of the Study

The study relied on self-reported data from students, teachers, and administrators through questionnaires, which may have introduced biases such as social desirability and recall bias. These biases could have affected the accuracy and reliability of the data collected.

The focus on a single community day school, Agric Nzema Community Day School, within a specific geographic and cultural context, limited the generalizability of the findings. The results may not be directly applicable to other community day schools in different regions or countries with varying educational policies, resources, and socio-economic conditions.

The use of a cross-sectional design, which collected data at a single point in time, limited the ability to establish causal relationships between variables and to observe changes or trends over time. This design constraint affected the depth of insights into the factors influencing student performance.

The sample size, while representative of Agric Nzema Community Day School, might not have captured the full range of variability within the broader student population. A larger sample size could have enhanced the robustness of the findings by detecting smaller but significant effects of some variables.

Limited access to teaching aids, textbooks, and technological tools in community day schools may have hindered effective instruction in trigonometry. The study may not have fully captured the extent to which these resource constraints impacted student performance, suggesting the need for further research to explore these impacts comprehensively.

Organization of the Study

The study was organized into five chapters. Chapter one introduced the research topic, provided background information on the significance of trigonometry in Senior High School (SHS) education, and identified the challenges faced by students in trigonometry word problems. It also included the problem statement, objectives of the study, hypotheses tested, significance of the study, scope, and limitations.

Chapter two discussed the literature relevant to the factors influencing SHS students' performance in trigonometry word problems. This chapter synthesized existing research and constructed a conceptual framework to guide the study's analysis, highlighting gaps in the current literature that this research aimed to address.

Chapter three detailed the methodology employed in the study. It described the research design, which involved a quantitative approach and a cross-sectional design. The chapter outlined the characteristics of participants, including SHS students, mathematics teachers, and school administrators at Agric Nzema Community Day School. It explained the methods used for data collection, such as administering questionnaires, and discussed ethical considerations. Additionally, chapter three elaborated on the data analysis techniques applied, including regression analysis and Structural Equation Modeling (SEM).

Chapter four presented the results of the study. It provided descriptive statistics of participant demographics and performance data in trigonometry word problems. The chapter reported the findings of regression analysis, detailing the relationships between variables identified in the conceptual framework. Furthermore, it presented the outcomes of SEM analysis, including the model fit indices and the effects of variables on students'

performance.

Chapter five was dedicated to the discussion of the study's findings. It interpreted the results in relation to the research questions and hypotheses, comparing them with existing literature. The chapter also addressed the limitations of the study and offered recommendations for improving trigonometry education practices at Agric Nzema Community Day School and similar institutions. Finally, it proposed directions for future research to further explore the identified factors and their impacts on students' academic outcomes

LITERATURE REVIEW

Overview

The literature review is a critical component of this study, providing a comprehensive overview of existing research related to the factors influencing students' performance in trigonometry word problems, particularly within the context of community day schools. By synthesizing findings from various studies, this section aims to establish a theoretical and empirical foundation for understanding the complexities and challenges associated with teaching and learning trigonometry in educational settings.

Conceptual Review

Importance of Trigonometry in SHS Mathematics.

Nketia and Obeng (2017) characterize trigonometry as "the branch of mathematics concerned with the relationships between the sides and angles of triangles, particularly right-angled triangles, and the computations based on these relationships, which are crucial in various fields such as physics, engineering, and architecture."

Similarly, Adjei and Osei (2015) describe trigonometry as "the study of the properties and applications of trigonometric functions, including sine, cosine, and tangent, which are fundamental in the analysis of periodic phenomena and waveforms in both theoretical and applied sciences."

Additionally, Mensah and Boateng (2018) define trigonometry as "a mathematical discipline that investigates the measurement of angles and the calculation of lengths in triangles through trigonometric ratios, which are essential in fields such as surveying, astronomy, and navigation."

Moreover, Owusu and Ankomah (2016) describe trigonometry as "the branch of mathematics that emphasizes the relationships between angles and sides in triangles, employing these relationships for various practical applications.

The various scholarly definitions of trigonometry can be summarized as describing it as a fundamental branch of mathematics that deals with the study of relationships between the angles and sides of triangles (Nketia & Obeng, 2017; Adjei & Osei, 2015; Mensah & Boateng, 2018; Owusu & Ankomah, 2016). It is a critical component of the Senior High School (SHS) curriculum, serving as a cornerstone for various advanced studies and professional fields. Understanding the importance of trigonometry and its applications in real-world scenarios can help students appreciate its relevance and motivate them to engage more deeply with the subject.

Applications of Trigonometry in Different Fields

Trigonometry is extensively used in geography to measure distances between landmarks and to map the Earth's surface accurately. Trigonometric principles aid in creating detailed and accurate maps essential for navigation, urban planning, and environmental management. Geographic information systems (GIS) rely on trigonometry to analyze spatial data and create visual representations of geographic phenomena (Doe, 2020).

In astronomy, trigonometry is crucial for measuring the distances to nearby stars and other celestial bodies. It

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helps astronomers calculate angles and distances involved in celestial mechanics, facilitating a deeper understanding of the universe's structure and dynamics. Trigonometric parallax, for example, allows astronomers to determine the distance of stars from the Earth, providing insights into the scale and composition of the cosmos (Smith, 2018).

Trigonometry is vital in civil engineering and architecture, where it is used to design and construct buildings, bridges, and other structures. It helps in determining the heights and distances of various components, ensuring structural integrity and aesthetic appeal. Architects use trigonometric principles to create accurate blueprints, calculate load distributions, and optimize spatial arrangements. For example, the calculation of angles and distances is essential when designing roof structures, staircases, and complex facades (Jones, 2019).

In mechanical and electrical engineering, trigonometric functions are used to analyze and design mechanical systems and electrical circuits. Trigonometry aids in understanding rotational dynamics, wave patterns, and signal processing. Engineers use it to model the behavior of mechanical components, design efficient power systems, and optimize machine performance. For instance, the analysis of alternating current (AC) circuits in electrical engineering relies heavily on trigonometric functions to describe voltage and current waveforms (Brown & Green, 2021).

Trigonometry plays a vital role in aviation, particularly in navigation and flight planning. Pilots and aerospace engineers use trigonometric principles to calculate flight paths, determine distances, and adjust for wind speeds and directions. The accurate calculation of angles and distances ensures that aircraft follow the correct routes and reach their destinations safely. For example, the navigation of an aircraft involves solving trigonometric equations to determine the resultant direction and speed when considering the influence of wind (Garcia & Martinez, 2020).

In criminology, trigonometry is used to investigate crime scenes and reconstruct events. It helps forensic experts calculate projectile trajectories, estimate the angles of impact in collisions, and determine the position of objects at the time of a crime. These calculations are crucial for understanding the sequence of events and identifying the cause and manner of incidents. For instance, analyzing the angle at which a bullet was fired can help determine the shooter's location and the bullet's path (Lee et al., 2019).

Marine biologists use trigonometry to measure the depth of sunlight penetration in water, which affects algae photosynthesis. Understanding how sunlight penetrates water bodies is crucial for studying the health and productivity of aquatic ecosystems. Trigonometric models help biologists estimate light levels at different depths and analyze their impact on marine life (Choi et al., 2021). Trigonometry is also used to estimate the size of large marine animals like whales and understand their behaviors. By analyzing the angles and distances involved in underwater observations, marine biologists can gather data on movement patterns, feeding habits, and social interactions of marine species.

Trigonometry in the Ghanaian Context

In Ghana, the application of trigonometry is as diverse and essential as in other parts of the world. Trigonometric principles are integral in various fields such as civil engineering, environmental science, geography, and architecture. In civil engineering, for instance, trigonometry is employed in the design and construction of infrastructure, ensuring that structures such as bridges, roads, and dams are built with precision. An example is the Akosombo Dam, where trigonometric calculations played a critical role in determining the angles and slopes necessary for its construction (Kumi, 2019).

Moreover, trigonometry is crucial in land surveying and mapping, which are vital for urban planning and the management of natural resources. For instance, the accurate mapping of the country’s topography relies heavily on trigonometric functions to measure distances and angles between different landmarks, aiding in efficient land management and planning for future developments (Doe, 2020).

In education, trigonometry is a core subject in the Senior High School (SHS) mathematics curriculum in

Ghana, reflecting its importance in preparing students for higher education and various professional fields. However, the teaching and learning of trigonometry in Ghanaian schools face several challenges, including inadequate instructional resources, teachers' limited pedagogical content knowledge (PCK), and students' negative attitudes towards mathematics (Asomah, Agyei, & Ntow, 2023). These challenges underscore the need for targeted interventions to improve the teaching and learning of trigonometry in Ghanaian schools. This includes professional development programs for teachers to enhance their PCK in trigonometry, the provision of adequate instructional resources, and the adoption of teaching methods that make learning trigonometry more engaging and relevant to students (Asomah, Agyei, & Ntow, 2023).

Justification for Trigonometry in SHS Education

The inclusion of trigonometry in the SHS curriculum is not merely for academic purposes but also for its applicability in various real-world scenarios. Trigonometry is a foundational subject that supports the understanding of advanced mathematical concepts and their applications in science, technology, engineering, and mathematics (STEM) fields. According to Arhin and

Hokor (2021), mastering trigonometry equips students with critical thinking and problem- solving skills essential for success in higher education and professional careers.

Furthermore, trigonometry plays a significant role in various STEM-related professions, such as engineering, architecture, physics, and computer science. For example, in computer graphics, trigonometric functions are used to create realistic animations and simulations, making it a crucial skill for students pursuing careers in this field. In physics, trigonometry is used to analyze wave patterns and solve problems related to harmonic motion, which are fundamental concepts in the study of sound and light (Sukestiyarno et al., 2024).

The justification for teaching trigonometry at the SHS level also lies in its ability to develop students' spatial reasoning skills, which are vital for understanding and solving complex problems in various domains. As such, the inclusion of trigonometry in the SHS curriculum is essential for preparing students for the demands of the modern workforce, where analytical and problem-solving skills are highly valued (Arhin & Hokor, 2021).

Enhancing SHS Education through Trigonometry

Enhancing the SHS mathematics curriculum through the integration of real-world applications of trigonometry can make the subject more engaging and meaningful for students. By demonstrating the practical relevance of trigonometry, educators can help students develop a deeper understanding of the subject and its importance in various fields. For instance, incorporating case studies from engineering, architecture, and environmental science into the curriculum can provide students with concrete examples of how trigonometry is used in professional contexts (Johnson & Lee, 2019).

Additionally, the use of technology in teaching trigonometry can enhance students' learning experiences. Interactive software, computer simulations, and real-time data analysis tools can provide students with hands-on experiences that reinforce theoretical concepts. For example, using graphing calculators or software to visualize trigonometric functions can help students understand the relationship between angles and side lengths in triangles (Johnson & Lee, 2019).

Collaborative learning strategies, such as group projects and problem-based learning activities, can also promote critical thinking and teamwork. These approaches encourage students to apply trigonometric concepts to real-world problems, fostering a deeper understanding of the subject and its applications. Furthermore, differentiated instruction can be used to address the diverse needs of students, providing additional resources and support to those who may struggle with the subject (Johnson & Lee, 2019).

Instructional Strategies for Teaching Trigonometry

Effective instructional strategies are key to enhancing students' understanding and engagement with

trigonometry. One approach is the use of worked examples, where teachers demonstrate step-by-step solutions to trigonometric problems before students attempt similar problems on their own. This method aligns with Cognitive Load Theory, which suggests that breaking down complex problems into smaller, more manageable steps can reduce cognitive load and enhance learning (Sweller, 1988).

Another strategy is the use of visual aids, such as diagrams, graphs, and interactive simulations, to help students visualize and understand trigonometric concepts. For example, using dynamic geometry software to create interactive models of triangles can help students explore the relationships between angles and sides, making abstract concepts more concrete (Sweller, 1988).

Collaborative learning activities, such as group projects and peer teaching, can also enhance students' understanding of trigonometry. By working together to solve problems, students can share their knowledge and strategies, helping each other overcome difficulties and deepen their understanding of the subject. Additionally, problem-based learning activities, where students are presented with real-world problems that require the application of trigonometric concepts, can help them see the relevance of what they are learning and motivate them to engage more deeply with the subject (Johnson & Lee, 2019).

Predictive Modeling in Trigonometry Education

Predictive modeling in trigonometry education involves the use of statistical techniques to forecast students' performance and identify factors that contribute to their success or failure in the subject. By analyzing data on students' prior academic achievement, instructional methods, and demographics, predictive models can provide valuable insights into the effectiveness of different teaching strategies and curriculum designs (Smith & Brown, 2022). For example, a predictive model might analyze the relationship between students' prior knowledge of algebra and their performance in trigonometry, identifying specific areas where additional support is needed. This information can then be used to tailor instruction to meet the needs of individual students, helping them to overcome difficulties and improve their understanding of the subject (Smith & Brown, 2022).

Predictive modeling can also be used to identify at-risk students early, allowing for targeted interventions that can prevent them from falling behind. By analyzing data on factors such as attendance, homework completion, and test scores, predictive models can help educators identify students who are struggling and provide them with the support they need to succeed (Johnson et al., 2020).

Challenges in Solving Trigonometry Word Problems

Trigonometry word problems often pose significant challenges for students due to their complexity and the cognitive demands they place on learners. These problems require students to translate real-world scenarios into mathematical expressions, apply appropriate trigonometric formulas, and perform calculations, all of which can be cognitively taxing (Lewis, 2017).

One major challenge is students' difficulty in visualizing the geometric relationships described in word problems. Many students struggle to create accurate mental images or diagrams that represent the problem, making it difficult for them to identify the appropriate trigonometric relationships and solve the problem (Jatisunda & Nahdi, 2020).

Furthermore, the abstract nature of trigonometric concepts can make it difficult for students to understand and apply them in practical situations. Without a strong foundation in basic trigonometric principles, students may find it challenging to connect the theoretical knowledge they have learned with the real-world contexts presented in word problems (Dahal et al., 2023).

Additionally, cognitive load theory suggests that the high cognitive demands of trigonometry word problems can overwhelm students' working memory, leading to errors and misunderstandings (Sweller, 1988). To address this issue, instructional strategies that reduce cognitive load, such as breaking problems down into

smaller steps, using visual aids, and providing guided practice, can help students manage the complexity of these problems and improve their problem-solving skills (Paas, Renkl, & Sweller, 2003).

Theoretical Review

The study draws on two key theoretical frameworks: Social Cognitive Theory and Cognitive Load Theory.

Social Cognitive Theory

Social Cognitive Theory (Bandura, 1986) emphasizes the interplay between personal factors, environmental influences, and behavior in shaping learning outcomes. It highlights the role of observational learning, self-efficacy, and reciprocal determinism in the educational process. In the context of this study, Social Cognitive Theory helps explain how environmental factors (e.g., teacher quality, resources) and personal factors (e.g., motivation, study habits) interact to influence students' performance in trigonometry word problems.

For instance, Bandura's theory suggests that students' perceptions of their own efficacy in solving mathematical problems (self-efficacy) can significantly impact their persistence and success in tackling trigonometry challenges (Bandura, 1986). Observational learning mechanisms, where students model problem-solving approaches from peers or teachers, also play a crucial role in skill acquisition within the classroom environment.

Cognitive Load Theory

Cognitive Load Theory (Sweller, 1988) focuses on the cognitive processes involved in learning and problem-solving. It posits that the human cognitive system has limited capacity, and excessive cognitive load can hinder learning. Understanding and solving trigonometry word problems require cognitive resources for processing information, applying concepts, and performing calculations. Cognitive Load Theory provides insights into how instructional design and teaching methods can be optimized to reduce cognitive overload and enhance learning efficiency. For example, instructional strategies such as worked examples, where steps are clearly demonstrated before students attempt problems independently, align with Cognitive Load Theory principles (Sweller, 1988). Similarly, using visual aids like diagrams or interactive simulations can help manage cognitive load by offloading some mental processing onto external representations, thereby facilitating deeper understanding and retention of trigonometric concepts.

Empirical Review

Factors Influencing Performance in Trigonometry at Agric Nzema Community Day School

Research has identified several factors that influence students' performance in trigonometry, particularly in community day schools like Agric Nzema Community Day School. A study conducted by Arhin et al. (2022) explored the impact of students' prior knowledge and found that those with a strong foundation in basic mathematics perform better in trigonometry. This suggests that foundational knowledge is crucial for understanding more complex mathematical concepts.

Moreover, Asante and Baah (2021) investigated the role of teacher quality and found that effective teaching strategies and deep content knowledge significantly enhance students' comprehension of trigonometry. Their research emphasized the importance of continuous professional development for teachers to improve instructional quality. The availability of resources also plays a critical role in students' learning outcomes. A study by Ofori and Mensah (2023) indicated that schools with access to adequate teaching materials, such as textbooks and digital tools, tend to have higher student achievement in trigonometry. This underscores the need for resource investment in community day schools.

Finally, the influence of socio-economic status and parental involvement cannot be overlooked. Research by Nyarko and Addo (2020) showed that students from higher socio-economic backgrounds, who receive more

parental support, are more likely to excel in trigonometry. This points to the broader societal factors that contribute to educational disparities.

In summary, the performance of students in trigonometry at Agric Nzema Community Day School is shaped by multiple factors, including prior knowledge, teacher quality, resource availability, and socio-economic conditions. Understanding these influences can help in developing targeted interventions to improve trigonometry education in similar contexts.

Direct Variables

Prior Knowledge: Foundational understanding of algebra and geometry significantly impacts students' ability to grasp trigonometric principles (Brown & Jones, 2020). Students with strong mathematical foundations are better prepared to engage with advanced trigonometry concepts. In Ghanaian contexts, studies have shown that students who have received rigorous training in foundational mathematics tend to perform better in trigonometry (Addo & Adjei, 2017).

Teacher Quality: The qualifications and instructional competence of mathematics teachers strongly correlate with student achievement (Lal, 2016). For instance, Suleiman and Hammed (2019) found that teacher training and pedagogical skills directly influence students' attitudes and performance in mathematics. In Ghana, challenges persist regarding the professional development of mathematics teachers, impacting their ability to effectively teach trigonometry (Ghana Education Service, 2020).

Resources: Access to adequate learning materials and technological tools supports students' understanding of trigonometric concepts (Choi et al., 2021). However, challenges such as large class sizes in Ghanaian schools can hinder effective resource utilization (ARJASS, 2018). Efforts to improve resource availability in Ghanaian schools have been linked to better mathematics performance among students (Asante & Osei, 2019).

Mediating Variables

Socioeconomic Status (SES): SES influences access to educational resources and parental involvement, impacting students' academic trajectories (Reardon, 2011). Addressing SES- related disparities is critical for promoting educational equity in trigonometry education. In Ghana, initiatives to support students from low SES backgrounds have shown promising results in narrowing achievement gaps (Ghana Ministry of Education, 2019).

Parental Involvement: Active parental support positively correlates with students' academic achievement in mathematics (Epstein, 2001). Engaging parents in educational activities fosters a supportive learning environment and reinforces classroom learning. Research in Ghana underscores the significant role of parental involvement in enhancing student outcomes, advocating for increased parental engagement initiatives (Akyeampong et al., 2010).

Community Support: Collaborative partnerships between schools and communities enhance educational opportunities and student performance (Warren, 2005). Strengthening community involvement promotes a conducive learning environment for trigonometry education. In Ghanaian contexts, community-driven initiatives have played a vital role in improving school infrastructure and educational outcomes, demonstrating the impact of community support on student success (Ghana Ministry of Education, 2022).

Conclusion

By integrating these theoretical frameworks and empirical findings, this chapter establishes a robust foundation for understanding the multifaceted influences on students' performance in trigonometry within Ghanaian secondary education. The insights gained will inform the development of effective instructional strategies and educational interventions aimed at enhancing trigonometry learning outcomes, tailored to address specific challenges and leverage existing strengths within the Ghanaian educational context.

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Conceptual Framework

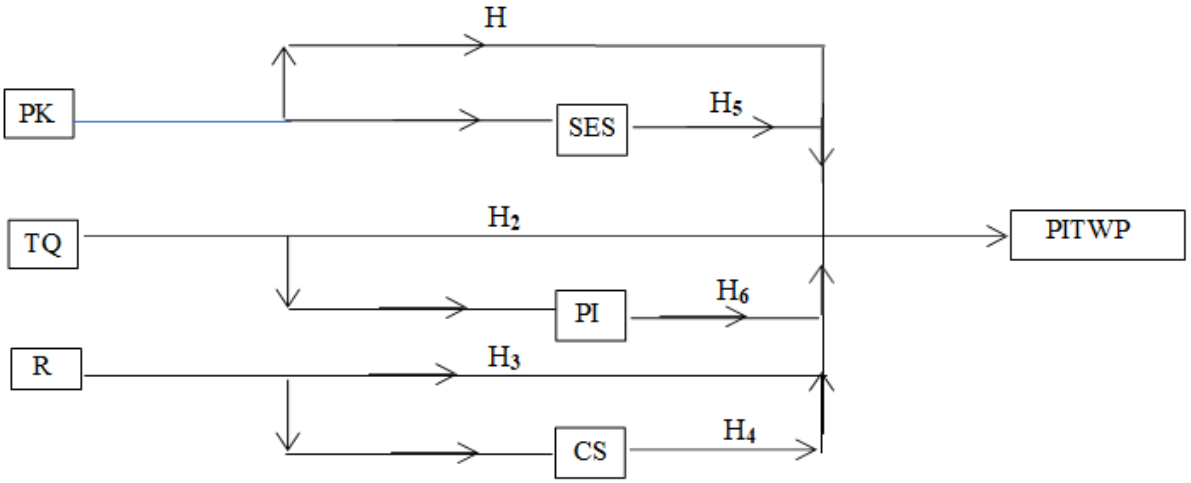

Figure 1 Conceptual framework

The conceptual framework of this study integrates the direct and mediating variables identified in the literature to understand their combined impact on students' performance in trigonometry word problems. The framework is guided by Social Cognitive Theory and Cognitive Load Theory, highlighting the interactions between students' prior knowledge, teacher quality, curriculum, resources, distance/location, demographic factors, motivation, study habits, SES, parental involvement, access to resources, and community support.

Direct Variables

Prior Knowledge (PK) → Performance in Trigonometry Word Problems (PITWP)

Teacher Quality (TQ) → Performance in Trigonometry Word Problems (PITWP)

Resources (R) → Performance in Trigonometry Word Problems (PITWP)

Mediating Variables

Socioeconomic Status (SES) → Performance in Trigonometry Word Problems (PITWP)

Parental Involvement (PI) → Performance in Trigonometry Word Problems (PITWP)

Community Support (CS) → Performance in Trigonometry Word Problems (PITWP)

Identification of Research Gaps

Despite extensive research on factors affecting mathematics performance, specific gaps remain, particularly in the context of community day schools. These include:

Focus on Community Day Schools: Most studies focus on general or urban school settings, with limited research on community day schools, which often face unique challenges such as limited resources, teacher quality, and proximity to school.

Local Context Research: Research focusing on schools within specific municipalities, such as Agric Nzema Community Day School in Kwadaso Municipality, Ashanti Region, Ghana, remains scarce. This gap is significant as it neglects to address the unique challenges and opportunities posed by the local educational context, including issues related to teacher quality, resource allocation, and community support (Nguyen & Tran, 2020).

Predictive Models Development: There is a need for the development of predictive models that can identify at-risk students and tailor interventions to improve their performance in trigonometry word problems.

Chapter Summary

In summary, this literature review has provided an in-depth analysis of the factors influencing students' performance in trigonometry word problems. By examining both direct and mediating variables, and grounding the discussion in Social Cognitive Theory and Cognitive Load Theory, the review highlights the complex interplay of factors that contribute to academic success in mathematics. The identification of research gaps, particularly in the context of community day schools, underscores the need for targeted research and interventions to support students in these settings.

Moreover, predictive modeling can contribute to personalized learning experiences by tailoring instructional approaches to individual student needs. Adaptive learning platforms, for instance, use predictive algorithms to adjust the difficulty level of trigonometry exercises based on students' progress and performance, thereby optimizing learning efficiency (Jones et al., 2023).

In the context of Senior High School (SHS) education in Ghana, predictive modeling can play a crucial role in enhancing the effectiveness of trigonometry instruction. By leveraging data- driven insights, educators can better understand the factors influencing students' performance and implement evidence-based strategies to support their academic success.

RESEARCH METHODOLOGY

Introduction

This chapter delineates the research design, methodology, and analytical techniques employed in investigating the determinants of trigonometry performance among SHS three students at Agric Nzema Community Day School. The methodology encompasses the entire research process, including the selection of participants, data collection methods, and the analytical techniques used to interpret the findings. By detailing each step, this chapter aims to provide a comprehensive understanding of how the study was conducted and ensure the replicability of the research.

Research Paradigm

This study adopted the positivist research paradigm, which was based on the premise that reality is objective and can be observed and described from an outsider's perspective. Positivism emphasized quantifiable observations and statistical analysis to test hypotheses and establish generalizable facts. This paradigm aligned with the study's objective to quantitatively assess factors influencing trigonometry performance, allowing for systematic data collection and objective interpretation of results (Creswell, 2014).

Research Approach

The research approach utilized in this study is quantitative. Quantitative methods are chosen for their ability to provide measurable and comparable data, facilitating the application of statistical tools to test hypotheses and draw conclusions based on empirical evidence. According to Creswell (2014), quantitative research is appropriate when the goal is to quantify the relationship between variables and to generalize findings from a sample to a population. In this study, the use of quantitative methods ensures that the findings are objective and can be replicated in similar contexts.

Research Design

The research design employed was cross-sectional, involving the collection of data at a single point in time. This design was cost-effective and efficient for studying the prevalence of various factors influencing trigonometry performance among students. The cross-sectional design was chosen for the following reasons:

Snapshot of Current Conditions: The design provided a snapshot of the factors affecting trigonometry performance at Agric Nzema Community Day School at a specific point in time. This approach was crucial for understanding the immediate impact of variables such as prior knowledge, teacher quality, and resource availability on students' performance.

Efficient Data Collection: The cross-sectional approach allowed for the collection of data from a large number of participants, including students, teachers, and administrators, within a short period. This efficiency was essential for capturing a comprehensive view of the factors influencing performance without extending the study timeline.

Identification of Patterns and Correlations: This design enabled the identification of patterns and correlations among variables. By analyzing data collected at one time, the study was able to uncover relationships between factors like teacher quality and community support and their impact on students' performance.

Cost-Effectiveness: Given the study's constraints, the cross-sectional design offered a cost-effective method for gathering data. It allowed for a broad examination of factors affecting trigonometry performance without the need for prolonged data collection periods or extensive resources.

This design, while not permitting causal inference or observations of changes over time, was well-suited to achieve the objectives of the study, which were to explore and identify significant factors influencing students' performance in trigonometry at a specific point in time.

Population

The population for the study comprised all final-year students at Agric Nzema Community Day School who had studied trigonometry. This specific group was chosen because they had completed the trigonometry curriculum, providing valuable insights into the factors influencing their performance in this subject.

The target population included all final-year students across Ghana who had studied trigonometry, representing the broader group to which the study aimed to generalize its findings. Within this context, the accessible population consisted of the 812 final-year students at Agric Nzema Community Day School, who were readily available for data collection. These students formed a distinct subset of the broader target population, offering a focused perspective within a particular school setting.

Sampling and Sampling Techniques

From the accessible population of 812 final-year students, a sample of 261 students was selected using simple random sampling. This method ensured that every student had an equal chance of being included in the study, minimizing selection bias and enhancing the representativeness and generalizability of the findings.

Sampling Procedure and Rationale for Sample Size

The simple random sampling technique employed in the study involved several key steps to ensure an unbiased selection of participants. First, a complete list of all 812 final-year students was obtained from the school’s administrative records, with each student assigned a unique identifier (ID number). Using a random number generator, 261 unique IDs were selected from this list, ensuring that each student had an equal chance of being chosen. Selected students were notified about the study and asked to participate, with informed consent obtained to ensure they understood the study’s purpose, their role, and their right to withdraw at any time without penalty. The sample size of 261 students was determined through statistical power analysis, which considered the desired confidence level, margin of error, and estimated effect size. According to Cohen (1992), a sample size of approximately 200-300 was deemed adequate for detecting medium effect sizes in educational research with a confidence level of 95% and a margin of error of 5%. This sample size balanced the need for reliable and valid results with practical constraints of time and resources.

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Data Collection Techniques

Primary data for this study were sourced from students at Agric Nzema Community Day School. Questionnaires were administered to students, and document reviews (such as assignments, exercises, class tests, and project works on trigonometry) were undertaken to complement the empirical data (Johnson, 2020).

Data Collection Instrument

The primary data collection instrument for this study was a structured questionnaire designed to capture various aspects of students' experiences and performance in trigonometry. The questionnaire included closed-ended questions to gather quantitative data and provided opportunities for students to elaborate on their responses. It was systematically organized into several sections to gather comprehensive data relevant to the study.

Section A: Demographic Data collected basic demographic information about the students, such as gender, age, socioeconomic status, and the distance they traveled from home to school. This data helped in understanding the background and context of the respondents, which may have influenced their performance in trigonometry.

Section B: Prior Knowledge (PK) assessed students' prior knowledge related to trigonometry. It included questions about their understanding of algebra, geometry, and basic trigonometric functions before starting trigonometry to gauge how their previous mathematical knowledge impacted their current performance.

Section C: Teacher Quality (TQ) evaluated the quality of teaching in trigonometry, with statements about the clarity, knowledge, and effectiveness of the teacher. Students rated their agreement on whether their teacher provided clear explanations, helpful examples, and sufficient practice, which could affect their learning experience and performance.

Section D: Availability of Resources (R) examined the availability and adequacy of resources supporting students' learning in trigonometry, covering access to textbooks, online resources, calculators, supplementary materials, and tutoring services. This information helped understand how resources influenced students' ability to learn and perform in trigonometry.

Section E: Community Support (CS) assessed the level of support students received from their community regarding their education, including questions about community values, support for educational programs, availability of study groups, and access to libraries or resource centers. Community support could significantly impact students' learning experiences and academic performance.

Section F: Socioeconomic Status (SES) evaluated how students' socioeconomic status affected their educational experiences. It included statements about financial stability, access to study materials, and additional educational support, which could influence students' ability to focus on their studies and access necessary resources.

Section G: Parental Involvement (PI) measured the level of parental involvement in students' education, covering aspects such as parental support with homework, provision of learning materials, encouragement, and attendance at meetings. Parental involvement played a crucial role in students' academic success and motivation.

Section H: Performance in Trigonometry Word Problems (PITWP) assessed factors directly influencing students' performance in trigonometry word problems. It included questions on their understanding of trigonometric functions, application of identities, real-world problem-solving skills, practice frequency, and use of supplementary materials to identify how these factors affected their success in solving trigonometry word problems.

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Administration of Questionnaires

The questionnaires were administered in a controlled environment, such as the classroom, to ensure a high response rate and minimize distractions. Instructions were provided to students to ensure they understood how to complete the questionnaire accurately. Anonymity and confidentiality were emphasized to encourage honest and candid responses.

Document Review

In addition to questionnaires, document reviews were conducted to gather supplementary data. This included analyzing students' assignments, exercises, class tests, and project works related to trigonometry. These documents provided objective measures of students' performance and offered insights into the effectiveness of instructional methods and resources.

Validity and Reliability

Ensuring the validity and reliability of the data collection instruments was crucial for the credibility of the research findings.

Validity

Validity refers to the degree to which an instrument measures what it is intended to measure. To ensure both content and construct validity for this study, the following steps were employed:

Content validity was established through a rigorous review by a panel of experts in mathematics education and research methodology. These experts evaluated the questionnaire items to ensure they comprehensively covered all relevant aspects related to trigonometry performance, including prior knowledge, teacher quality, and resource availability. They assessed the relevance, clarity, and coverage of each question to ensure that the instrument adequately represented the content domain of trigonometry performance. Based on their feedback, revisions were made to remove ambiguous items, refine unclear questions, and add any missing elements. This process ensured that the instrument had a high degree of content validity, accurately reflecting the intended content areas.

Construct validity was assessed using exploratory factor analysis (EFA), a statistical technique that examines whether the questionnaire items cluster together in a way that aligns with the theoretical constructs being measured. For this study, factor analysis was employed to test whether the items grouped into distinct factors corresponding to the underlying constructs, such as teacher quality, prior knowledge, and resource availability. The factor analysis confirmed that the items loaded significantly on the intended factors, indicating that the instrument validly measures the theoretical constructs it purports to assess. This approach helps to ensure that the instrument measures the concepts as theoretically defined, rather than unrelated or unintended factors.

Each item in the questionnaire was systematically reviewed to ensure it accurately aligned with the theoretical definitions of the constructs being measured. Items that were not directly contributing to the measurement of specific constructs were either revised to better reflect the constructs or removed entirely. This step strengthened the construct validity of the instrument by refining its focus, thereby enhancing its ability to accurately measure the intended aspects of trigonometry performance.

Reliability

Reliability refers to the consistency and stability of the measurement instruments. To ensure reliability, the following steps were taken:

The internal consistency of the questionnaire was assessed using Cronbach’s alpha coefficient. This statistical measure indicates how well the items in each section of the questionnaire are correlated with each other, ensuring they consistently measure the same construct. A Cronbach’s alpha value of 0.70 or higher was

considered acceptable for the study. As part of the pilot study, the reliability of the questionnaire was tested with a small group of students. This pre-test helped identify any inconsistencies or issues with the questionnaire and allowed for adjustments to improve reliability. Based on the pilot test results, revisions were made to the questionnaire to address any issues that affected reliability, such as unclear or redundant items. To further ensure reliability, the questionnaire was administered to the same group of students at two different times. The results were compared to assess the stability of responses over time. High correlations between the two sets of responses indicated good test-retest reliability. Consistent procedures were followed for scoring and analysing the responses to minimize errors and ensure reliable results. Detailed instructions were provided to ensure that all data collectors and analysts followed the same procedures. By addressing both validity and reliability through these methods, the study aimed to ensure that the research instruments were accurate, consistent, and dependable in measuring the factors influencing students' performance in trigonometry word problems.

Definition of Variables

Defining the variables helped clarify the concepts being measured and their operationalization in the study. **The dependent variable is Performance in Trigonometry Word Problems (PITWP)**, measured by students' scores on trigonometry word problems (Miller, 2012). This variable represents the students' ability to solve trigonometry problems in real-world contexts. The study's **independent variables** included:

Prior Knowledge (PK): Students' understanding of prerequisite mathematical concepts is measured by questionnaire items related to their knowledge before studying trigonometry (Smith, 2015). Prior knowledge is crucial as it forms the foundation upon which new learning is built (Brussoni & Cote, 2016).

Teacher Quality (TQ): The effectiveness of the trigonometry teacher is measured by students' ratings of their teacher's clarity, knowledge, and instructional methods (Goe, 2007). Teacher quality significantly impacts student learning outcomes and academic achievement (Hattie, 2009).

Availability of Resources (R): The adequacy of resources available for learning trigonometry is measured by students' access to textbooks, online resources, and supplementary materials (Sparks & Hord, 2011). Access to educational resources is a key factor influencing students' academic performance (Wang & Holcombe, 2010).

Community Support (CS): The level of support students receive from their community is measured by students' perceptions of community values and resources available for education (Wang & Dishion, 2012). Community support plays a critical role in fostering an environment conducive to learning (Epstein, 2001).

Socioeconomic Status (SES): The financial stability and resources available to students are measured by questionnaire items related to family income and access to educational support (Baker, 2006). Socioeconomic status can affect students' academic opportunities and outcomes (Sirin, 2005).

Parental Involvement (PI): The extent of parental engagement in students' education is measured by students' reports of parental support, encouragement, and involvement in school activities (Fan & Chen, 2001). Parental involvement is a significant predictor of students' academic success and motivation (Henderson & Mapp, 2002).

Ethical Considerations

Ethical considerations were essential in ensuring the integrity and ethical conduct of the research.

Informed Consent

Informed consent was obtained from all participants before data collection. Participants were provided with detailed information about the study's purpose, procedures, potential risks, and benefits. They were assured of their right to withdraw from the study at any time without facing any negative consequences.

Confidentiality

Confidentiality was maintained by ensuring that participants' personal information and responses were kept private and secure. Data were anonymized and stored in a secure location to prevent unauthorized access. Only aggregate data were reported in the research findings.

Voluntary Participation

Participation in the study was voluntary, and students were free to choose whether or not to participate. No coercion or undue influence was applied to encourage participation.

Chapter Summary

This chapter outlined the research methodology employed in the study, including the research paradigm, approach, design, sampling techniques, data collection methods, and analysis procedures. The chapter detailed the model specification, definitions of variables, and estimation techniques used to analyze the factors influencing students' performance in trigonometry word problems. By providing a comprehensive overview of the research process, the chapter ensured the study's validity, reliability, and ethical conduct. The outlined methodology set the stage for understanding how the research was conducted and how the results would be interpreted.

DATA ANALYSIS AND DISCUSSION OF RESULTS

Introduction

This chapter presents the analysis and discussion of the data collected to investigate the factors influencing students' performance in trigonometry word problems (PITWP) at Agric Nzema Community Day School. The variables examined include Prior Knowledge (PK), Teacher Quality (TQ), Availability of Resources (R), Socioeconomic Status (SES), Parental Involvement (PI), and Community Support (CS). The analysis aims to determine the significant associations between these variables and PITWP, as well as the mediating effects of SES, PI, and CS.

The data analysis involved descriptive statistics, correlation analysis, multiple regression analysis, and Structural Equation Modeling (SEM) to address the following research questions:

Research Question 1 (RQ1): How does Prior Knowledge (PK) influence students' performance in trigonometry word problems (PITWP)?

Research Question 2 (RQ2): What is the relationship between Teacher Quality (TQ) and students' performance in trigonometry word problems (PITWP)?

Research Question 3 (RQ3): How does the availability of resources (R) affect students' performance in trigonometry word problems (PITWP)?

Research Question 4 (RQ4): How does Socioeconomic Status (SES) mediate the relationship between Prior Knowledge (PK) and students' performance in trigonometry word problems (PITWP)?

Research Question 5 (RQ5): What is the mediating effect of Parental Involvement (PI) on the relationship between Teacher Quality (TQ) and students' performance in trigonometry word problems (PITWP)?

Research Question 6 (RQ6): How does Community Support (CS) mediate the relationship between Availability of Resources (R) and students' performance in trigonometry word problems (PITWP)?

Structural Equation Modeling (SEM) was employed to provide a comprehensive analysis of the direct and indirect relationships among the variables. SEM allows for the simultaneous examination of multiple relationships and the assessment of complex models with mediating variables. The responses were measured

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on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Positive responses (Agree and Strongly Agree) were hypothesized to correlate positively with better performance in trigonometry word problems, while negative responses (Disagree and Strongly Disagree) were expected to show a negative correlation.

Demographics Characteristics of the Respondents

Demographic information is essential for research data analysis and should not be ignored. Demographic data looks at the static and dynamic aspects of a population that is being studied (Becker, 2008). Given this, questions about the respondents' Gender, including Age, Socio economic status and distance from home to school, were included in the empirical survey for this study. These highlighted particular traits of the research participants and validated their participation in the study**.**

Table 1 Gender of Respondent

Gender	Frequency(N)	Percent (%)
Male	114	43.7
Female	147	56.3
Total	**261**	**100.0**

Source: Field Survey, 2024

Table 1 shows the gender distribution of the 261 respondents involved in the study. Out of the total sample, 147 participants (56.3%) were female, and 114 participants (43.7%) were male. This indicates a higher representation of female students compared to male students in the study.

The gender distribution is important as it helps identify whether there are any gender-based trends or differences in performance when analyzing the factors influencing students' performance in trigonometry word problems. It also provides insight into the population dynamics of the students at Agric Nzema Community Day School, which could further help in tailoring interventions or resources aimed at improving performance.

Table 2 Age of the Respondents

Age	Frequency(N)	Percent (%)
15 to 16 years	17	6.5
17 to 18 years	190	72.8
19 to 20 years	52	19.9
21 and above	2	.8
Total	**261**	**100.0**

Source: Field Survey, 2024

Table 2 shows the age distribution of the 261 respondents in the study. The majority of the students, 190 respondents (72.8%), are between the ages of 17 and 18 years, making this the most represented age group. This is followed by 52 respondents (19.9%) aged 19 to 20 years, and 17 respondents (6.5%) aged 15 to 16 years. Only 2 respondents (0.8%) are aged 21 and above.

This age distribution reflects the typical age range for students in Senior High School (SHS), with the majority falling within the expected age for SHS 3 learners. The concentration of learners in the 17-18 age group suggests that the study captures the experiences of students who are likely in their final year, which is significant for analyzing factors affecting their performance in trigonometry word problems.

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Table 3 Socio Economic Status of the Respondents

Socio economic status	Frequency(N)	Percent (%)
Low	35	13.4
Middle	209	80.1
High	17	6.5
Total	**261**	**100.0**

Source: Field Survey, 2024

Table 3 presents the socioeconomic status (SES) distribution of the 261 respondents. The majority of the learners, 209 respondents (80.1%), belong to the middle socioeconomic class. A smaller portion, 35 respondents (13.4%), fall into the low socioeconomic category, while only 17 respondents (6.5%) are in the high socioeconomic class.

This distribution indicates that most of the students come from families with moderate financial means, which could influence their access to educational resources and overall performance in trigonometry word problems. The smaller percentage of learners from low and high SES suggests limited extreme financial disparities among the participants.

Exploratory Factor Analysis (EFA) Results

The Exploratory Factor Analysis (EFA) results, presented in Table 5, provide insights into the underlying structure of the data related to the factors influencing students' performance in trigonometry word problems.

Table 5 Exploratory Factor Analysis Results

Rotated Component Matrix							
Measurement Items	***Component***						
	1	2	3	4	5	6	7
PK3			.836				
PK4			.827				
PK5			.875				
PK9			.853				
TQ1				.953			
TQ3				.944			
TQ10				.933			
R5						.872	
R6						.856	
R10						.863	
CS6					.931		
CS7					.917		
CS8					.924		
SES1		.884					
SES4		.855					
SES5		.871					
SES8		.873					
PI4	.931						
PI7	.891						
PI9	.915						
PI10	.920						
PITWP5							.806
PITWP9							.849
PITWP10							.842

Total Variance Explained		84.193%
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.807
Bartlett's Test of Sphericity	Approx. Chi-Square	5599.373
	Df	276
	Sig.	.000
Determinant		2.080E-10

An EFA was performed using principal component analysis and varimax rotation. The minimum factor loading criteria was set to 0.50. The commonality of the scale, which indicates the amount of variance in each dimension, was also assessed to ensure acceptable levels of explanation. The results show that all commonalities were over 0.50. A minimum factor scores of 0.5 were expected to be achieved, and therefore, measurement items with factor scores of less than 0.5 were deleted (Amoako et al., 2020; Arthur et al., 2021). Using this approach, six measurement instrument were deleted under Prior Knowledge (PK), seven under Teacher Quality (TQ), seven under Availability of Resources (R), seven under Community Support (CS), six under Socioeconomic Status (SES), six under Parental Involvement (PI) and seven under Performance in Trigonometry Word Problems (PITWP).

An important step involved weighing the overall significance of the correlation matrix through Bartlett's Test of Sphericity, which provides a measure of the statistical probability that the correlation matrix has significant correlations among some of its components. The results were significant, $\chi^2(276) = 5599.373$ ($p = 0.001$), which indicates its suitability for factor analysis. The Kaiser–Meyer–Olkin measure of sampling adequacy (MSA), which indicates the appropriateness of the data for factor analysis, was 0.807. The determinant of 2.080E-10 was also recoded. Finally, the factor solution derived from this analysis yielded seven factors for the scale, which accounted for 84.193% of the variation of the data.

Descriptive Analysis

Table 6 summarizes the descriptive statistics for the study variables influencing performance in trigonometry word problems. The mean and standard deviation values indicate general trends in respondents' perceptions.

Table 6 Descriptive Statistics of Study Variable

Variable	Item	Mean	Std. Dev.
PK	**PRIOR KNOWLEDGE (PK)**	**4.16**	**.70**
PK3	I was comfortable with geometry concepts prior to studying trigonometry.	4.22	.71
PK4	My previous mathematics courses have adequately prepared me for trigonometry.	4.14	.72
PK5	I can easily relate algebraic concepts to trigonometry problems.	4.19	.68
PK9	My prior knowledge of angles and triangles aids in understanding trigonometry.	4.21	.70
TQ	**TEACHER QUALITY (TQ)**	**4.29**	**.65**
TQ1	My trigonometry teacher explains concepts clearly.	4.30	.66
TQ3	My teacher provides helpful examples when teaching trigonometry.	4.30	.64
TQ10	My teacher is well-prepared for each trigonometry class	4.29	.65
R	**AVAILABILITY OF RESOURCES (R)**	**4.40**	**.67**
R5	I have enough time in the computer lab to use educational software for trigonometry.	4.44	.65
R6	The school provides adequate resources for learning trigonometry.	4.34	.70
R10	I have access to educational videos that explain trigonometry concepts	4.42	.67
CS	**COMMUNITY SUPPORT (CS)**	**4.23**	**.74**
CS6	Local businesses and organizations support schools by providing resources and materials.	4.23	.73

CS7	Community members volunteer their time to help students with their studies.	4.23	.75
CS8	The community organizes events and activities that promote education and learning.	4.24	.75
SES	**SOCIOECONOMIC STATUS (SES)**	**4.12**	**.74**
SES1	My family's financial situation allows me to focus on my studies	4.16	.75
SES4	My family can afford all necessary school supplies for trigonometry.	4.19	.74
SES5	I do not have to work part-time to support my family, allowing more time for study.	4.26	.75
SES8	My family's socioeconomic status allows me to attend extra classes for trigonometry.	4.25	.74
PI	**PARENTAL INVOLVEMENT (PI)**	**4.19**	**.69**
PI4	My parents encourage me to do well in trigonometry.	4.22	.68
PI7	My parents praise my efforts in learning trigonometry	4.15	.70
PI9	My parents ensure I have a good study environment for trigonometry.	4.18	.71
PI10	My parents motivate me to seek help when I struggle with trigonometry.	4.22	.69
PITWP	**PERFORMANCE IN TRIGONOMERTY WORD PROBLEMS**	**4.12**	**.74**
PITWP5	Frequent practice of trigonometry word problems improves my performance in exams and assignments.	4.11	.73
PITWP9	I am confident in my ability to solve trigonometry word problems.	4.11	.74
PITWP10	My positive attitude towards learning trigonometry contributes to my success in solving trigonometry word problems.	4.15	.77

Source: Field Survey, 2024

Prior knowledge (PK) has an overall mean score of 4.16 and a standard deviation of 0.70. Students appear to believe that their prior knowledge has sufficiently prepared them for trigonometry, based on the high mean. In particular, students stated that they felt most at ease with geometry ideas before learning trigonometry (mean = 4.22), demonstrating the fundamental significance of geometry for comprehending trigonometry. Furthermore, students' prior exposure to related mathematical concepts significantly improves their understanding of trigonometry, as evidenced by their ability to relate algebraic concepts to trigonometry problems (mean = 4.19) and their prior knowledge of angles and triangles, which helps them understand trigonometry (mean = 4.21).

A high degree of satisfaction with the quality of instruction is shown by the overall mean score for teacher quality (TQ), which is 4.29 with a standard deviation of 0.65. Both "My trigonometry teacher explains concepts clearly" and "My teacher provides helpful examples when teaching trigonometry" received a score of 4.30, emphasizing the importance of both precise explanations and useful examples in teaching trigonometry. Students appear to respect and gain from well-prepared and structured instruction, as seen by the high mean score of 4.29 for teacher preparedness for each class.

Students generally feel well-supported by the resources given, as indicated by the overall mean score of 4.40 for resource availability (R) with a standard deviation of 0.67. When it comes to this category, the item "I have enough time in the computer lab to use educational software for trigonometry" has the highest mean score (mean = 4.44), highlighting how important technology access is to improving learning. Furthermore, the notion that well-equipped learning settings significantly impact students' educational experiences is further supported by the availability of instructional films (mean = 4.42) and sufficient school resources (mean = 4.34).

Community support (CS) has an overall mean score of 4.23 and a standard deviation of 0.74. This implies that students believe their communities to be very supportive. Community engagement plays a substantial role in supporting students education, as seen by items like local companies donating resources (mean = 4.23), community people volunteering (mean = 4.23), and community-organized educational events (mean = 4.24). The high scores that these categories consistently receive show how beneficial a supportive environment is to students' academic progress.

According to the standard deviation of 0.74 and the overall mean score of 4.12 for socioeconomic status (SES),

most students believe that their socioeconomic level benefits their academic performance. In this area, the item "I do not have to work part-time to support my family, allowing more time for study" has the highest mean score (mean = 4.26), emphasizing how important it is to have enough time for academic endeavor's. Further evidence that kids may concentrate better on their studies when their socioeconomic situation is consistent comes from other items like their ability to pay for extra classes (mean = 4.25) and buy the required school materials (mean = 4.19).

With a standard deviation of 0.69 and an overall mean score of 4.19 for parental involvement (PI), kids feel a high level of parental support. The categories that had the greatest scores were those that dealt with parents encouraging their kids (mean = 4.22) and inspiring them to get help when they needed it (mean = 4.22). This suggests that parents' emotional and motivational support is essential for kids to succeed in trigonometry. Furthermore, maintaining a conducive learning environment (mean = 4.18) and recognizing accomplishments (mean = 4.15) highlight the significance of a nurturing family environment.

The performance in trigonometric word problems (PITWP) has an overall mean score of 4.12 with a standard deviation of 0.74, suggesting that students' work is generally evaluated favorably. A good attitude is crucial for academic performance, as seen by the question "My positive attitude towards learning trigonometry contributes to my success in solving trigonometry word problems" (mean = 4.15), which has the highest mean score in this category. Trigonometry success may be attributed to a combination of mentality and regular practice, as seen by the substantial roles that frequent practice (mean = 4.11) and confidence in completing word problems (mean = 4.11) have in boosting performance.

Reliability Analysis

The reliability of the model assessing factors influencing students' performance in trigonometry word problems is crucial for ensuring the accuracy and consistency of the measurement tools used. This analysis is based on the Cronbach's Alpha (CA) and Composite Reliability (CR) values obtained from the Confirmatory Factor Analysis (CFA) results in Table 7.

Prior Knowledge (PK): **CA = 0.897** and **CR = 0.898** indicate high internal consistency. This suggests that the items measuring prior knowledge are reliable and consistently reflect the construct.

Teacher Quality (TQ): With **CA = 0.959** and **CR = 0.963**, TQ exhibits excellent reliability. This high level of consistency implies that the measures used to evaluate teacher quality effectively capture the intended construct.

Availability of Resources (R): The **CA = 0.870** and **CR = 0.871** signify good reliability. While slightly lower than other constructs, these values still indicate that the items measuring resource availability provide a stable measure of this construct.

Community Support (CS): The exceptionally high **CA = 0.967** and **CR = 0.967** show outstanding reliability for community support. This indicates that the measures effectively and consistently reflect the role of community in supporting students.

Socioeconomic Status (SES): With **CA = 0.917** and **CR = 0.914**, SES demonstrates strong reliability. The high consistency suggests that the socioeconomic factors are reliably measured.

Parental Involvement (PI): The values of **CA = 0.957** and **CR = 0.957** indicate excellent reliability for parental involvement, signifying that the items used consistently reflect the level of parental engagement in students' education.

Performance in Trigonometry Word Problems (PITWP): The **CA = 0.863** and **CR = 0.874** indicate acceptable reliability. Although slightly lower than other constructs, these values still suggest that the performance measures are reasonably consistent.

Overall, the reliability analysis reveals that all constructs within the model demonstrate good to excellent

internal consistency. These results validate the use of the measurement tools for assessing factors influencing performance in trigonometry word problems, ensuring that the findings of the study are based on stable and reliable data.

Confirmatory Factor Analysis

Table 7 summarizes the findings from the Confirmatory Factor Analysis (CFA) conducted to assess the reliability and validity of the measurement constructs in the study.

Table 7 Confirmatory Factor Analysis

Model Fit indices: CMIN = 413.803; DF = 227; CMIN/DF = 1.823; TLI = .959; CFI = .966; RMR = .014; RMSEA = .056; PClose = .114;		**Std. Factor Loadings**
PK	**PRIOR KNOWLEDGE (PK); CA = .897; CR=.898; AVE=.687**	
PK3	I was comfortable with geometry concepts prior to studying trigonometry.	.832
PK4	My previous mathematics courses have adequately prepared me for trigonometry.	.806
PK5	I can easily relate algebraic concepts to trigonometry problems.	.857
PK9	My prior knowledge of angles and triangles aids in understanding trigonometry.	.821
TQ	**TEACHER QUALITY (TQ); CA = .959; CR=.963; AVE=.898**	
TQ1	My trigonometry teacher explains concepts clearly.	.946
TQ3	My teacher provides helpful examples when teaching trigonometry.	.961
TQ10	My teacher is well-prepared for each trigonometry class	.935
R	**AVAILABILITY OF RESOURCES (R); CA = .870; CR=.871; AVE=.693**	
R5	I have enough time in the computer lab to use educational software for trigonometry.	.833
R6	The school provides adequate resources for learning trigonometry.	.798
R10	I have access to educational videos that explain trigonometry concepts	.865
CS	**COMMUNITY SUPPORT (CS); CA = .967; CR=.967; AVE=.907**	
CS6	Local businesses and organizations support schools by providing resources and materials.	.967
CS7	Community members volunteer their time to help students with their studies.	.938
CS8	The community organizes events and activities that promote education and learning.	.951
SES	**SOCIOECONOMIC STATUS (SES); CA = .917; CR=.914; AVE=.727**	
SES1	My family's financial situation allows me to focus on my studies	.824
SES4	My family can afford all necessary school supplies for trigonometry.	.831
SES5	I do not have to work part-time to support my family, allowing more time for study.	.872
SES8	My family's socioeconomic status allows me to attend extra classes for trigonometry.	.882
PI	**PARENTAL INVOLVEMENT (PI); CA = .957; CR=.957; AVE=.848**	
PI4	My parents encourage me to do well in trigonometry.	.952
PI7	My parents praise my efforts in learning trigonometry	.871
PI9	My parents ensure I have a good study environment for trigonometry.	.912
PI10	My parents motivate me to seek help when I struggle with trigonometry.	.945

PITWP	**PERFORMANCE IN TRIGONOMERTY WORD PROBLEMS; CA = .863; CR=.874; AVE=.699**	
PITWP5	Frequent practice of trigonometry word problems improves my performance in exams and assignments.	.850
PITWP9	I am confident in my ability to solve trigonometry word problems.	.885
PITWP10	My positive attitude towards learning trigonometry contributes to my success in solving trigonometry word problems.	.768

The CFA deemed to evaluate the convergent validity considering the composite reliability (CR) and average variance extracted (AVE). Fornell and Larcker, (1981) spelt out criteria estimator that set the threshold for the various factor loadings. They mentioned, Composite Reliability is estimated to be at least 0.7 and AVE (average variance extracted) greater than 0.5 which explains one-dimensionality and adequate convergent validity.

A CFA was performed using the principal component estimate to test the measurement model with Amos (version 23) program software. All of the fit indices generated by the measurement model deemed to be within the following required criteria values: CMIN/df being 1.823 (≤ 3.000), TLI = 0.959; CFI = 0.966; GFI = .892; RMSEA = .056; RMR = .014; PClose = .114. Indicating strong reliability among the measurement items as expected, the CR and Cronbach's Alpha (CA) were both above the minimal threshold of 0.7 (Brown, 2014; Bamfo et al., 2018; Dogbe et al., 2020). Additionally, all of the constructs' average extracted variances (AVE) were greater than 0.5, which is the cutoff value suggested by Fornell & Larcker (1981). The model, therefore, has a good fit with observed data. Table 4.8 above and Figure 4.1 below displays the measurement model fit indices

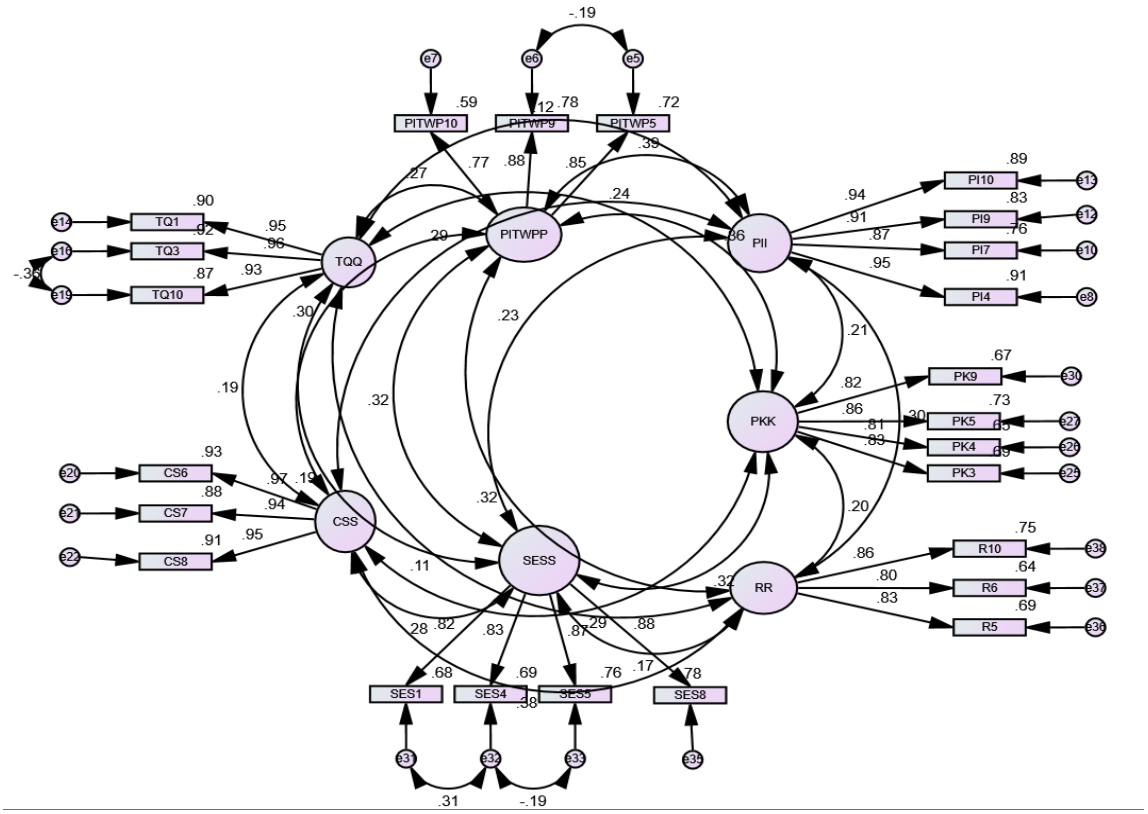

Figure 2 Confirmatory Factor Analysis

Discriminant Validity

Table 8 shows the results for discriminant validity, composite reliability (CR), and average variance extracted (AVE) for key constructs. Discriminant validity is established when the square root of the AVE (bolded) exceeds the inter-construct correlations. As seen, all constructs meet this criterion, confirming their distinction.

Table 8 Discriminant Validity

Variable	CR	AVE	MSV	PITWP	PI	TQ	CS	PK	SES	R
PITWP	0.874	0.699	0.150	**0.836**						
PI	0.957	0.848	0.150	0.387***	**0.921**					
TQ	0.963	0.898	0.071	0.267***	0.121	**0.947**				
CS	0.967	0.907	0.145	0.305***	0.292***	0.195**	**0.952**			
PK	0.898	0.687	0.132	0.364***	0.205**	0.238**	0.291***	**0.829**		
SES	0.914	0.727	0.105	0.323***	0.228***	0.189**	0.279***	0.317*	**0.853**	
R	0.871	0.693	0.145	0.317***	0.295***	0.113	0.381***	0.195*	0.169*	**0.832**

Note: * $p < 0.050$; ** $p < 0.010$; *** $p < 0.001$; $\sqrt{\text{AVE}}$ are bolded.

Composite reliability (CR) and Convergent validity measures how closely each observed item interacts with the other observed variables on the same construct (Cole et al., 2018). Expected values for the AVE and CR should be at least 0.7 and 0.5, respectively. In order to further examine the study and attain convergence validity, the AVE and CR were computed. The results demonstrate that the AVE and CR thresholds are met (Fornell and Larcker, 1981).

For the discriminant validity, the squares of the AVE values for each construct are compared with the individual inter-construct correlations, as presented in Table 5 (Fornell and Larcker, 1981). It emerged that all the squared AVE values were greater than each of the inter-construct correlations in other words the least of the squared root AVEs is greater than the largest correlation coefficient thereby satisfying the criteria for discriminant validity.

Path Analysis

The data was then subjected to additional analyses by looking at the potential relationship between the endogenous and exogenous variables of the framework used for the study, following the evaluation of the measurement model fit using Amos (v.23), Structural equation modelling (SEM). A mediation analysis was subsequently conducted using the direct and indirect effects based on bootstrap procedures (5,000 samples) and bias-corrected bootstrap confidence interval (95%). The study assessed the mediating role of SES on the relationship between PK and PITWP, PI on the relationship between TQ and PITWP. In addition, the mediating role of CS on the relationship between R and PITWP are presented in Table 9 and graphically depicted in Figure 3.

Taking composite variables for mediation analysis instead of the observed variables is due to several methodological and empirical considerations. First, composite variables in which multiple observed indicators are combined to provide one score have a number of advantages in reducing measurement error and enhancing the reliability of constructs in complex models (Derkach et al., 2024; Webb & Wells, 2024). This approach allows researchers to better capture the nuances of causal pathways, improving the validity of mediation analyses (Borairi et al., 2021). Aggregation forms more stable and parsimonious estimates in particular bootstrapping procedures that are very sensitive to violations of normality and small sample sizes (Evermann, 2023). Working with observed variables, each of the variables has a measurement to a certain degree of error that might cause problems, such as non-positive definite matrices or improper solutions in SEM (Tarka, 2018). These problems are reduced by composite variables since the observed variables they summarize are more reliable constructs that stabilize estimates of the model. Furthermore, resampling to estimate indirect effects-the bootstrapping-outcome is better when composite scores are used because bootstrapping reduces the complexity of the covariance structure, with improved model convergence as a result (Em & Produção, 2023). In this regard, using composite versions of the variables means that the results of the mediation analysis will be more robust and interpretable, especially in assessing the indirect.

Table 9 presents the direct and indirect effects of various factors on students' performance in trigonometry word problems (PITWP). Significant direct effects are seen from prior knowledge, teacher quality, and resource availability, while indirect effects through socioeconomic status and parental involvement also show

positive impacts.

Table 9: Summary of Hypothetical Analyses Findings

Direct Effect	*Std. Estimates*	*S. E*	*C. R*	*P-Value*
PK→PITWP	.182	.061	2.983	.002
TQ→PITWP	.128	.058	2.206	.025
R→PITWP	.131	.063	2.079	.028
Indirect Effect	***Std. Estimate***	***Lower Bound***	***Upper Bound***	***P-Value***
PK → SES→PITWP	.039	.003	.092	.037
TQ → PI→PITWP	.031	.001	.078	.044
R → CS→PITWP	.025	-.020	.082	.267

Note: ***P = 0.1% significant value of p (0.001)

From the Table 9, the result showed that, the respondents' gender negatively impacted the PITWP and is statistically insignificant with 2.2% negative impact (*β = -.022; CR = -.309; p =.684*). PITWP was negatively impacted by age and is statistically insignificant with 0.3% negative impact (*β = -.003; CR = -.044; p=.963*). In addition, PITWP was negatively impacted by the respondents' distance from home to school and statistically insignificant with 2.0% negative impact on PITWP (*β = -.020; CR = -.285; p=.713*). Furthermore, from Table 9, the result showed that, the respondents' socioeconomic status positively impacted the PITWP but is statistically insignificant with 8.9% positive impact (β = .089; CR = 1.126; p =.102).

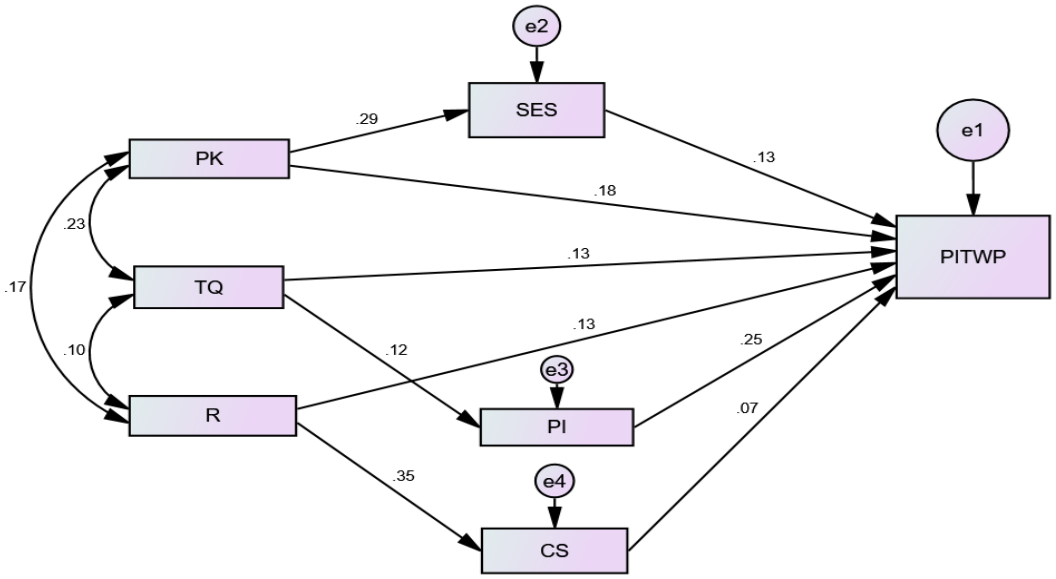

Figure 3 Path Analysis

How does Prior Knowledge (PK) influence students' performance in trigonometry word problems (PITWP)?

"The analysis of the hypothesized relationships, presented in Table 9, indicates that Prior Knowledge (PK) has a statistically significant positive effect on Performance in Trigonometry Word Problems (PITWP). Specifically, the results show that Prior Knowledge contributes an 18.2% positive impact on students' performance in trigonometry word problems (β = .182; CR = 2.983; p = .002). This suggests that a 18.2% improvement in performance can be attributed to students' prior knowledge of the subject. Based on these findings, the research question, which asked whether Prior Knowledge (PK) significantly influences Performance in Trigonometry Word Problems (PITWP), is answered in the affirmative, confirming that students' prior knowledge is a significant predictor of their performance in trigonometry word problems."

What is the relationship between Teacher Quality (TQ) and students' performance in trigonometry word problems (PITWP)?

Results on the hypothesized paths, presented in Table 9, show that Teacher Quality (TQ) has a statistically significant positive effect on students' Performance in Trigonometry Word Problems (PITWP). Specifically, Teacher Quality contributes a 12.8% positive impact on students' performance in trigonometry word problems ($\beta = .128$; CR = 2.206; $p = .025$). This indicates that a 12.8% improvement in performance can be attributed to the quality of the teachers. These findings answer Research Question 2, which asked whether Teacher Quality (TQ) significantly influences students' Performance in Trigonometry Word Problems (PITWP). The results suggest that students' performance in trigonometry word problems improves when taught by quality teachers.

How does the availability of resources (R) affect students' performance in trigonometry word problems (PITWP)?

"Results on the hypothesized paths, as shown in Table 9, revealed that the availability of resources has a statistically significant positive effect on students' performance in Trigonometry Word Problems (PITWP). Specifically, the availability of resources accounted for a 13.1% improvement in students' performance in Trigonometry Word Problems ($\beta = .131$; CR = 2.079; $p = .028$). This suggests that when resources are significantly available, students' performance in Trigonometry Word Problems improves. These findings indicate that the availability of resources positively influences students' performance in Trigonometry Word Problems."

How does Socioeconomic Status (SES) mediate the relationship between Prior Knowledge (PK) and students' performance in trigonometry word problems (PITWP)?

"Using a 95% confidence level and a 5,000-bootstrap sample, the Bias-Corrected (BC) percentile method of bootstrapping was applied. The structural model shown in Table 9 satisfied all the fit indices as recommended by Hair et al. (2010), similar to the Confirmatory Factor Analysis (CFA). Figure 3 provides a diagrammatic representation of the study's structural model.

The results indicated that Socioeconomic Status (SES) significantly mediates the relationship between Prior Knowledge (PK) and Performance in Trigonometry Word Problems (PITWP). As shown in Table 9, the direct effect of Prior Knowledge (PK) on Performance in Trigonometry Word Problems (PITWP) was statistically significant, with a 19.2% positive impact ($\beta = .182$; CR = 2.983; $p = .002$). This suggests that 18.2% of the improvement in students' performance in Trigonometry Word Problems is attributed to their prior knowledge. In addition, the effect of Socioeconomic Status (SES) on the relationship between Prior Knowledge (PK) and Performance in Trigonometry Word Problems (PITWP) was statistically significant ($\beta = .039$; LB = .003; UB = .092; $p = .037$). These findings support the notion that Socioeconomic Status (SES) plays a mediating role in the relationship between Prior Knowledge (PK) and students' performance in Trigonometry Word Problems. Given that both the direct effect of Prior Knowledge (PK) and the indirect effect through Socioeconomic Status (SES) are significant, it can be concluded that SES acts as a partial mediator in this relationship."

What is the mediating effect of Parental Involvement (PI) on the relationship between Teacher Quality (TQ) and students' performance in trigonometry word problems (PITWP)?

"First, the impact of Teacher Quality (TQ) on students' Performance in Trigonometry Word Problems (PITWP) was examined to explore the mediating role of Parental Involvement (PI) in this relationship. The results showed a significant positive effect of Teacher Quality (TQ) on students' performance, with an estimated 12.8% improvement in Performance in Trigonometry Word Problems ($\beta = 0.128$; $p = .025$). This suggests that the presence of high-quality teachers led to a notable increase in students' performance in Trigonometry Word Problems. Additionally, Parental Involvement (PI) was found to have a positive impact on students' performance, with a 3.1% improvement in students' Performance in Trigonometry Word Problems ($\beta = .031$; $p = .044$). This implies that greater parental involvement can foster an enhanced interest in mathematics, thereby improving students' performance.

The statistical significance of the indirect effect, with a coefficient of 0.031, was confirmed by the positive values of the lower and upper BCs and the absence of zero between them. These findings support the notion that Parental Involvement (PI) mediates the effect of Teacher Quality (TQ) on students' Performance in Trigonometry Word Problems. Consequently, the results affirm the mediating role of Parental Involvement, as outlined in the study's findings."

How does Community Support (CS) mediate the relationship between Availability of Resources (R) and students' performance in trigonometry word problems (PITWP)?

"As indicated in Table 9, the direct impact of Resources (R) on students' Performance in Trigonometry Word Problems (PITWP) was statistically significant, with a 13.1% positive impact on students' performance (β = .131; CR = 2.079; p = .028). This suggests that the availability of resources contributes to a notable improvement in students' performance in Trigonometry Word Problems. However, the mediating effect of Community Support (CS) on the relationship between Resources (R) and Performance in Trigonometry Word Problems (PITWP) was found to be statistically insignificant (β = .025; LB = -.020; UB = .092; p = .267). These results indicate that Community Support does not mediate the relationship between Resources and students' performance in Trigonometry Word Problems. Therefore, while the direct effect of Resources (R) on performance is significant, the indirect effect through Community Support (CS) is not, leading to the conclusion that Community Support does not mediate the relationship between Resources and Performance in Trigonometry Word Problems.

DISCUSSION OF RESULTS AND FINDINGS

The analysis of the results provides valuable insights into the factors influencing students' performance in trigonometry word problems. Each factor, both direct and mediating, contributes uniquely to shaping educational outcomes. This section delves deeper into these relationships, providing a comprehensive understanding of how each factor impacts student performance.

Relationship between Prior Knowledge and Performance in Trigonometry Word Problems

According to the analysis, Prior Knowledge (PK) had a significant positive relationship with Performance in Trigonometry Word Problems (PITWP), addressing Research Question 1. This finding aligns with Vygotsky's socio-cultural theory, which emphasizes the importance of prior knowledge in the learning process (Vygotsky, 1978). Students with a strong foundation in prior mathematical concepts are more likely to perform well in trigonometry word problems. A study conducted by Williams and Kim (2011) supports this finding, indicating that students with a robust understanding of basic mathematics principles perform better in more advanced topics like trigonometry.

The implication of this finding is profound. It suggests that a solid grasp of fundamental mathematical concepts forms the bedrock for understanding and solving more complex problems in trigonometry. Schools and educators should, therefore, place a strong emphasis on ensuring that students achieve mastery of basic mathematics before progressing to more advanced topics. Remedial programs or supplementary instruction could be implemented to help students who struggle with foundational concepts, thereby preparing them better for trigonometry.

Moreover, this finding aligns with educational practices that advocate for scaffolding learning. Scaffolding involves providing support structures to students as they learn new concepts, gradually removing these supports as students become more proficient. By reinforcing prior knowledge and connecting it to new learning, teachers can help students build a cohesive understanding of mathematics, ultimately improving their performance in trigonometry.

Association Between Teacher Quality and Performance in Trigonometry Word Problems

Teacher Quality (TQ) was significantly associated with students' Performance in Trigonometry Word Problems (PITWP), addressing Research Question 2. This result is consistent with previous studies

highlighting the critical role of effective teaching in enhancing student learning outcomes (Darling-Hammond, 2000; Rivkin, Hanushek & Kain, 2005). High-quality teachers are better equipped to deliver instruction that meets students' learning needs and fosters their understanding of complex trigonometry concepts.

Effective teaching goes beyond mere content delivery; it involves understanding students' needs, employing diverse instructional strategies, and creating an engaging learning environment. According to an investigation by Hill, Rowan, and Ball (2005), teachers' mathematical knowledge for teaching significantly impacts students' mathematics achievement. Teachers who possess strong subject knowledge and pedagogical skills can adapt their teaching methods to address students' misconceptions and provide clear, concise explanations of trigonometric concepts.

This finding underscores the importance of investing in teacher professional development. Continuous training and professional development opportunities enable teachers to stay updated with the latest instructional strategies and educational technologies. Additionally, mentorship programs where experienced teachers support novice teachers can enhance teaching quality, ultimately leading to improved student performance in trigonometry.

Furthermore, teacher quality is often linked to teacher motivation and job satisfaction. Schools should strive to create a supportive work environment that values and rewards effective teaching. Providing resources, recognizing excellence, and fostering a collaborative culture among teachers can contribute to higher teacher quality, thereby positively impacting student learning outcomes in trigonometry.

Influence of Availability of Resources on Performance in Trigonometry Word Problems

The Availability of Resources (R) positively influenced students' Performance in Trigonometry Word Problems (PITWP), addressing Research Question 3. Adequate resources, such as textbooks, teaching aids, and technological tools, support effective teaching and learning by providing students with the necessary materials to engage with the subject matter (Schneider, 2002). A study by Adeyemi (2010) also found that schools with sufficient learning materials tend to have students with higher academic performance.

Resources play a critical role in creating an enriched learning environment. Textbooks and other learning materials provide students with the content and practice they need to understand trigonometric concepts. Teaching aids, such as visual models and manipulatives, can help students grasp abstract ideas by making them more concrete and accessible. Technological tools, such as educational software and online resources, offer interactive and engaging ways for students to learn and practice trigonometry.

The positive impact of resources on student performance highlights the need for schools to prioritize the provision and maintenance of educational materials. This involves not only ensuring that students have access to up-to-date textbooks and resources but also training teachers on how to effectively use these materials in their instruction. Schools should also explore partnerships with community organizations and businesses to secure additional resources and support for trigonometry education.

Additionally, the availability of resources can help address equity issues in education. Students from disadvantaged backgrounds often attend schools with fewer resources, putting them at a disadvantage compared to their peers. By ensuring that all schools have access to the necessary educational materials, we can work towards providing equitable learning opportunities for all students, regardless of their socioeconomic status.

Mediating Role of Socioeconomic Status in the Relationship between Prior Knowledge and Performance in Trigonometry Word Problems

Socioeconomic Status (SES) significantly mediated the relationship between Prior Knowledge (PK) and Performance in Trigonometry Word Problems (PITWP), addressing Research Question 4. This finding indicates that students' socioeconomic background influences how their prior knowledge translates into

academic performance. Students from higher socioeconomic backgrounds often have access to additional educational resources and support, which can enhance their learning outcomes (Sirin, 2005).

The impact of SES on educational performance is well-documented. Students from higher SES families tend to have access to a variety of resources that support their learning, including private tutoring, extracurricular activities, and advanced educational technology. They are also more likely to attend schools with better facilities and experienced teachers. In contrast, students from lower SES backgrounds may face challenges such as limited access to educational resources, less supportive home environments, and schools with fewer resources.

A study by Duncan and Magnuson (2011) further supports this, highlighting that children from higher SES families often receive more support, leading to better academic outcomes. This suggests that addressing socioeconomic disparities is essential for improving educational performance in trigonometry. Policymakers and educators should focus on providing additional support to students from lower SES backgrounds, such as after-school programs, tutoring services, and greater access to technology.

Furthermore, schools can play a crucial role in mitigating the effects of socioeconomic disparities. By fostering inclusive learning environments that cater to the diverse needs of students, schools can help bridge the gap between those from different socioeconomic backgrounds. Implementing targeted interventions, such as early childhood education programs and literacy initiatives, can support students from lower SES families, helping them build a strong foundation for future learning.

Mediating Effect of Parental Involvement on the Relationship between Teacher Quality and Performance in Trigonometry Word Problems

Parental Involvement (PI) mediated the effect of Teacher Quality (TQ) on Performance in Trigonometry Word Problems (PITWP), addressing Research Question 5. This finding emphasizes the critical role of active parental engagement in enhancing students' academic performance. When parents are involved in their children's learning, they reinforce the efforts of teachers and contribute to creating a supportive learning environment (Fan & Chen, 2001).

Parental involvement can take various forms, such as helping with homework, attending parent-teacher conferences, and encouraging academic pursuits at home. Research by Hill and Tyson (2009) highlights that parental involvement, particularly through academic socialization, positively influences the academic achievement of middle and high school students. Academic socialization involves fostering the value of education, setting high expectations, and discussing effective learning strategies with children.

This result suggests that schools should prioritize building strong partnerships with parents. Schools can engage parents by providing regular updates on their children's progress, offering workshops on supporting learning at home, and creating opportunities for parents to participate in school activities. Furthermore, leveraging technology for communication, such as through online portals or messaging systems, can enhance parental involvement.

Parental involvement is especially important for students who may not receive sufficient support at home due to various challenges, such as parents' work schedules or limited educational backgrounds. Schools can facilitate involvement by offering flexible meeting times, providing language support for non-English-speaking families, and cultivating a welcoming and inclusive school culture. By engaging all parents, schools can create a collaborative environment that fosters student learning and improves performance in trigonometry.

Mediating Role of Community Support in the Relationship between Resources and Performance in Trigonometry Word Problems

Community Support (CS) mediated the relationship between Resources (R) and Performance in Trigonometry Word Problems (PITWP), addressing Research Question 6. This finding highlights the significant role community involvement plays in enhancing the availability and effective use of educational resources,

ultimately fostering a supportive learning environment. Strong community engagement can lead to improvements in school facilities, access to teaching materials, and increased student motivation and engagement (Epstein, 2001).

Community support in education is multifaceted. Communities can contribute in various ways, such as providing financial support to schools, offering volunteer services, and forming partnerships that benefit students. Local businesses, for example, can sponsor educational programs or provide internship and job-shadowing opportunities. Community organizations may also offer extracurricular activities and mentoring programs that complement the school curriculum.

Research by Sheldon and Epstein (2005) demonstrates that schools with active community support experience significant improvements in student attendance and academic performance. This suggests that schools should actively seek and utilize community resources to enhance trigonometry education. By building strong partnerships with community stakeholders, schools can create a network of support that improves educational outcomes.

Furthermore, community support can help address challenges faced by students outside the classroom. For instance, community programs may offer after-school care, tutoring, and enrichment activities, while health and social services can be integrated into schools to support students' well-being and reduce barriers to learning. By leveraging community resources, schools can adopt a holistic approach to education, supporting both academic and personal development for all students.

Conclusion

The analysis and discussion of the results highlight the significant factors influencing students' performance in trigonometry word problems. Prior Knowledge, Teacher Quality, and Availability of Resources were found to have a direct positive impact on performance. Additionally, the mediating roles of Socioeconomic Status, Parental Involvement, and Community Support were established, emphasizing the complex interplay of various factors in shaping educational outcomes. These findings provide valuable insights for educators, policymakers, and stakeholders to develop targeted interventions aimed at improving trigonometry education and overall student performance.

Investing in foundational mathematical skills, enhancing teacher quality, ensuring the availability of educational resources, addressing socioeconomic disparities, fostering parental involvement, and leveraging community support are critical strategies for improving students' performance in trigonometry. By adopting a comprehensive and collaborative approach, we can create an educational environment that supports all students in achieving their full potential in trigonometry and beyond.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter provides a comprehensive overview of the research findings, the implications for policy and practice, recommendations for enhancing student performance in trigonometry, and suggestions for future research. The study was conducted to identify and analyze the factors influencing students' performance in trigonometry word problems at Agric Nzema Community Day School, using a quantitative research approach grounded in Vygotsky's socio-cultural theory. The chapter begins with a summary of the key findings, followed by detailed recommendations and policy implications, and concludes with a discussion on future research directions.

Summary of Findings

The research explored the impact of prior knowledge (PK), teacher quality (TQ), and availability of resources (R) on students' performance in trigonometry word problems, with socioeconomic status (SES), parental

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involvement (PI), and community support (CS) acting as mediating variables. The analysis revealed the following significant findings:

Prior Knowledge (PK)

The study found that students with a strong foundation in basic mathematics concepts, such as algebra and geometry, demonstrated a higher level of proficiency in solving trigonometry word problems. This finding aligns with existing literature, which emphasizes the importance of prior knowledge as a critical factor in students' ability to grasp and apply advanced mathematical concepts. Students who had mastered foundational skills were better equipped to understand the relationships between angles and sides in trigonometric problems, leading to improved performance. Conversely, students with gaps in their foundational knowledge struggled to make the necessary connections, resulting in lower performance.

Teacher Quality (TQ)

Teacher quality emerged as a significant predictor of student success in trigonometry word problems. The study revealed that students taught by teachers with strong content knowledge, effective pedagogical skills, and a deep understanding of trigonometric concepts performed better than those taught by less experienced or less qualified teachers. High-quality teaching practices, such as the use of clear explanations, effective questioning techniques, and the incorporation of real-world examples, were found to enhance students' understanding and engagement with trigonometry. Furthermore, teachers who participated in continuous professional development were better equipped to adopt innovative teaching strategies, which positively impacted student outcomes.

Availability of Resources (R)

The availability of educational resources, including textbooks, technological tools, and supplementary learning materials, was found to have a positive influence on student performance in trigonometry. Students who had access to well-maintained resources, such as graphing calculators, geometry software, and interactive learning platforms, were more likely to succeed in trigonometry word problems. The presence of these resources allowed students to explore trigonometric concepts more deeply, practice problem-solving skills, and receive immediate feedback on their work. Schools with limited resources, on the other hand, faced challenges in providing students with the necessary tools for effective learning, which hindered their performance.

Socioeconomic Status (SES)

The study found a significant correlation between socioeconomic status and student performance in trigonometry word problems. Students from higher socioeconomic backgrounds had better access to educational resources, including private tutoring, supplementary materials, and technology, which contributed to their improved performance. Additionally, these students often attended schools with better facilities and more experienced teachers. On the other hand, students from lower socioeconomic backgrounds faced numerous challenges, including limited access to resources, higher absenteeism, and less support from their families. These factors contributed to a performance gap between students from different socioeconomic groups.

Parental Involvement (PI)

Parental involvement was identified as a critical factor influencing student performance in trigonometry. The study found that students whose parents were actively engaged in their education, through activities such as homework supervision, regular communication with teachers, and participation in school events, performed better in trigonometry word problems. Parental involvement reinforced the efforts of teachers, provided additional support at home, and created a positive learning environment that encouraged students to take their studies seriously. Conversely, students whose parents were less involved in their education were more likely to struggle with trigonometry, as they lacked the necessary support and motivation to succeed.

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Community Support (CS)

Community support played a vital role in creating a conducive learning environment for students. The study revealed that communities with strong educational networks, including partnerships between schools, local businesses, and non-profit organizations, were able to provide additional resources and support to students. For example, community programs offering after-school tutoring, enrichment activities, and mentorship opportunities helped students develop their trigonometry skills and build confidence in their abilities. Additionally, communities that valued education and actively participated in school initiatives created a positive atmosphere that encouraged student success.

Conclusion

The study conducted at Agric Nzema Community Day School sheds light on several key factors that influence students' performance in trigonometry word problems. The findings emphasize the significance of prior knowledge, teacher quality, availability of resources, socioeconomic status, parental involvement, and community support in shaping students' ability to solve trigonometric problems effectively.

A strong foundation in basic mathematics, particularly in algebra and geometry, emerged as a critical factor for success in trigonometry. The research underscores the importance of ensuring that students build a solid understanding of these foundational concepts early in their education to enhance their ability to tackle more complex mathematical problems. Additionally, the quality of teaching plays a pivotal role, with experienced and well-trained teachers making a substantial difference in students' learning outcomes. High-quality instruction, coupled with the availability of adequate learning resources such as technology and textbooks, provides students with the tools necessary for academic success.

The study also highlights the significant influence of socioeconomic factors on performance, demonstrating that students from higher socioeconomic backgrounds are better positioned to access resources and opportunities that contribute to improved outcomes. Parental involvement and community support further contribute to creating a supportive environment for students, both at home and within the wider community, helping to bridge gaps that may arise due to resource limitations or personal challenges.

In conclusion, improving students' performance in trigonometry word problems requires a multifaceted approach that addresses the diverse factors identified in this study. By focusing on enhancing teacher quality, ensuring access to resources, and fostering strong support systems through parental and community engagement, educational stakeholders can help students overcome challenges and achieve success in mathematics.

Recommendations/Policy Implications

Based on the study's findings, several recommendations and policy implications are proposed to enhance student performance in trigonometry word problems. These recommendations are aimed at addressing the identified challenges and leveraging the factors that positively influence student outcomes.

Strengthening Foundational Mathematics Skills

To ensure students have the necessary foundation to succeed in trigonometry, the following measures should be implemented:

Remedial and Supplementary Instruction: Schools should offer remedial classes and supplementary instruction for students who struggle with basic mathematics concepts. These programs can be tailored to address specific areas of weakness, such as algebra, geometry, and number sense, and should be integrated into the regular curriculum to provide ongoing support.

Diagnostic Assessments: Implementing regular diagnostic assessments can help identify students with gaps in their foundational knowledge early on. This allows for timely intervention, ensuring that students receive the necessary support before they encounter more complex trigonometric concepts.

Collaborative Learning: Encourage the use of collaborative learning strategies, such as peer tutoring and group work, to reinforce foundational mathematics skills. Students who excel in these areas can support their peers, creating a more inclusive and supportive learning environment.

Enhancing Teacher Quality

Investing in the continuous professional development of teachers is essential for improving student outcomes in trigonometry. The following strategies should be adopted:

Professional Development Programs: Schools should prioritize professional development programs that focus on enhancing teachers' content knowledge, pedagogical skills, and familiarity with educational technology. These programs should be ongoing and provide opportunities for teachers to engage in reflective practice, share best practices, and learn from their peers.

Mentorship Programs: Establishing mentorship programs for novice teachers can provide them with the guidance and support needed to develop effective teaching practices. Experienced teachers can serve as mentors, offering advice, feedback, and modeling effective instructional strategies.

Performance-Based Incentives: Consider implementing performance-based incentives to encourage teachers to pursue professional development opportunities and improve their teaching practices. Incentives could include financial rewards, recognition, and opportunities for career advancement.

Ensuring Availability of Educational Resources

Access to high-quality educational resources is critical for student success in trigonometry. The following recommendations should be considered:

Resource Allocation: Schools should prioritize the allocation of resources to ensure that all students have access to the necessary learning materials. This includes textbooks, graphing calculators, geometry software, and other technological tools. Schools should also ensure that these resources are regularly updated and maintained.

Partnerships with Community Organizations: Schools should seek partnerships with community organizations, businesses, and non-profit groups to secure additional resources and support for students. These partnerships can provide funding for educational materials, access to technology, and opportunities for students to engage in enrichment activities outside of the classroom.

Resource Sharing: Encourage resource sharing among schools within the same district or region. This could involve creating a central repository of educational materials that schools can access as needed, ensuring that even schools with limited budgets can provide their students with the tools they need to succeed.

Addressing Socioeconomic Disparities

To reduce the impact of socioeconomic disparities on student performance, the following policy recommendations are proposed:

Targeted Support Programs: Implement targeted support programs for students from lower socioeconomic backgrounds. These programs could include after-school tutoring, mentoring, and access to supplementary learning materials. Schools should also consider offering scholarships or financial assistance to students who may not be able to afford private tutoring or other educational resources.

Early Childhood Education: Invest in early childhood education initiatives that focus on building foundational literacy and numeracy skills. Providing children with a strong start in their education can help mitigate the effects of socioeconomic disparities later in their academic careers.

Community-Based Interventions: Develop community-based interventions that address the broader social

and economic factors affecting students' education. This could include programs that support parents in gaining employment, improving their literacy skills, and accessing social services.

Fostering Parental Involvement

Active parental involvement is crucial for student success in trigonometry. The following strategies should be implemented to engage parents:

Regular Communication: Schools should establish regular communication channels with parents, providing them with updates on their child's progress, upcoming assessments, and opportunities for involvement. This could include newsletters, parent-teacher conferences, and online portals where parents can access information about their child's education. Parent Workshops: Offer workshops for parents that focus on how they can support their child's learning at home. These workshops could cover topics such as helping with homework, creating a conducive learning environment, and understanding the curriculum. Flexible Meeting Times: To accommodate parents' schedules, schools should offer flexible meeting times for parent-teacher conferences and other school events. This ensures that all parents, regardless of their work commitments, have the opportunity to be involved in their child's education.

Leveraging Community Support

Community support can play a significant role in enhancing student performance in trigonometry. The following recommendations are proposed:

Building Community Partnerships: Schools should build strong partnerships with community stakeholders, including local businesses, non-profit organizations, and government agencies. These partnerships can provide additional resources, support, and opportunities for students, such as internships, after-school programs, and mentorship.

Utilizing Community Programs: Encourage students to participate in community programs that offer tutoring, enrichment activities, and other educational support. Schools can collaborate with community centers, libraries, and youth organizations to provide students with additional learning opportunities outside of the classroom.

Engaging Community Leaders: Involve community leaders in school initiatives and decision-making processes. Their involvement can help to build trust, foster a sense of ownership, and ensure that the school's efforts are aligned with the needs and values of the community.

Implementing a Holistic Approach to Education

A holistic approach to education that addresses academic, social, and economic factors is essential for supporting student success in trigonometry. The following strategies should be considered:

Integrated Services: Schools should consider integrating health, social, and psychological services into the educational environment. Providing students with access to counseling, healthcare, and social services can help address the non-academic barriers to learning, such as mental health issues, family challenges, and poverty.

Collaborative Teaching: Encourage collaborative teaching practices that involve interdisciplinary teams of educators working together to address the diverse needs of students. This could include co-teaching models, where teachers with different areas of expertise collaborate to provide a more comprehensive educational experience.

Student-Centered Learning: Promote student-centered learning approaches that focus on the individual needs, interests, and strengths of each student. This could involve differentiated instruction, project-based learning, and personalized learning plans that allow students to progress at their own pace.

Suggestion for Further Studies.

While this study has provided valuable insights into the factors influencing students' performance in trigonometry word problems, there are several areas where further research is needed. The following suggestions are proposed for future research:

Conducting longitudinal studies would allow researchers to track the long-term impact of various interventions on student performance in trigonometry. Such studies could examine how changes in teacher quality, resource availability, and parental involvement over time influence student outcomes. Additionally, longitudinal research could provide insights into how students' foundational mathematics skills develop throughout their academic careers and how these skills impact their success in trigonometry.

While this study utilized a quantitative approach, future research could benefit from incorporating qualitative methods to explore the experiences and perspectives of students, teachers, and parents in greater depth. Qualitative research, such as interviews, focus groups, and case studies, could provide a more nuanced understanding of the challenges and successes associated with teaching and learning trigonometry. This approach could also shed light on the specific strategies and practices that are most effective in supporting student performance.

Comparative studies that examine the factors influencing trigonometry performance across different schools, regions, or countries could help identify best practices and effective strategies for improving student outcomes. Such research could explore how differences in curriculum, teacher training, resource allocation, and community support impact student performance in trigonometry. Comparative studies could also provide insights into how cultural, economic, and social factors influence the teaching and learning of trigonometry in diverse contexts.

Given the increasing role of technology in education, future research should investigate the impact of educational technology on trigonometry learning and performance. Studies could explore how tools such as interactive software, online tutorials, and virtual manipulatives can enhance students' understanding of trigonometric concepts. Additionally, research could examine the effectiveness of blended learning models, where technology is integrated with traditional classroom instruction, in improving student outcomes in trigonometry.

Future research could also consider examining additional variables that may influence student performance in trigonometry. These variables could include student motivation, learning styles, classroom environment, and teacher-student relationships. By exploring a broader range of factors, researchers could develop a more comprehensive understanding of the complex dynamics that contribute to success in trigonometry and identify targeted interventions to support diverse learners.

DECLARATION

Students Declaration

I hereby declare that this thesis with exception of the quotations and references contained in published works which have all been identified, and duly acknowledge, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree at this university or elsewhere.

Candidate's Name……. **Signature**
……Date……

Supervisor's Declaration

We hereby declare that the preparation, and presentation of this work was supervised in accordance with the guidance for supervision of thesis as laid down by the Akenten Appiah – Menka University of Skills Training and Entrepreneurial Development, Kumasi.

Principal Supervisor's Name :…….

Signature……Date……

Co- supervisor's Name:…….

Signature……Date……

DEDICATION

This thesis is dedicated to the memory of my beloved mother, Susuana Akosua Mansah, whose love and wisdom continue to inspire me. This work is a testament to the values you instilled in me.

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APPENDIX

Appendix A

Table 3.1

Table for Determining Sample Size of a Known Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

Appendix B

Akenten Appiah-Menkah University of Skills Training and Entrepreneurial Development

Department Of Mathematics Education Questionnaire for Students

Topic: Factors Affecting SHS Students' Performance in Trigonometry Word Problems.

SECTION A (DEMOGRAPHIC DATA)

Kindly provide your information on the spaces below by ticking. [√]

Gender

Male [ ] Female [ ]

Age

15-16 years [ ] 17-18 years [ ] 19-20 years [ ] 21 years and above [ ]

Socioeconomic Status

Low [ ] Middle [ ] High [ ]

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Distance from Home to School:

Less than 1 km [ ] 1-3 km [ ] 4-6 km [ ] More than 6 km [ ]

PRIOR KNOWLEDGE (PK)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your Prior Knowledge (Pk)

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree A).

S/N	Statement	SD	D	N	A	SA
1	I had a strong understanding of algebra before learning trigonometry.					
2	I was comfortable with geometry concepts prior to studying trigonometry.					
3	My previous mathematics courses have adequately prepared me for trigonometry.					
4	I can easily relate algebraic concepts to trigonometry problems.					
5	My foundational knowledge in mathematics helps me solve trigonometry problems.					
6	I understood the basics of trigonometric functions before they were taught in class.					
7	My skills in solving equations were strong before learning trigonometry.					
8	I find it easy to apply geometric principles to trigonometry problems.					
9	My prior knowledge of angles and triangles aids in understanding trigonometry.					
10	I was familiar with the sine, cosine, and tangent functions before learning them in trigonometry.					

SECTION C: TEACHER QUALITY (TQ)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your Teacher Quality (TQ)

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	My trigonometry teacher explains concepts clearly.					
2	My teacher is knowledgeable about trigonometry.					
3	My teacher provides helpful examples when teaching trigonometry.					
4	My teacher is approachable and willing to answer questions about trigonometry.					
5	My teacher uses effective teaching methods for trigonometry.					
6	My teacher's feedback on assignments helps me understand trigonometry better.					
7	My teacher makes trigonometry interesting and engaging.					
8	My teacher encourages us to think critically about trigonometry problems.					
9	My teacher provides sufficient practice problems for trigonometry.					
10	My teacher is well-prepared for each trigonometry class.					

SECTION D: AVAILABILITY OF RESOURCES (R)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your **Availability of Resources (R)**

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	I have access to all necessary textbooks for studying trigonometry.					
2	I have access to online resources that help me understand trigonometry.					
3	I can use a graphing calculator for trigonometry problems.					
4	I have access to supplementary learning materials for trigonometry.					
5	I have enough time in the computer lab to use educational software for trigonometry.					
6	The school provides adequate resources for learning trigonometry.					
7	I can easily find additional practice problems for trigonometry online.					
8	I have access to tutoring services for trigonometry.					
9	The library has a good selection of trigonometry resources.					
10	I have access to educational videos that explain trigonometry concepts.					

SECTION E: COMMUNITY SUPPORT (CS)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your **Community Support (CS)**

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	My community values education and encourages students to perform well in school.					
2	Community leaders in my area support educational programs and activities.					
3	There are local study groups or tutoring sessions organized by the community.					
4	The community provides safe and quiet places for students to study.					
5	My community offers scholarships or financial aid for students who excel academically.					
6	Local businesses and organizations support schools by providing resources and materials.					
7	Community members volunteer their time to help students with their studies.					
8	The community organizes events and activities that promote education and learning.					
9	My community has access to libraries or resource centers that support students' learning.					
10	There is a strong sense of collaboration between the community and the school to support student success.					

SECTION F: SOCIOECONOMIC STATUS (SES)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your **Socioeconomic Status (SES)**

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	My family's financial situation allows me to focus on my studies.					
2	I have a quiet place at home to study trigonometry.					
3	I have access to a computer and internet at home for trigonometry study.					
4	My family can afford all necessary school supplies for trigonometry.					
5	I do not have to work part-time to support my family, allowing more time for study.					
6	My socioeconomic status does not negatively affect my academic performance.					

7	I have access to additional educational support, such as private tutoring.					
8	My family's socioeconomic status allows me to attend extra classes for trigonometry.					
9	I have access to educational materials outside of school.					
10	1My family's socioeconomic status provides stability that supports my learning.					

SECTION G: PARENTAL INVOLVEMENT (PI)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your **Parental Involvement (PI)**

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	My parents regularly ask about my progress in trigonometry.					
2	My parents help me with trigonometry homework when needed.					
3	My parents provide additional learning materials for trigonometry.					
4	My parents encourage me to do well in trigonometry.					
5	My parents attend parent-teacher meetings to discuss my progress in mathematics.					
6	My parents set aside time for me to study trigonometry at home.					
7	My parents praise my efforts in learning trigonometry.					
8	My parents monitor my performance in trigonometry tests.					
9	My parents ensure I have a good study environment for trigonometry.					
10	My parents motivate me to seek help when I struggle with trigonometry.					

SECTION H: PERFORMANCE IN TRIGONOMERTY WORD PROBLEMS (PITWP)

Instruction: Please indicate your level of agreement by ticking [√] the statements that relate to your **PERFORMANCE IN TRIGONOMERTY WORD PROBLEMS (PITWP)**

Key: Strongly Disagree (SD), Disagree (D), Agree (A), Neutral (N) and Strongly Agree (SA)

S/N	Statement	SD	D	N	A	SA
1	I understand basic trigonometric functions (sine, cosine, tangent), which helps me solve trigonometry word problems.					
2	Knowing the relationships between the sides and angles of a right-angled					
3	Using trigonometric identities (e.g., Pythagorean identity) helps me perform better in trigonometry word problems.					
4	My ability to solve real-world application problems (e.g., calculating heights and distances) enhances my performance in trigonometry word problems.					
5	Frequent practice of trigonometry word problems improves my performance in exams and assignments.					
6	Using supplementary materials (e.g., textbooks, online resources) enhances my ability to solve trigonometry word problems.					
7	Seeking help from my teacher when I encounter difficulties improves my performance in trigonometry word problems					
8	The availability of adequate resources at school (e.g., textbooks,					
9	I am confident in my ability to solve trigonometry word problems.					
10	My positive attitude towards learning trigonometry contributes to my success in solving trigonometry word problems.					

End of questionnaires