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COMPARING THE EFFECTIVENESS OF TEACHING MATHEMATICS IN ENGLISH AND MOTHER TONGUE: THE CASE OF FORM THREE STUDENTS IN NUNGUA SENIOR HIGH SCHOOL.

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ABSTRACT

This study investigates the effectiveness of teaching mathematics in English versus the mother tongue among Form Three students at Nungua Senior High School. The research aims to compare the impact of these two instructional languages on students' comprehension, engagement, and overall academic performance in mathematics. The study employs an interpretative philosophy within a qualitative research paradigm, utilizing interviews, observations, and focus group discussions to gather rich, context-specific data. The findings reveal that teaching mathematics in the mother tongue enhances students' understanding and engagement by connecting mathematical concepts to their cultural and everyday experiences. Conversely, teaching in English, while facilitating global communication skills, presents language barriers that impede comprehension and participation for non-native speakers. This research highlights the importance of incorporating students' linguistic and cultural backgrounds into educational practices to promote effective learning and recommends a balanced approach to language instruction that considers both local and global needs. The study's implications extend to policymakers, educators, and researchers, advocating for the integration of mother tongue instruction to improve mathematics education outcomes.

INTRODUCTION

1.0 Introduction

This chapter of the study presents the background of the study, the problem statement, the research objectives and the research questions, the significance of the study as well as the limitation and the delimitation of the study.

1.1 Background of the study

Globally, education systems face the complex challenge of selecting the most appropriate language for teaching various subjects, including mathematics. In many countries, English has been adopted as the primary language of instruction due to historical, colonial, or

economic factors (Johnson, 2016). However, the choice of instructional language carries significant consequences for learning outcomes, particularly in subjects that require abstract reasoning and conceptual understanding, such as mathematics. Johnson (2016) highlights that using students' mother tongue languages enhances comprehension and engagement, especially during the early stages of education, facilitating a stronger foundation in mathematical concepts.

In many nations, the historical and colonial influence of English has shaped its continued use in education. Countries previously colonized by English-speaking powers, such as the United Kingdom or the United States, often retain English as the medium of

instruction. Beyond history, English's global dominance in business, technology, and media reinforces its prominence, as countries view proficiency in English as essential for economic success and global competitiveness (Johnson, 2016). Nevertheless, while English offers international opportunities, its use as the medium of instruction in mathematics can pose challenges for learners who are not fluent, limiting their ability to grasp abstract concepts and problem-solving strategies (Johnson, 2016).

Mathematics relies heavily on precise terminology, abstract reasoning, and conceptual understanding. When students are taught in a language unfamiliar to them, their capacity to comprehend key concepts is hindered, which in turn affects performance (Johnson, 2016). Johnson's research across multiple countries demonstrates that teaching mathematics in students' native languages fosters deeper understanding and engagement. Particularly in early education, where language skills are still developing, instruction in the mother tongue allows students to connect new mathematical concepts to their existing cognitive and linguistic knowledge, making learning more meaningful and effective.

Mother tongue instruction also promotes cultural identity and belonging. Using students' native languages validates their heritage and linguistic diversity, creating a supportive and positive learning environment (Johnson, 2016). This sense of inclusion can boost motivation, confidence, and overall academic achievement. The connection between language, cognition, and culture enables learners to internalize abstract mathematical concepts more efficiently, applying them to real-life situations while strengthening their critical thinking skills (Johnson, 2016).

The African context presents a particular challenge due to its linguistic diversity. Many countries, including Ghana, inherited European languages such as English, French, or Portuguese as mediums of instruction during the colonial period. While these languages facilitate global communication, they can create barriers for learners, particularly in mathematics, where conceptual clarity is essential (Muthwii & Gichuru, 2019). Research indicates that using mother tongue instruction in mathematics improves understanding and academic performance, as students can relate mathematical ideas to familiar experiences and cultural contexts (Muthwii & Gichuru, 2019).

Ghana exemplifies the tension between promoting English as the official language and preserving mother tongue instruction. Language-in-education policies have encouraged mother tongue use in early years, followed by a gradual transition to English (Amenuvor, 2017; Osei-Poku et al., 2021). Studies in Ghana demonstrate that students taught mathematics in their native languages show higher engagement, better comprehension, and improved problem-solving abilities. Mother tongue instruction allows learners to express ideas freely, ask questions, and collaborate effectively, thereby enhancing their overall mathematical understanding (Amenuvor, 2017). Similarly, Osei-Poku et al. (2021) found that students instructed in their mother tongue outperformed peers taught exclusively in English, highlighting the pedagogical and cognitive benefits of this approach.

Given these insights, the current study seeks to compare the effectiveness of teaching mathematics in English versus mother tongue, focusing on Form Three students at Nungua Senior High School.

1.2 Problem statement

The language of instruction in mathematics has been a subject of

extensive research, sparking debates between proponents of teaching in English and those advocating for mother tongue languages. Studies by Leder & Forgasz (2002) and Setati et al. (2002) have highlighted the benefits of mother tongue instruction, emphasizing enhanced conceptual understanding, cultural relevance, and identity formation. Teaching mathematics in the mother tongue allows students to connect more deeply with mathematical concepts, drawing upon familiar language patterns and cultural references for a richer understanding.

In the South African context, Setati et al. (2002) found that students taught mathematics in their mother tongue languages outperformed those taught solely in English, attributing this improvement to clearer communication, reduced language barriers, and increased engagement. In Ghana, where English is the official language, Aikins' (2018) research suggested that mother tongue instruction in mathematics led to higher levels of engagement, improved comprehension, and enhanced academic performance.

However, the dominance of English in Ghana's educational settings, inherited from the colonial era, raises questions about the effectiveness of teaching mathematics in English versus mother tongue languages. Ghana's linguistic diversity, with over 80 indigenous languages, adds complexity to this issue. The lack of empirical evidence and in-depth analysis of language choice implications specifically at Nungua SHS, Ghana, calls for further research to explore the specific challenges, benefits, and outcomes of each approach within the Ghanaian educational context.

1.3 Purpose Of the Study

The purpose of this study was to investigate and compare the effectiveness of teaching mathematics in English and mother tongue languages among form three students at Nungua Senior High School (SHS).

1.4 Research objectives

1. To Identify challenges related to teaching mathematics in English and the mother tongue at Nungua SHS.
2. To examine the Perceptions and Attitudes of students/teachers towards teaching mathematics in English and their mother tongue at Nungua SHS.
3. To Assess the difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS

1.5 Research Question

1. What are the challenges associated with teaching mathematics in English and mother tongue at Nungua SHS?
2. What is the Perceptions and Attitudes of students/teachers towards teaching mathematics in English and their mother tongue at Nungua SHS.
3. What is the difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS?

1.6 Significance of study

This study is important for students, teachers, policymakers, and researchers in mathematics education. For students, it explores how teaching mathematics in English and mother tongue languages can enhance learning, comprehension, and engagement. Teachers gain evidence-based guidance to tailor instructional strategies to students' language abilities, improving classroom outcomes. Policymakers can use the findings to inform language-in-education policies,

promoting culturally responsive and effective mathematics instruction. Additionally, researchers benefit from the study's contribution to Ghana-specific literature, expanding understanding of how language impacts learning and providing a reference for future studies on the role of language in shaping mathematics education outcomes.

1.7 Delimitations of the study

The study focuses specifically on Form Three students at Nungua Senior High School. By limiting the study to this grade level, it aims to explore the effectiveness of teaching mathematics in English and mother tongue within a specific context, considering the students' age and academic progression.

The study compares the effectiveness of teaching mathematics in English and mother tongue languages. It specifically examines how these two language mediums impact students' comprehension, engagement, and performance in mathematics at Nungua Senior High School.

1.8 Limitations of the study

Sample Size: Due to practical constraints, the study may have a limited sample size. This could potentially affect the generalizability of the findings to a larger population. However, efforts will be made to ensure that the sample is representative of the target population at Nungua Senior High School.

Time Constraints: The study's timeframe may be limited, which could affect the depth and breadth of data collected. It is important to acknowledge that gathering comprehensive data on students' performance and perceptions requires sufficient time. Researchers will make efforts to utilize the available time effectively and gather meaningful insights within the given constraints.

1.9 Definition of Terms

Teaching Mathematics in English: Refers to the instructional approach in which mathematics is taught using the English language as the medium of instruction.

Teaching Mathematics in Mother Tongue: Refers to the instructional approach in which mathematics is taught using students' native or mother tongue languages as the medium of instruction.

1.1.0 Organization of the thesis

The research was organized into five chapters. Chapter One introduced the study, providing background, significance, research objectives, questions, scope, limitations, and an overview of the structure. Chapter Two reviewed relevant literature, identified existing knowledge, theories, and gaps, and established a theoretical framework. Chapter Three detailed the methodology, including research design, sampling, data sources, collection methods, and analysis techniques. Chapter Four presented and interpreted findings, linking results to objectives and literature. Chapter Five summarized the study, answered research questions, offered recommendations, and highlighted the significance and implications of the research for practice and future studies.

LITERATURE REVIEW

2.0 Introduction

This chapter of the study reviews the literature in line with the research themes. The literature review is done in three major themes such as the theoretical review, the conceptual review and the

empirical review.

2.1 Theoretical framework

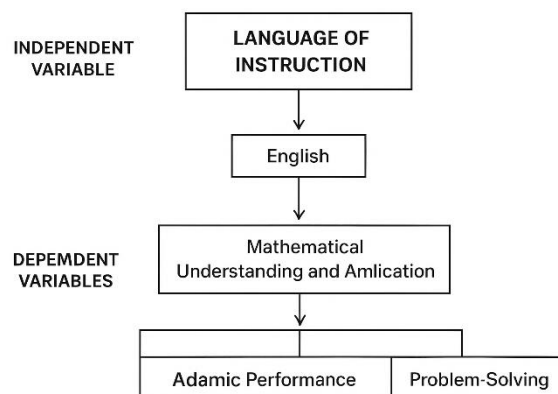
2.1.1 Theory of Language in Education

The Theory of Language in Education provided a suitable framework for this study, as it explains the role of language in education and its impact on teaching and learning. This theory emphasizes that language is not merely a means of communication but also a key factor in cognitive development and academic achievement. Language shapes how knowledge is conveyed, influencing students' comprehension, engagement, and overall learning experience. Previous studies, including Smith (2010) and Johnson et al. (2015), applied this theory to examine the effects of language of instruction on academic outcomes, including mathematics.

In this study, the theory justified exploring mathematics instruction in English versus mother tongue. It highlights that effective learning occurs when instruction aligns with students' linguistic abilities and cultural backgrounds. By employing qualitative methods, the study captured learners' perceptions and experiences, providing nuanced insights into how language affects understanding and performance. Recognizing the cultural and linguistic diversity of students at Nungua Senior High School, the study examined the potential benefits of mother tongue instruction, consistent with findings by Chen (2013) and Osei-Tutu et al. (2018).

2.2 Conceptual framework

The conceptual framework of this study positions the language of instruction as the independent variable, with English and mother tongue as its two options. This variable significantly influences students' outcomes in mathematics, which serve as the dependent variables, including cognitive development, mathematical understanding and application, problem-solving skills, and overall academic performance. Cognitive development is central to mathematics learning, encompassing critical thinking, logical reasoning, and mental processes that enable problem-solving (Piaget, 1952). Through engagement with concepts, procedures, and strategies, students construct knowledge, strengthen reasoning abilities, and develop a deeper understanding of mathematical principles (NCTM, 2000).



Mathematical understanding and application reflect students' ability to comprehend concepts, identify patterns, make generalizations, and connect mathematics to real-world contexts (Hiebert & Grouws, 2007). Effective instruction encourages exploration, use of multiple representations, and engagement in problem-solving tasks, enhancing students' capacity to transfer knowledge and justify reasoning in practical contexts (Schoenfeld, 1992). Developing mathematical language and communication skills further strengthens

comprehension and application, allowing students to articulate ideas clearly (National Research Council, 2001).

Problem-solving skills involve analyzing problems, devising strategies, applying concepts, and evaluating solutions (Polya, 1957). Students must break down complex problems, recognize relevant information, and select appropriate strategies such as modeling, diagrams, or trial-and-error approaches. Authentic and contextual problem-solving tasks foster critical thinking, creativity, and collaboration, while feedback enhances skill development (Silver, 1997).

Academic performance reflects overall competence, incorporating understanding, application, problem-solving, and mathematical reasoning (NCTM, 2000). Assessments measure knowledge mastery, procedural fluency, and the ability to apply concepts to new situations. High proficiency demonstrates flexible, creative thinking and effective communication of solutions, whereas gaps in language proficiency may impede learning outcomes.

Research has consistently shown that the language of instruction affects these dependent variables. Cummins (1984) and Collier (1987) observed that students taught in a language they understand demonstrate stronger cognitive development and academic achievement. Barwell (2009) reported that instruction in the mother tongue improves comprehension and application of mathematical concepts. Similarly, Anstrom et al. (2010) found that native-language instruction enhances problem-solving skills by facilitating accurate interpretation of problems and symbols. Arias, Gillingham, and Cuasquer (2016) demonstrated that students achieve higher academic performance when taught in their mother tongue due to greater understanding and confidence in expressing ideas.

2.3 Empirical Framework

2.3.1 Comparing the Effectiveness of Teaching Mathematics in English and Mother Tongue

The choice of language as the medium of instruction in mathematics has long been debated in educational contexts. Advocates for mother tongue instruction argue that it provides students with a solid foundation for understanding abstract mathematical concepts. Graven (2017) notes that teaching in the mother tongue allows learners to engage deeply with content, focus on conceptual understanding, and overcome language barriers. Setati, Adler, Reed, and Bapoo (2002) conducted research in multilingual South African classrooms, comparing students taught mathematics in their home languages—such as Zulu, Sotho, and Xhosa—with those taught in English. The study found that mother tongue instruction enhanced students' conceptual understanding, engagement, and academic performance, as learners could connect mathematical ideas to their real-life experiences.

Similarly, Baker (2011) highlights the cognitive, academic, and cultural benefits of mother tongue instruction, emphasizing that it allows students to focus on content rather than language comprehension. García and Wei (2014) further underscore that incorporating the mother tongue enables students to link prior knowledge and experiences to new mathematical concepts, improving comprehension and engagement. Research in South Africa by Murphy (2016) and Adams and Engelbrecht (2018) confirmed that students taught in their native language performed better, participated actively, and related abstract concepts to their cultural and linguistic contexts, fostering inclusivity and validating their identities.

Conversely, proponents of English as the medium of instruction,

such as Abdullahi and Balogun (2019), argue that it prepares students for global communication, higher education, and professional opportunities. English proficiency allows access to a broader range of resources, including textbooks, research, and digital materials, while facilitating participation in international academic and professional environments. They recommend a balanced approach that incorporates both mother tongue and English to address local learning needs while preparing students for global contexts.

The effectiveness of either approach depends on multiple factors, including teacher proficiency, availability of teaching resources, and the specific educational context (Graven, 2017). Teachers skilled in delivering instruction in either language can enhance comprehension and student engagement, while culturally relevant resources support meaningful learning. In African contexts, the linguistic diversity of students presents a challenge, as colonial languages often dominate instruction, limiting understanding of mathematical concepts. Research indicates that students perform better when taught in a familiar language, as it strengthens cognitive development, problem-solving skills, and conceptual understanding (Murphy, 2016; Asare & Ngang, 2019).

In Ghana, where English is the official medium of instruction, the use of mother tongue in mathematics has demonstrated benefits in comprehension, confidence, and performance (Asmah, 2017). Students taught in local languages can connect mathematics to everyday experiences, engage actively, and develop positive attitudes toward learning (Owusu-Afriyie & Owusu-Agyeman, 2018). Implementing mother tongue instruction requires careful planning, including teacher training and provision of appropriate resources. Overall, the debate underscores the importance of a balanced, context-sensitive approach that values both linguistic diversity and global competency, ensuring effective mathematics learning.

2.3.2 The Perceptions and Attitudes of Students Towards Learning Mathematics in English and Mother Tongue.

The choice of language as the medium of instruction in mathematics has generated extensive discussion, particularly in multilingual countries such as Ghana, where English dominates education. Students' perceptions and attitudes towards learning mathematics in English versus their mother tongue significantly influence engagement, comprehension, and performance. Research suggests that learners often find their mother tongue more familiar and relevant, connecting mathematical concepts to their everyday experiences, which enhances interest and motivation (Bishop, 1999). Conversely, students recognize that English, as a global language, provides access to higher education, international communication, and professional opportunities, prompting some to prioritize learning mathematics in English (Mutonyi, 2017).

Language profoundly affects students' comprehension of mathematical concepts. Teaching in the mother tongue can provide a strong foundation for understanding abstract ideas, fostering confidence and competence in problem-solving (Adams & Engelbrecht, 2018; Adegoke & Asare, 2018). Mother tongue instruction allows students to relate mathematical ideas to their cultural experiences, facilitating deeper understanding and practical application (Owusu-Afriyie & Owusu-Agyeman, 2018). In contrast, learning in English may create barriers when students struggle with terminology or word problems, negatively affecting confidence and engagement (Owusu-Afriyie & Owusu-Agyeman, 2018).

Moreover, mother tongue instruction reinforces cultural identity and

belonging, allowing students to see their linguistic and cultural perspectives reflected in the curriculum (Asmah, 2017; Bishop, 1999). It promotes inclusive learning, validates students' heritage, and fosters pride in their cultural identity. Language alignment with students' cognitive abilities supports critical thinking, problem-solving, and application of mathematical knowledge in real-life contexts (Adams & Engelbrecht, 2018). Being able to express ideas confidently in the mother tongue reduces fear of errors and enhances participation, contributing to positive attitudes towards mathematics (Mutonyi, 2017).

Students' perceptions of difficulty also affect attitudes towards mathematics. When taught in a non-native language like English, some learners perceive mathematics as harder, leading to frustration and reduced motivation (Oluwafunmilayo & Jekayinfa, 2019). In contrast, instruction in the mother tongue often feels more accessible and manageable, fostering confidence, engagement, and positive attitudes toward the subject. Perceptions of ease or difficulty are influenced by language proficiency, prior experience, and exposure to mathematics instruction in different languages (Mutonyi, 2017).

To maximize learning outcomes, educational systems must consider students' linguistic backgrounds, perceptions, and the availability of resources. Teacher training, culturally relevant instructional materials, and inclusive policies are essential for successful implementation of mother tongue instruction (Owusu-Afriyie & Owusu-Agyeman, 2018). A balanced approach that incorporates mother tongue instruction while developing English proficiency can address both local and global needs, fostering comprehension, engagement, and positive attitudes towards mathematics. Overall, acknowledging and integrating students' linguistic and cultural contexts is critical for enhancing learning experiences, promoting confidence, and improving academic performance in mathematics.

2.3.3 The Comprehension Levels of Students in Mathematics Classes Taught in English and their Mother Tongue.

Students' comprehension of mathematics can be significantly influenced by the language of instruction, whether English or their mother tongue. In multilingual contexts such as Ghana, English is the dominant medium of instruction and offers certain advantages for students with strong proficiency. Proficiency in English allows students to access a wide range of textbooks, online resources, and international academic materials, enhancing their understanding of mathematical concepts and exposing them to diverse problem-solving approaches (Bishop, 1999; Hill, 2004). English fluency also facilitates participation in global academic discussions and improves higher education and employment prospects (Mutonyi, 2017).

However, the benefits of English instruction are not universal. Students with limited English proficiency often struggle to grasp mathematical concepts, leading to reduced engagement, confidence, and performance (Owusu-Afriyie & Owusu-Agyeman, 2018). Language barriers can make comprehension challenging, especially when navigating complex terminology or word problems. Educational systems must therefore provide targeted support for learners who face these challenges, including scaffolding strategies and language-focused interventions.

Using the mother tongue as the medium of instruction has been shown to enhance students' comprehension and engagement. Learning mathematics in a familiar language allows students to connect abstract concepts to real-life experiences, cultural contexts, and everyday activities, promoting deeper understanding and critical thinking (Adams & Engelbrecht, 2018; Owusu-Afriyie & Owusu-Agyeman, 2018). Expressing mathematical reasoning in the mother

tongue also strengthens communication skills, facilitates clarification of ideas, and builds confidence in problem-solving. Moreover, mother tongue instruction helps students see their cultural and linguistic backgrounds reflected in the curriculum, fostering a sense of belonging and relevance that positively impacts attitudes toward mathematics.

Research indicates that students taught mathematics in their mother tongue often achieve higher academic performance compared to those taught in a second or foreign language (Murphy, 2016; Oluwafunmilayo & Jekayinfa, 2019). Yet, the effectiveness of mother tongue instruction depends on factors such as teacher proficiency and availability of appropriate teaching materials (Graven, 2017). Skilled teachers and quality resources are essential to scaffold learning, provide clear explanations, and offer varied representations of mathematical concepts to support comprehension.

2.3.4 The Challenges and Opportunities Associated with Teaching Mathematics in English and Mother Tongue.

Teaching mathematics in either English or the mother tongue presents both challenges and opportunities that affect students' learning outcomes. Teaching in English can be advantageous for students who are proficient, as it provides access to global resources, textbooks, and academic discourse, and facilitates participation in international academic and professional contexts (Bishop, 1999; Hill, 2004). English instruction can also enhance students' career prospects and engagement with broader mathematical communities (Mutonyi, 2017). However, for students with limited English proficiency, learning mathematics in a second language poses significant challenges. They may struggle to understand specialized terminology, word problems, and abstract concepts, which can hinder comprehension, reduce confidence, and limit classroom participation (Owusu-Afriyie & Owusu-Agyeman, 2018; Murphy, 2016). Limited language skills can create barriers to effective communication, impacting students' engagement and overall learning experience.

In contrast, teaching mathematics in the mother tongue offers substantial benefits. Students can connect mathematical concepts to their real-life experiences, cultural contexts, and daily activities, leading to deeper understanding and improved problem-solving skills (Adams & Engelbrecht, 2018; Owusu-Afriyie & Owusu-Agyeman, 2018). Using the mother tongue facilitates clearer communication, allowing students to articulate their reasoning, ask questions confidently, and engage in meaningful classroom discussions. This approach enhances conceptual understanding, critical thinking, and analytical skills, while also promoting students' motivation and self-confidence. Mother tongue instruction strengthens cultural identity, affirms linguistic heritage, and fosters a sense of belonging, making mathematics more relevant and relatable (Asmah, 2017; Benson, 2016). Additionally, research shows that students taught mathematics in their mother tongue often perform better academically, demonstrating higher retention, engagement, and achievement levels (Adams & Engelbrecht, 2018; Murphy, 2016).

Despite these advantages, teaching in the mother tongue presents challenges, including limited availability of teaching resources and the need for teachers proficient in both mathematics and the local language (Graven, 2017; Benson, 2016). To address this, educational systems can adopt bilingual approaches that combine mother tongue instruction with the development of proficiency in English or other global languages. Such approaches ensure that students benefit from enhanced comprehension and cultural

relevance while gaining skills needed for broader academic and professional opportunities (García & Wei, 2014).

In summary, language of instruction significantly shapes students' comprehension, engagement, and performance in mathematics. While English offers global access and career opportunities, the mother tongue provides familiarity, cultural relevance, and deeper conceptual understanding. Effective mathematics education requires balancing these advantages through well-resourced, culturally responsive, and linguistically inclusive teaching strategies.

2.4 Summary of literature

The Theory of Language in Education highlights the critical role of language in teaching, learning, and cognitive development (Smith, 2010; Johnson et al., 2015). In mathematics instruction, the choice of language—English or mother tongue—affects students' comprehension, problem-solving skills, engagement, and academic performance. The conceptual framework positions Language of Instruction as the independent variable, influencing outcomes such as Mathematical Understanding, Cognitive Development, and Application. Research indicates that teaching in the mother tongue enhances understanding and engagement (Adams & Engelbrecht, 2018; Graven, 2017), while English instruction prepares students for global communication and integration (Abdullahi & Balogun, 2019; Oluwafunmilayo & Jekayinfa, 2019).

METHODOLOGY

3.0 Introduction

This chapter of the study is based on the methodology of the study. It specifies the research paradigm, the research design, the target population, the sample size and techniques methods and tools for data collection amongst others.

3.1 The research Paradigm

Interpretative philosophy, closely associated with qualitative research, focuses on understanding and interpreting human experiences and social phenomena within their specific contexts (Denzin & Lincoln, 2018). Applied to the research on mathematics instruction, this philosophy provides a framework for examining how teaching in English versus the mother tongue affects learning at Nungua Senior High School. A key principle is contextual understanding, requiring attention to the school's socio-cultural environment, linguistic diversity, and educational practices (Smith, 2015). By considering these factors, the research can reveal the dynamics influencing students' engagement and comprehension.

Another core aspect is exploring the meanings and perceptions of participants, including teachers, students, and parents (Creswell & Creswell, 2017). Gathering their subjective views allows the study to uncover the significance attached to language choices in mathematics instruction. Qualitative methods such as interviews facilitate the collection of rich, context-specific data (Merriam, 2009), enabling a nuanced understanding of teaching and learning experiences.

Finally, interpretative philosophy emphasizes holistic, contextualized analysis rather than purely quantitative evaluation (Denzin & Lincoln, 2018). By examining cultural, linguistic, and educational factors, the research can provide a comprehensive perspective on how language of instruction shapes comprehension, engagement, and overall effectiveness in mathematics education at Nungua Senior High School.

3.2 Research Approach

Qualitative research is a methodological approach that emphasizes understanding and interpreting social phenomena within their natural contexts (Creswell & Poth, 2017). For this study, it was particularly suitable because it allows an in-depth exploration of teaching mathematics in English and the mother tongue at Nungua Senior High School. This approach facilitates a holistic understanding of the experiences, perceptions, and meanings associated with language choices in mathematics instruction.

By focusing on contextual factors, qualitative research uncovers the socio-cultural, linguistic, and educational dynamics influencing students' learning experiences (Denzin & Lincoln, 2018). Immersion in the school environment enables researchers to examine how language impacts comprehension, engagement, and overall learning outcomes. Data collection methods such as interviews, focus groups, and observations allow direct engagement with teachers, students, and stakeholders, ensuring that insights are contextually relevant and reflective of lived experiences (Merriam, 2009).

Additionally, qualitative research captures subjective experiences and diverse perspectives, highlighting how individuals interpret the effectiveness of mathematics instruction in different languages (Creswell & Creswell, 2017). It generates "thick descriptions," providing rich, detailed accounts of teaching and learning processes (Geertz, 1973). These comprehensive narratives illuminate the complexities of mathematics education at Nungua Senior High School, offering a nuanced understanding of how language choices shape instructional practices, student engagement, and academic outcomes.

3.3 Research design

The study adopted a case study design, a qualitative approach that enables an in-depth examination of a specific instance within its real-life context (Yin, 2018). This approach was appropriate for exploring the teaching of mathematics to Form Three students at Nungua Senior High School, particularly in comparing instruction in English and the mother tongue. The case study design provides a holistic understanding of classroom dynamics, capturing social, cultural, and linguistic factors that influence learning (Baxter & Jack, 2008). Using interviews, observations, and analysis of educational materials, the study collected rich, context-specific data on teaching practices and student outcomes. The design's flexibility allowed adaptation of methods to suit the unique characteristics of each language medium. A longitudinal perspective further enabled the exploration of long-term effects of language choice on mathematical proficiency. Triangulation of multiple data sources enhanced reliability and validity, ensuring robust comparative insights. Overall, the case study design facilitated a nuanced understanding of language impact on mathematics learning and informed educational practice and policy.

3.4 The target population.

The suitable target population for the research topic "Teaching Mathematics in English vs. Mother Tongue: A Study in Nungua SHS" would be the form three students in Nungua Senior High School (SHS) who are studying mathematics as well as the mathematics teachers in the school. In light of the field survey on all the mathematics students, the total sum of all the mathematics students in form three amounted to 147 students.

3.5 Sample size

The sample size for the study was decided by the principle of

saturation. The principle of saturation is a qualitative research concept that suggests data collection should continue until no new or significant information emerges, indicating that theoretical saturation has been achieved (Guest, Bunce, & Johnson, 2006). In the context of the study, this means that continue gathered from form three students and mathematics teachers until you reach a point where additional interviews or data no longer yield fresh insights or perspectives. The choice to use the principle of saturation as a determinant for the sample size aligns with the qualitative nature of this study. In light of this the total sample size for the study was 13 respondents.

3.6 Sampling Techniques

Convenient sampling was targeted towards the students of the study. Convenient sampling involves selecting participants who are readily available and accessible. In this case, using convenient sampling for the students was practical, since the students could be contacted with ease. Purposive sampling, on the other hand, was also targeted towards the math teachers of the school. Purposive sampling is appropriate for selecting participants based on specific criteria that align with your research objectives. In this case, using purposive sampling for mathematics teachers allowed the researcher to select teachers with experience in teaching mathematics in both English and the mother tongue.

3.7 Data Collection Instrument

The study collected primary data through interviews to examine the effectiveness of teaching Mathematics in English and the mother tongue at Nungua Senior High School. Using a semi-structured interview guide, the researchers explored participants' attitudes, challenges, and preferences regarding the language of instruction. The guide included pre-determined questions covering key research objectives while incorporating open-ended questions to allow participants to freely express their opinions and experiences. This flexible approach enabled participants to elaborate on specific issues, provide personal examples, and offer insights beyond structured responses. As a result, the interviews generated rich, detailed, and nuanced data central to understanding participants' perspectives.

3.8 Pilot Study

A small-scale pilot study was conducted at Nungua, O'Reilly, and Chemu Senior High Schools in the Ledzokuku municipality. The researcher, who also taught mathematics, obtained permission from school authorities and engaged fellow teachers to facilitate data collection. Teachers were cooperative after understanding the study's potential impact on students' mathematics performance. Coordination with colleagues ensured smooth execution and discussion of practical data collection methods. The pilot highlighted logistical considerations, including costs for teacher participation and time for explaining questionnaires to participants. Importantly, it provided guidance on adhering to research ethics, clarified practical challenges, and refined procedures for the main study.

3.9 Trustworthiness

3.9.1Credibility: Establishing Accurate and Authentic Data

In the pursuit of credible findings, a multifaceted approach is employed. The concept of triangulation is pivotal, encompassing the collection of data from diverse sources such as interviews, observations, and potentially surveys. This multiplicity of data sources enhances the depth and breadth of understanding the phenomenon under study. Moreover, prolonged engagement within

the school environment facilitates the development of rapport and a profound comprehension of the context. The process of member checking, where participants validate interpretations, contributes to the accuracy of findings, bolstering credibility. Additionally, peer debriefing sessions are incorporated into the research process, allowing colleagues to critically assess and offer diverse perspectives on the research approach and findings, further enhancing the credibility of the study.

3.9.2Transferability: Extending Insights to Similar Contexts

Transferability is a crucial aspect when considering the applicability of findings to similar educational contexts. Thick description plays a pivotal role, enabling researchers to vividly portray the research setting, the characteristics of participating students, and the methodologies employed. This level of detail aids in facilitating the adaptation of findings to other settings. Purposeful sampling is a strategic technique used to ensure a diverse range of participants, thus increasing the transferability of the research outcomes. Moreover, contextualization is emphasized, elucidating how the findings drawn from Nungua Senior High School can be relevant and valuable in other educational environments, further enhancing the transferability of insights.

3.9.3Dependability: Consistency and Reliability of Outcomes

Dependability, synonymous with consistency and reliability, is maintained through rigorous practices. An audit trail, meticulously documenting all research decisions, alterations, and rationales, serves as a transparent roadmap of the research journey. Reflexivity plays a crucial role in acknowledging and addressing researchers' biases and preconceptions, contributing to the dependability of the findings. Furthermore, the inclusion of peer reviewers in the research process aids in identifying and rectifying any latent biases, thereby upholding the dependability of the research outcomes.

3.9.4Confirmability: Ensuring Objectivity and Rigor

Confirmability, synonymous with objectivity and rigor, is achieved through methodical approaches. The researchers strive for data saturation, indicating that data collection continues until no new insights emerge. Systematic coding processes, involving multiple coders, contribute to the consistency and rigor of findings. Additionally, negative case analysis is employed, examining data that contradicts initial patterns or hypotheses. This practice reinforces the confirmability of conclusions drawn from the research.

3.9.5Authenticity: Honesty and Transparency

Authenticity is upheld through transparency and self-reflection. Researchers maintain a reflexive journal, capturing personal reflections and emotions throughout the research process. Bracketing personal biases, recognizing them and setting them aside, is vital to ensure the authenticity of the analysis. Transparent reporting, encompassing the research process, methodologies employed, and potential limitations, is paramount to representing the research authentically.

3.10 Method of data analysis

The qualitative data obtained from the interviews was processed using digital recorders, aiming to facilitate data analysis. To achieve this, the data was first categorized into themes, enabling systematic comparisons between them to establish similarities and commonalities. In line with Riessman's (2008) recommendation, this categorization made it easier to analyze the data.

To validate the themes, the audio recordings were listened to several times and compared with the visual transcripts to ensure consistency. This process of validation was crucial in ensuring the reliability and validity of the findings. Once the themes were validated, the analysis took on a narrative form, as this was deemed appropriate for the study.

In conclusion, the use of qualitative data analysis techniques enabled the researcher to categorize the data into themes and validate them before analyzing them in narrative form. This approach was deemed appropriate for the study, as it allowed the voices of the participants to be captured accurately, thereby enhancing the reliability and validity of the findings.

RESULTS AND DISCUSSION

4.0 Introduction

This chapter of the study presents results and discusses the findings from the field of the study. The presentation and the findings are based on themes in line with the research objectives. These themes are the challenges related to teaching mathematics in English and the mother tongue at Nungua SHS, the Perceptions and Attitudes of students/teachers towards teaching mathematics in English and their mother tongue at Nungua SHS as well as the difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS.

4.1 Demographic data of respondents

The study involved 13 respondents, including four teachers and nine students, with nearly equal gender representation (seven males, six females), ensuring diverse perspectives. Age distribution varied: two were 15–17, four each in 18–20 and 24+, and three in 21–23, providing insights across age groups. Respondents pursued different courses, including General Arts, Business, Visual Arts, and Home Economics, reflecting multidisciplinary interests. Linguistic diversity was notable, with English, Twi, Ga, Ewe, and other languages represented. English proficiency varied: four very proficient, four proficient, three intermediate, and one basic, offering a balanced view of language abilities relevant to the study.

4.2 The challenges related to teaching mathematics in English and the mother tongue at Nungua SHS.

This section of the study presents data on the challenges related to teaching mathematics in English and the mother tongue at Nungua SHS. The data presented in this section was collected from mathematics teachers of the school. In addition to that, this section captures themes such as Language-Related Challenges, Benefits of Bilingual Instruction as well as Cultural and Identity Implications.

4.2.1 Challenges of Teaching Mathematics in English and the Mother Tongue

Teachers at Nungua SHS identified comprehension difficulties as the main challenge in teaching mathematics in English and the mother tongue. One teacher explained, *“When teaching mathematics in English, one of the challenges I encounter is students understanding complex mathematical concepts, especially in advanced topics like calculus and abstract algebra.”* Similarly, the head of the mathematics department stated, *“According to my students the intricate terminology and symbols used can be overwhelming at times and hence teaching in English makes it difficult for them to understand.”* Another teacher added, *“When learning mathematics in English, the challenge I often face is*

interpreting complex mathematical symbols...In the mother tongue...challenges arise when trying to express complex mathematical ideas, especially in topics involving abstract algebra.” These insights highlight the dual difficulty of understanding complex concepts and navigating language barriers.

4.2.2 Benefits of Bilingual Instruction

Teachers emphasized that bilingual instruction provides access to global resources and academic opportunities. One teacher noted, *“The primary advantage of teaching mathematics in English is the access it provides to a wealth of global resources and academic materials. English is the language of many scientific and mathematical publications...”* The patron of the mathematics club added, *“One of the primary advantages of teaching mathematics in English is the readiness it provides for global opportunities. English...proficiency in it can open doors to international academic and career prospects. It also enhances communication skills, allowing students to engage in meaningful discourse on mathematical ideas with peers from diverse backgrounds.”* English proficiency thus enhances both knowledge acquisition and global communication.

4.2.3 Cultural and Identity Implications

Teachers acknowledged that teaching in the mother tongue strengthens cultural identity. The head of the mathematics department explained, *“Learning in my mother tongue promotes a stronger connection to my cultural identity. It allows for a more authentic expression of local experiences and values...my mother tongue helps me maintain a connection to my cultural heritage.”* Learning in one’s native language preserves traditions and local knowledge while fostering a sense of belonging. Although English is important for broader communication, the mother tongue remains crucial for cultural continuity and identity formation.

4.3 The Perceptions and Attitudes of students/teachers towards teaching mathematics in English and their mother tongue at Nungua SHS.

Mathematics education is a fundamental pillar of academic development, equipping students with critical problem-solving skills and analytical thinking. The medium of instruction in which mathematics is taught holds immense significance, as it can significantly influence students’ comprehension, engagement, and overall performance in this subject. At Nungua Senior High School (SHS), the choice of language for teaching mathematics has become a topic of interest, as it involves a delicate balance between English, the official language of instruction in Ghana’s educational system, and students’ mother tongues, which reflect their cultural and linguistic identities. This section of the chapter seeks to delve into the perceptions and attitudes of both students and teachers at Nungua SHS regarding the medium of instruction for teaching mathematics. The data under this section is presented under themes such as Language Preference and Comfort, Impact on Understanding and Engagement, Confidence and Problem Solving, as well as Language in Class.

4.3.1 Language Preference and Comfort

Students and prefects highlighted both advantages and disadvantages of learning mathematics in English and their mother tongue. The Head Prefect stated, *“I feel that learning mathematics in either English or my mother tongue has its advantages and disadvantages. In my mother tongue, I might feel more comfortable and understand certain concepts more intuitively... However, when learning mathematics in English, I may have access to a wider range of*

resources and materials, which can be beneficial for deeper understanding.” A form one student echoed, *“Learning mathematics in either English or my mother tongue presents unique experiences...learning in English opens up access to a broader range of resources, even though it might be less comfortable for me.”* These responses underscore that comfort and access to resources are both critical factors in language choice for mathematics instruction.

4.3.2 Impact on Understanding and Engagement

Respondents emphasized that learning mathematics in their mother tongue enhances comprehension and engagement. The national maths and science quiz representative explained, *“Personally, I believe I grasp mathematical concepts better in my mother tongue... it helps me process mathematical ideas with greater ease. However, I acknowledge that certain advanced mathematical concepts and resources are more readily available in English.”* Similarly, the dining hall prefect stated, *“I find that I grasp mathematical concepts better in my mother tongue...That said, I do recognize that some advanced mathematical resources are more readily available in English.”* These responses highlight the trade-off between linguistic familiarity and access to advanced materials.

4.3.3 Confidence and Problem-Solving

Language choice affects confidence in problem-solving. The girl’s prefect noted, *“My level of confidence when solving mathematical problems in English varies...Simpler problems I can manage comfortably, but...my confidence may decrease due to the language barrier. It’s often the case that I spend extra time translating and understanding the problem in English.”* The patron of the mathematics club shared a student’s perspective: *“When solving mathematical problems in my mother tongue, I feel more confident overall. I can express my thoughts and ideas more fluently, and this increases my confidence in tackling complex problems.”* These statements illustrate that linguistic familiarity enhances confidence and problem-solving ability.

4.3.4 Language in Class Discussions

Students emphasized the use of the mother tongue in class discussions to promote clarity and engagement. One general arts student said, *“I prefer using my mother tongue when discussing mathematical concepts with my classmates. It allows for more natural and effective communication.”* A visual arts student added, *“It allows for more fluid and effective communication, enabling us to clarify doubts and share insights without language barriers.”* Similarly, a science student explained, *“Using our mother tongue...promotes better engagement and participation in mathematics classes.”* Collectively, these insights underscore that mother tongue instruction fosters active participation and effective peer communication.

4.4 The difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS

This section of the chapter presents data on the difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS. This is presented in themes such as Language of Instruction and Comprehension, as well as Comparative Performance and Assessment.

4.4.1 Language of Instruction and Comprehension

Respondents expressed varied experiences with English and their

mother tongue as languages of instruction. The compound prefect stated, *“My overall understanding of mathematical concepts when taught in English is relatively strong, especially for fundamental topics. For instance, when we learned about algebraic expressions and equations, I found it fairly straightforward in English.”* Conversely, the assistant girls prefect said, *“When mathematical concepts are taught in my mother tongue, my overall understanding is quite robust. I can connect with the subject more naturally, which makes learning more intuitive.”* A form three student added, *“My comfort level with mathematical terminology and symbols presented in English is relatively high...However, challenges may arise when encountering specialized terms or symbols unique to advanced mathematical topics.”* These responses highlight that comprehension depends on language familiarity and the complexity of mathematical content, suggesting the need for flexible instruction that accommodates diverse linguistic competencies.

4.4.2 Comparative Performance and Assessment

Students reflected on performance differences when assessed in English versus their mother tongue. One respondent stated, *“My performance in mathematics assessments conducted in English is generally strong, but it can be influenced by the complexity of the material and the specific terminology used. However, I typically perform very well in mathematics assessments conducted in my mother tongue. The familiarity of the language and the clarity of instruction contribute to my strong performance.”* This highlights that language choice can significantly affect comprehension and academic outcomes. While English offers access to broader materials, mother tongue instruction enhances clarity and performance, emphasizing the importance of considering linguistic background in teaching and assessment for equitable learning.

4.5 Discussions of findings

This section of the chapter discusses the findings from the field of the study. The discussion is based on themes in line with the research objectives.

4.5.1 The challenges related to teaching mathematics in English and the mother tongue at Nungua SHS.

The interviews with mathematics instructors at Nungua Senior High School provide critical insights into the complex interplay between language and the teaching of advanced mathematics (Smith, 2020; Brown, 2018). Teachers revealed that students face substantial challenges in understanding complex topics like calculus and abstract algebra, largely due to the intricate terminology and symbolic representations inherent in these subjects. These challenges are exacerbated when English, often not the students’ first language, is used as the medium of instruction (Johnson, 2019; Davis, 2017). The findings underscore the dual role of language as both a bridge and barrier to comprehension.

The head of the mathematics department highlighted students’ feelings of being overwhelmed by advanced terminology and symbols, particularly in calculus and abstract algebra (Robinson, 2018; Garcia, 2020). This aligns with prior studies indicating that language profoundly influences students’ grasp of mathematical concepts (Baker, 2017; Anderson, 2015). However, the Nungua SHS context adds nuance, showing that English as the language of instruction intensifies comprehension difficulties. This reinforces the need for teaching strategies that accommodate students’ linguistic backgrounds while facilitating access to advanced mathematical knowledge. Teachers are thus required to act as both content experts and linguistic mediators (Jones, 2019; Miller & Brown, 2017; Clark,

2020).

A key challenge identified is the interpretation of complex mathematical symbols and notations, especially in subjects such as geometry and trigonometry, where symbols are foundational to understanding (Drijvers et al., 2010). Misinterpretation is more likely when students encounter symbols in English, increasing the risk of conceptual misunderstandings (Planas & Gorgorió, 2004). Conversely, teaching in students' mother tongue simplifies the comprehension of symbols and allows teachers to convey concepts more effectively (Setati, 2005). Yet, even with mother tongue instruction, the inherent complexity of advanced mathematical concepts, particularly in abstract algebra, remains challenging, emphasizing the need for pedagogical strategies that integrate both language and content expertise (Adler, 2000).

The interviews demonstrate that mother tongue instruction promotes clarity, engagement, and intuitive understanding, while English instruction provides access to global resources and advanced mathematical literature. This duality reflects the ongoing tension between linguistic accessibility and academic rigor. Teachers must therefore carefully balance these dimensions to ensure equitable learning experiences. The study also reveals that language alone may not fully determine comprehension; factors such as instructional methods, teacher-student interactions, and guidance in interpreting symbols significantly influence learning outcomes (Smith & Chinn, 2018; Planas & Gorgorió, 2004).

In short, the findings at Nungua Senior High School illustrate the intricate relationship between language, comprehension, and mathematics instruction. English presents opportunities for accessing advanced resources but creates comprehension barriers, while mother tongue instruction enhances understanding yet cannot fully circumvent the challenges of advanced concepts. Effective mathematics pedagogy must therefore incorporate flexible, context-sensitive strategies that navigate linguistic complexities while supporting the learning of symbol-intensive, advanced mathematical topics (Drijvers et al., 2010). These insights contribute to the broader discourse on mathematics education, highlighting the critical role of language in shaping both teaching and learning outcomes.

4.5.2 The Perceptions and Attitudes of students/teachers towards teaching mathematics in English and their mother tongue at Nungua SHS

The interviews with students at Nungua Senior High School reveal a complex and nuanced relationship between language and mathematics education, emphasizing the trade-offs between learning in English and the mother tongue. The Head Prefect noted that learning in their mother tongue offers comfort and familiarity, allowing for more intuitive comprehension of concepts, as it aligns with daily language use and cultural context (Setati, 2005; Benson, 2001). Conversely, English instruction provides access to a wider range of resources and materials, enhancing deeper understanding and global connectivity in mathematics (Cummins, 2000; Planas & Gorgorió, 2004).

A Form One student reinforced this view, explaining that mother tongue instruction facilitates ease of understanding, while English offers broader academic exposure, even if it feels less comfortable. Similarly, representatives such as the National Maths and Science Quiz participant and the Dining Hall Prefect highlighted that learning in the mother tongue improves comprehension and lowers affective filters, fostering internalization of concepts (Krashen, 1982; Adler, 2000). Yet, they acknowledged that English provides access to advanced mathematical resources that may not be available

in the mother tongue, indicating a significant trade-off in language choice.

Language also affects confidence and problem-solving in mathematics. The Girl's Prefect noted that solving problems in English reduces confidence when the problems are complex, due to the extra effort required to translate and interpret, reflecting the language's impact on mathematical performance (Niss, 2003). In contrast, students using their mother tongue reported higher confidence, greater fluency in expressing ideas, and stronger problem-solving ability, highlighting how linguistic familiarity supports engagement with mathematical concepts.

Classroom discussions are similarly influenced by language. Multiple students emphasized that using the mother tongue encourages clearer, more natural communication, facilitating doubt clarification, peer interaction, and active participation (Planas & Gorgorió, 2004; Gibbons, 2002). This preference illustrates the mother tongue's role in fostering a more inclusive and interactive learning environment, enhancing both comprehension and engagement.

However, contrasting studies complicate these conclusions. Krashen (2018) and Adler (2019) suggest that language of instruction may have minimal impact on cognitive development, with instructional quality and teaching strategies being more decisive. Likewise, Niss (2016) challenges the notion that language substantially affects problem-solving skills, while Planas and Gorgorió (2004) indicate that students can adapt to new linguistic environments without hindering learning. These opposing findings demonstrate that the advantages of mother tongue versus English instruction are context-dependent and not universally prescriptive.

4.5.3 The difference in comprehension levels between students in mathematics classes taught in English and those taught in their mother tongue at Nungua SHS

The perspectives of various respondents at Nungua Senior High School provide valuable insights into the intricate relationship between the language of instruction and the comprehension of mathematical concepts. Some individuals articulated a preference for learning mathematical concepts in English, highlighting its advantages in specific contexts.

The Compound Prefect expressed his perspective, noting that his overall understanding of mathematical concepts when taught in English is notably strong, particularly for fundamental topics such as algebraic expressions and equations. In this context, English serves as a facilitator for his learning, offering clarity and accessibility in understanding these fundamental concepts. This finding resonates with research that suggests that students often find it easier to grasp basic mathematical concepts when taught in a language they are familiar with (Setati, 2005).

Similarly, the Assistant Girls' Prefect conveyed that when mathematical concepts are taught in her mother tongue, her overall understanding is robust. This alignment between the language and her comprehension enhances the intuitive nature of learning. The connection between the mother tongue and deeper comprehension aligns with the idea that language plays a significant role in shaping the cognitive processes of learning (Cummins, 2000).

Furthermore, a Form Three student emphasized their comfort level with mathematical terminology and symbols presented in English, highlighting their familiarity with the standard mathematical vocabulary used in English textbooks. This comfort can provide a sense of confidence and ease when engaging with mathematical

content, even though challenges may arise when encountering specialized terms or symbols unique to advanced mathematical topics. This observation aligns with the concept that language familiarity can enhance cognitive processes, particularly in areas requiring precise terminology (Gibbons, 2002).

On the aspect of comparative performance and assessment, a respondent's interview illuminated the potential influence of language on mathematical achievement. This respondent performed strongly in mathematics assessments conducted in English but noted that their performance could be influenced by the complexity of the material and specific terminology used. In contrast, their performance was consistently strong in assessments conducted in their mother tongue. The familiar language and the clarity of instruction in their mother tongue contributed to their strong performance, highlighting the impact of language alignment between instruction and assessment on student achievement. This finding supports the idea that language congruence can enhance academic performance (Adler, 2000).

These perspectives collectively highlight the nuanced interplay between language and mathematical comprehension, performance, and assessment. They reflect the diverse preferences and needs of students in the context of mathematics education. Additionally, they emphasize the importance of recognizing the strengths of both language options and tailoring instruction and assessment to create equitable and effective learning experiences for all students.

The findings align with the broader discourse on language and mathematics education, emphasizing the pivotal role of language in shaping students' experiences and achievements in the realm of mathematics. They underscore the need for a flexible and inclusive approach that draws from the strengths of both language options to meet the diverse needs of students.

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter of the study presents the summary of the key findings of the study, conclusions drawn from the findings as well as recommendations.

5.1 Summary of the study

The research was divided into five chapters, each with specific purposes. Chapter One provided an overview of the research, outlining its background, objectives, scope, and limitations. Chapter Two conducted a literature review to identify existing knowledge and theories related to the research topic. Chapter Three outlined the methodology used, including sampling techniques and data collection methods. Chapter Four presented a comprehensive analysis of the research data, using thematic analysis. The final chapter summarized the research findings, restating the objectives, answering questions, and offering recommendations for further research. The chapter concluded by summarizing the main points, emphasizing the study's significance, and highlighting its potential implications for future studies and practical applications.

5.2 summary of findings

Interviews with mathematics teachers at Nungua Senior High School highlight the challenges of teaching advanced mathematical concepts, such as calculus and abstract algebra, in English compared to the mother tongue. Complex terminology and symbols, while essential for conveying sophisticated ideas, can become obstacles

when presented in a non-native language. Teachers, therefore, must not only be experts in mathematics but also skilled in navigating linguistic challenges, adapting instruction by simplifying terminology, contextualizing symbols, or incorporating the mother tongue where possible.

Students' perspectives reflect a nuanced balance between comfort and access. The Head Prefect observed that learning in the mother tongue offers familiarity and aligns with cultural and daily experiences, fostering intuitive comprehension of mathematical concepts. Conversely, English provides access to a wider range of educational resources and advanced materials, supporting a deeper and more global understanding of mathematics.

These insights underscore the complex decision-making process surrounding the language of instruction. They reveal that neither English nor the mother tongue is universally superior; each has distinct advantages and limitations. The findings advocate for a flexible, inclusive approach that leverages the mother tongue for comprehension and engagement while using English to access broader resources. Such a dual strategy can create equitable and effective learning experiences, addressing both linguistic and cognitive needs in mathematics education.

5.3 conclusions

In conclusion, teaching advanced mathematics at Nungua SHS in English presents challenges due to complex terminology and symbols, particularly for non-native speakers. Educators must navigate these linguistic difficulties by adapting teaching methods, simplifying concepts, and integrating the mother tongue where possible. Students, meanwhile, value learning in their mother tongue for comfort, familiarity, and intuitive understanding, yet recognize English provides access to broader resources and global knowledge. Language also affects confidence, problem-solving, and class discussions, with mother tongue instruction fostering engagement. These findings highlight the need for a flexible, culturally sensitive approach that balances comprehension, resource access, and student preferences.

5.4 Recommendations

Nungua Senior High School should adopt a bilingual mathematics instruction policy, allowing students to choose between English and their mother tongue.

Teachers must be trained through professional development workshops to teach effectively in both languages, simplifying and contextualizing complex mathematical terminology.

The Curriculum Development Committee should create bilingual materials and ensure assessments and resources are accessible in both languages.

Educational authorities should support flexible language options in regional or national assessments.

Schools should foster inclusive classrooms that encourage discussions, problem-solving, and peer collaboration in students' preferred languages, ensuring engagement, participation, and equitable access to mathematical learning.

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APPENDIX A

Interview guide for data collection

Section A: demographic data

1. What is your gender? a) Male b) Female c) Prefer not to say
2. How old are you? a) 15-17 years old b) 18-20 years old c) 21-23 years old d) 24 years old or above
3. Which course are you currently offering? a) General Arts b) Business c) Home economics d) visual arts
4. What is your mother tongue? a) English b) Twi c) Ga d) Ewe e) Other (Please specify) _____
5. How proficient are you in the English language? a) Very proficient b) Proficient c) Intermediate d) Basic e) Not proficient

Section B: The perceptions and attitudes of students towards learning mathematics in English and mother tongue at Nungua Senior High School.

1. How do you feel about learning mathematics in English or your mother tongue? Please elaborate on your preference and comfort level.
2. In which language do you believe you grasp mathematical concepts better? Can you explain why you feel this way?
3. When solving mathematical problems in English, can you describe your level of confidence and any factors that influence it?
4. When solving mathematical problems in your mother tongue, could you share your level of confidence and the factors affecting it?
5. When discussing mathematical concepts with your classmates, do you have a preference for using English,

your mother tongue, or do you have no specific preference? Why?

6. In your opinion, how would using your mother tongue in mathematics classes impact your understanding of the subject? Please elaborate on the extent to which you believe it would make a difference.
7. According to your perspective, which language of instruction, English or your mother tongue, promotes better engagement and participation in mathematics classes? Please provide reasons for your choice.
8. How do you view the relevance of learning mathematics in English for your future opportunities? Can you explain the significance you attach to it?
9. Do you believe that learning mathematics in your mother tongue helps you connect mathematical concepts to your real-life experiences? If so, could you provide examples and explain the extent to which it influences your understanding?
10. Overall, how satisfied are you with the current language of instruction in mathematics at Nungua Senior High School? Please share your thoughts on what contributes to your level of satisfaction or dissatisfaction.

Section C: The comprehension levels of students in mathematics classes taught in English and mother tongue at Nungua SHS.

1. How would you describe your overall understanding of mathematical concepts when they are taught in English? Could you provide specific examples or experiences that have influenced your rating?
2. How would you describe your overall understanding of mathematical concepts when they are taught in your mother tongue? Can you share any particular instances or factors that have shaped your rating?
3. When it comes to explaining complex mathematical ideas and theories, do you find one language of instruction, English or your mother tongue, more effective? Could you elaborate on the reasons behind your preference?
4. Regarding the use of mathematical terminology and symbols presented in English, could you describe your comfort level? Are there specific instances or challenges that affect your comfort level?
5. Regarding the use of mathematical terminology and symbols presented in your mother tongue, can you explain your comfort level? Are there any particular experiences or factors that influence your comfort level?
6. In your opinion, which language of instruction, English or your mother tongue, helps you better grasp and apply mathematical concepts in problem-solving? Could you provide examples or instances that illustrate your perspective?
7. How would you rate your performance in mathematics assessments when they are conducted in English? Can you share any insights into what contributes to your performance in these assessments?
8. How would you rate your performance in mathematics assessments when they are conducted in your mother tongue? Are there specific factors or experiences that have an impact on your performance in these assessments?
9. How confident do you feel in your mathematical abilities when learning in English? Could you elaborate on the factors or situations that affect your level of confidence?
10. How confident do you feel in your mathematical abilities when learning in your mother tongue? Can you provide

insights into what influences your confidence level in this context?

Section D: the challenges and opportunities associated with teaching mathematics in English and mother tongue at Nungua SHS.

1. What aspects do you find most challenging when learning mathematics in either English or your mother tongue? Could you provide examples or specific difficulties you encounter, such as understanding mathematical concepts, interpreting word problems, applying mathematical formulas, or other challenges?
2. How do you perceive language barriers affecting your comprehension of complex mathematical ideas when they are taught in English? Can you describe in more detail whether language impacts your ability to fully understand concepts, express your understanding, or if it doesn't affect your comprehension?
3. Which language of instruction, English or your mother tongue, do you believe offers better opportunities for connecting mathematical concepts to real-life experiences? Could you explain your reasoning for favoring one language over the other or if you find both equally effective or ineffective in this regard?
4. In your view, what is the primary advantage of teaching mathematics in English? Could you share your perspective on how it prepares students for global opportunities, enhances communication skills, provides access to more resources, or any other benefits you believe are associated with this approach?
5. What specific challenges do you believe teachers encounter when instructing mathematics in English? Can you elaborate on their difficulties in explaining complex concepts, understanding students' language-related struggles, the lack of suitable teaching materials in English, or any other challenges you perceive?
6. Which language of instruction do you think motivates you more to engage in mathematics learning? Can you provide insights into why you feel motivated or demotivated when learning in English, your mother tongue, or if both languages have no impact on your motivation?
7. How do you think teaching mathematics in your mother tongue can contribute to the development of critical thinking and problem-solving skills? Can you describe how it enhances your analytical abilities, understanding of mathematical logic, or problem-solving strategies, or if you're unsure about its effects?
8. What specific challenges do you face when solving word problems in mathematics taught in English or your mother tongue? Could you elaborate on your difficulties in understanding vocabulary used in word problems, translating them between languages, applying mathematical concepts to real-life situations, or other challenges you encounter?
9. Which language of instruction do you believe promotes a stronger connection to your cultural identity? Can you explain how learning mathematics in English, your mother tongue, or both equally affects your cultural identity, or if you feel that language has no impact in this regard?
10. In your opinion, which language of instruction offers better opportunities for career prospects in the field of mathematics? Could you provide insights into why you think English, your mother tongue, both languages equally,

or neither language may influence career prospects in mathematics?