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# English as a Medium of Instruction in Junior High Schools in the Yendi Municipality: A Boon or Bane for Mathematics Achievement

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## Abstract

This study explored the role that teachers' language of instruction plays in students' performance in mathematics. The research design and methods of this study were based on pragmatism as the guiding paradigm. This study used a mixed method approach that combined exploratory qualitative and quantitative phases. The target population comprised junior high school students and mathematics teachers in the Northern region of Ghana, and the accessible population comprised junior high school students and mathematics teachers in the Yendi Municipality. The instruments used in the study included an interview guide and an achievement test. The respondents of this study were two mathematics teachers, and 466 students were selected through a stratified sampling technique. The study was driven by a pair of research inquiries: First, it sought to understand the impact of a teacher's language of instruction on the process of teaching and learning mathematics. Second, the study aimed to compare the academic achievements of students who were taught exclusively in English or Dagbani with those who experienced a combination of these two languages in their instruction. The study concludes that the language of instruction can impact students' academic performances in mathematics. Using the native language of students as the instructional medium can yield more favourable academic results. Therefore, educational establishments are advised to incorporate students' native languages, particularly in the context of mathematics instructions.

Keywords: Ghanaian language; medium of instruction; language of instruction; English as language of instruction; Dagbani as medium of instruction; junior high mathematics achievement

## Introduction

Ghana, like many other developing countries, struggles with low performance in mathematics compared with other nations (Anamuah-Mensah, et., al., 2004, 2006 and 2008; Mereku & Anumel, 2011). This is a global and local concern that affects all levels of education (Mullis & Martin, 2017; Ministry of Education, Ghana, 2018). International assessments of mathematics and science achievement, such as the TIMSS, measure how well students in the fourth and eighth grades understand mathematical and scientific concepts (Mullis et al, 2004). They equally evaluate the curriculum and identify promising teaching strategies. Ghana participated in the TIMSS programme with eighth graders in 2003, 2007 and 2011. In the 2011 TIMSS, except Tunisia, the other African countries (Ghana, Morocco, South Africa and Botswana) that participated recorded points below the average scale score of 500 (Mullis et al. 2012).

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Language has been identified as a major contributing factor to students' poor learning of mathematics. Torbe (1982) pointed out that without language, without the telling and listening, the reading and the writing which fills every school day, there could be no communication and no educational process - it is language which makes the whole educational process, including learning mathematics, possible. Mathematics, as a language, provides a means of communicating information because it makes use of symbolic notation. Mathematical language requires using and interpreting this symbolic notation and grasping the abstract ideas and concepts which underlie it (Mereku & Cofie, 2008). For this reason, even many people for whom English is their first language find it difficult to use language in mathematics (Clements, 1984; Clements, 1980).

To understand and communicate a mathematical idea in English language, most children have to translate it into their first language and translate it back into English. Orton (1988) argues that errors and misunderstandings might arise at any stage of this two-way inner translation process which children, who are not taught in their first language, undergo any time they want to communicate an idea in mathematics.

Mereku & Cofie, (2008) assert that in mathematics, one's native language has to illuminate and translate the symbolic language. Native language provides a means of communication which is in use all the time and which, for a great majority of pupils, comes naturally', even though command of language needs to be developed through experience. Native language can convey its meaning intelligibly despite mistakes of grammar or of spelling. In contrast, mathematics does not 'come naturally' to most people in the same way as native language. It is not constantly used; it has to be learned and practised; it obeys exact rules; and it does not convey meaning except by exact interpretation of its symbols. Most young learners in Ghana, for whom English is not their native language, are most likely to encounter difficulties in studying mathematics in school if teachers ignore the fact that most children use the two-way inner translation process observed by Orton (1988).

Studies have shown that when teachers use language for learners to understand, it helps them to connect with the educators, gives them a sense of comfort, motivates them to participate in lessons, and makes them feel understood and heard (Francis, Lesaux & August, 2006). A language that is familiar to students and used in instruction speeds up the learning process and makes it more effective. An action research conducted in the classroom on language and instruction shows a strong positive correlation between teachers' language and the learner-centred nature of the classroom. When students are taught in a language they understand, it serves as a motivation that enhances their punctuality in class (Laitin, Ramachandran & Walter, 2015).

Considering the significant influence wielded by the language of instruction on the dynamics of education, there exists a compelling need to delve into the linguistic choices teachers make when instructing mathematics in the Yendi Municipality. The rationale behind this exploration lies in the potential ramifications of the study's findings for curriculum developers, educators, and policymakers. This research holds the promise of furnishing valuable perspectives on the role of language in educational initiatives.

*Statement of the Problem*

The language of instruction is an important element that policymakers consider at both international and national levels (Heneveld & Craig, 1996)). This rationale arises from the substantial influence of the language of instruction on the calibre of education students

acquire, their scholastic achievements, and their broader learning results (Espinas & Fuchs, 2022).

Ghana, being a multilingual country, has adopted the English language as its official language of communication. The language policy established by the Ministry of Education outlines English as the medium of instruction from Basic 3 onward, while the local language (L1) can be employed from kindergarten to Basic 3. Research endeavours pertinent to Ghana's educational language policy have primarily revolved around identifying strategies and obstacles within its implementation, assessing attitudes and incentives for studying Ghanaian languages at the tertiary level, gauging the NALAP's impact on schools in the North, and probing into the correlation between students' English and Ghanaian language performance as mediums of learning, and their achievements in mathematics and science (Owu-Ewie & Eshun, 2019; Owu-Ewie, 2012).

These studies were conducted in the southern part of Ghana where the predominant language is Akan (Fanti, Twi, etc.). As a result, more than 90% of teachers and students speak Akan. In addition, most of these studies used the qualitative design and a few used the quantitative design. Owu-Ewie, (2012) recommended further studies in this area in a multilingual setup. To address these disparities, the current study aims to use a mixed method approach for data collection, to investigate how teachers' choice of instructional language influences the mathematical achievements of students in a multilingual locality, namely Yendi.

*Purpose of the study*

This research was structured to explore the potential impact of teachers' selected language of instruction on the students' academic performance in the realm of mathematics.

*Research Questions*

The following research questions guided the study.

a. What is the influence of *the language chosen by a teacher for instructional purposes* on the process of teaching and learning mathematics?

b. How do the academic outcomes of students taught exclusively in English or Dagbani compare to those who experience a combination of the two languages in their instruction?

## Literature review

*Empirical framework*

Mathematics is a subject acknowledged to be the mother of other related subjects such as commerce, arts and others. It is a community that has its own language. Mathematics and mathematics education have always been areas of research interest due to their recognised utility and their interconnectedness with various other disciplines. Therefore, finding the solution to mathematics problems is the same as finding the solution to the world's problems. For instance, students who are good in mathematics are usually good in other subjects, hence the need to improve students' performance in mathematics (Ali, 2013).

Research in the field of mathematics has led to the formulation of theories, principles, and evidential support, all of which are designed to enrich the methodologies of teaching and learning this subject. Many of these investigations find their origin in the prevalent issue of inadequate achievement among learners in mathematics, a concern that transcends borders. Broadly, studies have pinpointed numerous factors responsible for the subpar performance of students of mathematics. Some of these factors include teachers' low knowledge of the subject, poor communication ability (the language of

instruction) among teachers and learners, unavailability of instructional resources, teachers' poor ability to manage the learning environment, class size (teacher-student ratio), the use of examination -driven curriculum, low supervision, and poor interaction between curriculum developers and implementers (Adler, 1998; Howie, 2004; Setati & Adler, 2000; Taylor & Vinjevold, 1999).

Within the array of factors influencing the process of teaching and learning mathematics, this research will focus on the language employed for communication within the mathematics classroom. Language plays a fundamental role in instructing and comprehending mathematics (Planas & Setati, 2009). However, literacy in mathematics first becomes a problem for students as they learn.

Literacy errors in reading, comprehension, and transformation have been identified in mathematics classrooms (White, 2018). According to Abosalem (2016), learners' ability to process information toimprove their understanding, aids in the development of their mathematics skills.

Ghana is a multilingual country with no officially accepted local language spoken by all. The Ghanaian Ministry of Education has a policy regarding the language used in education. From Basic 3 onwards, English is the primary language for teaching (L2). Before Basic 3, local Ghanaian languages (L1) were used for teaching, whereas English was used as a second language (L2) (Owu-Ewie, 2006). From the basic school curriculum, the Ghanaian language is a subject learned even up to the tertiary. This is somehow contrary to UNESCO Committee's report in 1953. The idea is that children should be taught in their native language. This is based on research that shows that using the mother tongue as the medium of instruction helps children develop cognitively, psychologically, and linguistically (Swain & Lapkin, 2000). However, Fernández and Yoshida (2010) argue that the language of instruction is not the only factor that affects students' academic achievement. They also highlighted the importance of other aspects such as teaching methods, curriculum design, and quality of instruction.

There is a direct link between the language used for teaching and how well learners do academically (Mwamwenda, 1996; Pierce, 2003; Gándara, Rumberger, Maxwell-Jolly, & Callahan, 2003). In addition, students perform well when they are taught in a language they are proficient in and vice versa (Owu-Ewie, 2012; Benson, 2004; Dearden et al., 2015). This was confirmed by Adanu and Kekessi (2013). They conducted a research endeavour investigating the influence of the language of instruction on academic attainment within the Ghanaian context. The findings of this study indicated that students who received instruction in their native language exhibited better performance than those who received instruction in English.

Mwinsheikhe (2009) examined English use as the medium of instruction within a science classroom. The study illuminated that both educators and students lacked proficiency in the English language. Consequently, instructors employed coping strategies such as code-switching, cautious communication, and punitive measures. The research revealed that the adoption of English as the medium of instruction posed challenges in the teaching and learning process. Considering these findings, it was recommended that a combined approach using both English and the local language be implemented as the instructional medium to enhance the teaching and learning process (Mwinsheikhe, 2009). In addition, teachers can resort to strategies such as slowing down the pace and using simple English to help the situation (Abedi & Lord, 2001).

Owu-Ewie and Eshun (2015) conducted a study within the Ajumako-Enyan-Essiam District, situated in the Central region of Ghana. Their investigation aimed to determine whether teachers in this locality were aligning with the prevailing language policy at the upper primary and junior high school (JHS) levels. The findings revealed a discrepancy, as teachers were employing the local language (Fanti) as the instructional medium, contrary to the language policy outlined within Ghana's educational framework. The reasons underlying this deviation from the language policy included teachers and students possessing proficiency in the local language and a lack of supervisory mechanisms to enforce the stipulated policy.

The bulk of existing literature has predominantly explored the connexion between the language of instructions and students' academic achievements in subjects other than mathematics. Also, most of the designs for this phenomenon were quantitative. This ongoing research will address the existing void by assessing students' competence in both the local language and English. Moreover, the chosen research design for this study is a mixed-method approach.

*Theoretical Framework*

This study draws its theoretical foundation from Vygotsky's Zone of Proximal Development and the sociocultural theory. The Zone of Proximal Development theory delineates the gap that separates a learner's independent abilities from their potential capabilities with the assistance of a mentor or through collaboration with a more proficient peer (Murray & Arroyo, 2002). In essence, it defines the spectrum of tasks that a learner can accomplish under the tutelage and support of a more knowledgeable individual, such as an educator or a peer with expertise.

Within this framework, language plays a pivotal role in shaping cognitive development. Thus, language is an element of culture that facilitates the development of human intelligence, which helps learners perceive the world around (environment) them. Another pillar is the role that teacher plays in cognitive development. The teacher uses communication skills such as good discourse, questioning and learning situations to lead the learner from his or her current stage to the desired level in solving a mathematics problem. These communication skills help the student to think critically, thus building understanding for him or herself (Bell & Woo, 1998).

In addition, when teachers use language that is too complex or unfamiliar to their students, there is a high possibility that these learners may struggle to understand the mathematics concepts being taught, and their performance may suffer. On the contrary, when teachers use language that is too simplistic, learners may feel not challenged, and this may affect their performance positively.

Sociocultural theory underscores the significance of social and cultural environments in the learning process. Within this framework, learning is shaped by the cultural and social interactions that learners engage in, including the language employed for instruction. The selection of the language of instruction by teachers is a noteworthy cultural element that influences learners' proficiency in mathematics. When the language of instruction does not harmonise with the learners' cultural and social contexts, it can erect obstacles to effective learning and consequently impede their mathematical performance.

*Conceptual Framework*

Determining the appropriate language for teaching mathematics is a multifaceted matter that has garnered substantial scholarly attention. Numerous nations, especially those characterised by diverse linguistic communities, grapple with the intricate task of selecting the language to be employed as the instructional medium in mathematics classrooms. This conceptual framework intends to investigate the impact of teachers' language of instruction choices on the academic achievements of learners in mathematics.

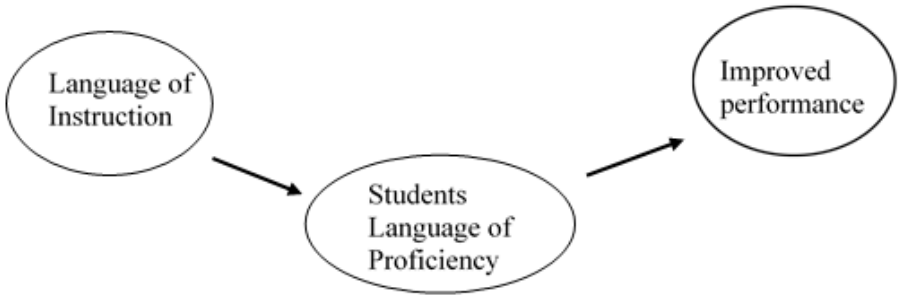


**Figure 1: Conceptual framework of the language of instruction and its impact on academic performance**

Existing scholarly works have established a clear link between the language used for instruction and the academic achievements of students (Espinas & Fuchs, 2022). This means that if students are not proficient in the language their teacher uses for instruction, it will affect their understanding of the concept and, hence their performance. For instance, if teachers use Dagbani to teach mathematics and most of the students are fluent in Dagbani, students will perform better in mathematics. This is because they will be able to cognitively process the information the teacher gives them. They can equally be able to ask questions that will clear their misconceptions, giving them a deeper understanding of mathematics concept.

## Research Methodology

*Research paradigm*

The paradigm or philosophy supporting this study is pragmatism. This paradigm proposes that a study should use research philosophies and/or approaches that work for a particular research question. Thus, the use of multiple methodologies (Creswell & Clark, 2018) in a particular study. This study employed both positivist and interpretivist philosophies to answer different research questions.

*Research Approach*

Mixed methods research is a "research approach or methodology that integrates quantitative and qualitative research techniques to address research inquiries" (Creswell & Clark, 2018, p. 4). This means that this approach combines data from different sources and methods at different stages of the research process, such as data collection, analysis, and interpretation. This study used a mixed-method approach, which involved collecting both qualitative and quantitative data to answer different research questions.

*Research Design*

Exploratory research design is a research framework that is used to study a phenomenon or issue in its early stages, without following a rigid or structured approach. This allows the

researcher to be flexible and open-minded in exploring the topic. This type of research is often conducted when little is known about the research question and, is used to gain insights and generate ideas for further research. According to Creswell (2014), the exploratory research design is particularly useful for understanding of complex social phenomena that are not easily quantifiable, such as social attitudes, beliefs, and perceptions. The design of the study was an exploratory case study. That is, this study aims to answer the 'what' and the 'how' of the language of instruction and its impact on learners' mathematics performance.

*Population*

The scope of this study encompasses junior high school students and mathematics educators situated in the Northern region of Ghana. The group accessible for examination specifically pertains to junior high school students and mathematics instructors within the confines of the Yendi municipality. The municipality has 296 basic schools and over 2800 teachers. There are approximately 1200 junior high school students.

*Sample and Sampling Technique*

A technique called proportionate stratified random sampling was used. The minimum required sample size was determined by using the Kerechi and Morgan formula for the whole population. The population was divided into three different groups based on the language of instruction (Dagbani, English, or both). For the 30,000 junior high school students, a sample size of 466 was chosen. The sample size for each group was calculated by multiplying the ratio of the group's population by the overall sample size. Each group had 150 junior high school students. For the qualitative part of the study, a method called convenience sampling was used. That is, focus members (not more than 10) from each group, who were readily available and accessible to the researcher, were engaged in focus group discussion (FGD).

*Instrument*

The instruments used in the collection of data were an interview guide (one for teachers and another for students' FGD) and an achievement test. The purpose of the teachers' interview was to gather information about the possible factors that influenced the choice of a particular language for teaching. These factors included policy guidelines, students' language skills, ease of language use, and other aspects. The achievement test constructed by the researcher was used to measure learners' performance in mathematics. The instrument was constructed on the basis of the curriculum and topics covered in lessons in the term. It was made up of five constructed-response items which required learners to clearly show their working to demonstrate their understanding. Out of the five, three were story or word problems.

*Pilot Testing of Research Instrument*

Because the instruments were developed by the researcher, they were pilot-tested in other to test their reliability and validity. They were piloted in the Mion district, which shares borders with Yendi and a multilingual community. Three schools were selected from the district for this exercise. Thus, a JHS handled by a mathematics teacher who teaches using the local language and/or English language.

Because the instruments were developed by the researcher, they were first piloted and tested for validity and reliability. To ensure that the instruments were valid, they were first submitted to some colleagues for their input to shape the instruments. Thus, the face, content, and construct validity of the instruments were tested.

From the pilot test results, Cronbach's alpha values (achievement test) were calculated for

and concluded based on the assertion of AERA et al. (2014). They stated that an alpha value less than 0.7 cannot be accepted, that is, it's not reliable. An alpha value of 0.76 was obtained, where the instrument is valid.

*Data Collection, Analysis and Trustworthiness of Qualitative Results*

The technique used to collect the data was the administration of the achievement test and interview guide. Teachers were interviewed about the factors they consider before they settle on a particular language of instruction to answer Research Question 1. The last procedure was the administration of the achievement test. The data obtained after marking the test scripts were used to address Research Question 2. To analyse the data, both qualitative and quantitative methods were used. The interviews with the teachers were first coded based on the themes that emerged. ANOVA was used to analyse the achievement test data to answer research question two.

Thematic analysis was performed to the data derived from the interviews. This approach helped uncover recurring patterns and themes linked to the credibility of qualitative research tools. The data were reviewed by two researchers to ensure rigour and reliability. To ensure the trustworthiness of the qualitative results, member checking and peer debriefing were employed. First, the findings from the study were shared with the participants to ensure that their responses were accurately captured. In addition, the findings of this study were shared with other researchers in this field to gain their perspectives on the analysis.

Also, the researcher combined the insights from both types of data, quantitative and qualitative, by comparing them. This involved checking whether the qualitative themes matched the quantitative trends or if there were any differences or new insights to discover. The goal was to merge the findings to provide a more complete understanding of the research questions. For example, the researcher might use qualitative insights from teachers' interviews to help explain or provide context to some quantitative patterns observed in students' math performances.

**Results**

*What is the influence of the language chosen by a teacher for instructional purposes on the process of teaching and learning mathematics?*

Data were collected through interviews with mathematics teachers.

Interview feedback from a teacher who uses only English as the language of instruction for teaching mathematics.

Q: How long have you been teaching mathematics?

R: *7 years*

Q. What is the medium of instruction in your mathematics class?

R: *English*

Q: What is the reason for opting to teach in English rather than using the local language?

R: *English is the sole language I am capable of communicating ineffectively, ensuring that my students comprehend the subject matter. As I'm not a native speaker, the local language I'm familiar with is not understandable to them, and vice versa.*

Q: How do you handle students in your mathematics class who are not well-versed in English?

R: *I employ strategies to support those students who struggle with English proficiency in my mathematics classes.*

R. *I sometimes ask those who were able to understand what we did in class to help them after class. Other times, I*

*pose and get one of my students (Teaching assistant) to translate all that I have said into their local language.*

Q. What is the percentage of students who have challenges with the English language?

R. *60%. What I do to help the situation is that, after teaching for about a week or two, I ask them to share their challenges with me. Some said I move too fast with the English language so I should slow down. Others also mention that I should use, simple English when explaining things. The challenge is moving at a slow pace, which means I can't do more examples within the lesson period; hence, fewer topics are covered in the term. This can affect them during BECE, and they will now blame me for not teaching them the topics that come in the examination. On the other hand, if I move fast, only 40 to 45% of them will be able to understand what I am teaching. For instance, if I teach something today and they can do it, the following day if I change the figures for them to do a similar one, most of them can't do it.*

Interview response from a teacher who uses Dagbani as a medium of instruction for teaching mathematics:

Q. How long have you been teaching mathematics?

*R. About 2 years now*

Q. What language do you mostly use to teach mathematics?

*R. I mostly use Dagbani to teach mathematics. Let's say about 90 to 95% of the time.*

Q. What are some of the challenges faced by students when you teach them using the Dagbani?

*R. They are okay; they are active in class; they ask and respond to the questions I ask them.*

Q. When deciding on the language of instruction, what are the things you take into consideration?

*R. I am motivated to use Dagbani because most of them understand Dagbani better than the English language. I am comfortable teaching mathematics using Dagbani*.

Q. How do you know that your students are comfortable when you use Dagbani to teach mathematics?

*R. When you use the English language to explain a mathematical concept, you will see them sitting quietly but when you change the instruction to Dagbani, you will hear them saying " Eii or Aha Sir, this was what you were saying"*

Q. Are there students in your class who do not understand Dagbani?

*R. Yes, about 5% of them.*

Q. How do you address this concern?

*R. Because their number is small, I use the English language to sometimes explain in class or after class. I also asked some of their colleagues to help them.*

The feedback provided by the interviewed educators revolved around the language of instruction adopted within their mathematics classrooms. This discussion revealed three primary themes: 'Educators' Background Information,' 'Effective Classroom Management during Language Barriers in Mathematics Teaching and Learning,' and 'Tackling Language-Related Hurdles in Mathematics Classrooms.'

On the basis of the outcomes extracted from these interviews, a conclusive inference can be drawn: the language employed as the medium of instruction in mathematics

classrooms significantly influences students' comprehension and performance in the subject. The teachers' personal backgrounds and language proficiency emerge as pivotal factors in determining the chosen instructional language. Teachers' using English as the instructional medium encounters complexities in handling students lacking proficiency in the language. Conversely, the teacher employing the indigenous language "Dagbani" faces fewer linguistic obstacles, given that most students are conversant with the language. As one teacher noted, "When explanations are given in English, students remain quiet, but upon switching to Dagbani, you can hear their expressions of realisation, like 'Eii' or 'Aha, Sir, now I understand.'"

Nevertheless, it is important to highlight that both educators are tasked with effectively assisting a small subset of students who encounter difficulties in grasping the language of instruction. Teachers also have to strike a balance between using a language that most students can understand and covering the necessary topics within the limited time available. To address language challenges in mathematics classrooms, the teachers use various strategies such as "I sometimes ask those who were able to understand what we did in class to help them after class. Other times, I pose and get one of my students (Teaching assistant) to translate all that I have said into their local language".

*How do the academic outcomes of students taught exclusively in English or Dagbani compare to those who experience a combination of the two languages in their instruction?*

Marks obtained in the test were used as proxy measures for the students' academic outcomes. Table 1 provides the descriptive statistics of the students' academic performance on the mathematics test. The results show the students' overall performance out of a total score of 10, was a mean of 5. The maximum score of 10 was obtained by students whose teachers used largely Dagbani as medium of instruction and the least score of zero was obtained by students whose teachers used mainly English language.

The best performance in mathematics, as can be seen in Table 1, was demonstrated by students whose teachers used largely Dagbani (M = 6.25, SD = 2.282); followed by students whose teachers used a blend of the two languages (M = 5.76, SD = 1.531); and the least performance was demonstrated by students whose teachers used mainly English.

**Table 1: Descriptive statistics of students' performances in mathematics**

| Medium of Instruction | N | Minimum | Maximum | Mean | Std. Dev. |
|---|---|---|---|---|---|
| English Language | 152 | 0 | 5 | 2.67 | 1.531 |
| Dagbani | 155 | 2 | 10 | 6.25 | 2.282 |
| Both | 159 | 2 | 8 | 5.76 | 2.041 |
| Total | 466 | 0 | 10 | 4.90 | 2.534 |

To data ascertain whether or not the differences observed in performance of students taught by teachers using the three categories of medium of instruction are statistically significant, the students' academic performance scores in mathematics were subjected to further analysis using analysis of variance (ANOVA).

**Table 2 Results of the ANOVA of mean mathematics scores of students taught in the 3 language categories**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Mean scores of students taught in the 3 language categories | Between Groups | 772.243 | 2 | 386.122 | 98.612 | .000 |
| | Within Groups | 1186.410 | 464 | 3.916 | | |
| | Total | 1958.654 | 466 | | | |

Table 2 shows the results of the ANOVA test for mean differences in mathematics scores of students taught by teachers using the three categories of medium of instruction. The obtained F-value of 98.612 and its corresponding p-value of 0.000 indicate a noteworthy contrast in the average achievement test scores among the students taught by teachers using the three categories of medium of instruction (English, Dagbani, or Both). This is supported by the considerable discrepancy between the sums of squares for groups (772.243) and those within groups (1186.410), underscoring the statistical significance of the dissimilarities among the groups.

In Table 3, the outcomes of the Tukey HSD test are presented. This test serves to compare the variations in mean achievement test scores between students who are instructed in the Dagbani, English, or a combination of both.

The findings reveal notable variations in achievement test scores among students instructed in the English language compared with those taught in the Dagbani language (average difference = -3.58095, $p < .001$). Furthermore, significant disparities in achievement test scores exist between students educated in English and those taught in both languages (average difference = -3.09091, $p < .001$). However, no substantial variations in achievement test scores were observed between students taught in the Dagbani language and those instructed in both languages (average difference = 0.49004, $p = .182$).

Table 4 presents the convergence and divergence of the findings obtained from both

Table 3: Comparison of means of paired groups

| Language | Language of Instruction | Mean Difference | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|
| English | Dagbani | -3.58095* | .27510 | .000* | -4.2289 | -2.9330 |
| | Both | -3.09091* | .27917 | .000* | -3.7484 | -2.4334 |
| Dagbani | English | 3.58095* | .27510 | .000* | 2.9330 | 4.2289 |
| | Both | .49004 | .27720 | .182 | -.1629 | 1.1429 |
| Both | English | 3.09091* | .27917 | .000* | 2.4334 | 3.7484 |
| | Dagbani | -.49004 | .27720 | .182 | -1.1429 | .1629 |

*Significant at the 0.05 level.

**Table 4: Convergence and Divergence of Qualitative and Quantitative Results**

| Themes and aspects | Qualitative Findings from the Interviews | Quantitative Findings from the Achievement Test |
|---|---|---|
| Effective classroom management amid language barriers | Teachers face challenges managing English proficiency disparities; strategies include peer assistance and simplified English. | Students taught in Dagbani show higher mean scores (6.2476) than those taught in English (2.6667) and a blend of both (5.7576). |
| Tackling language-related hurdles | Teachers address language difficulties using peer assistance and after-class explanations. | Students taught in Dagbani significantly outperformed those taught in English ($p < .001$). |

qualitative interviews and quantitative achievement test scores.

Qualitative results highlight the role of teachers' language proficiency and comfort in determining the chosen instructional language, whereas quantitative outcomes demonstrate significant differences in students' performance based on the language of instruction. Additionally, the qualitative data shed light on strategies employed by teachers to manage language barriers, while quantitative findings confirm that students taught in the Dagbani language exhibit better performance than those taught English. The qualitative and quantitative results complement each other, providing a comprehensive understanding of the influence of instructional language on teaching and learning mathematics.

## Discussion

The collected data about the first research question suggests that adopting English as the instructional language for mathematics presents a challenge to approximately 60% of the students. Teachers have attempted to address this concern by adjusting their teaching pace and simplifying their English explanations of concepts. However, this approach comes at the cost of covering less content within the allocated class time, potentially affecting students' performances in the BECE examination.

Previous research has underscored the substantial impact of language barriers on students' academic achievements, particularly in subjects such as mathematics (Pierce, 2003). The utilization of a second language as the medium of instruction can pose difficulties for students lacking proficiency in that language (Gándara, Rumberger, Maxwell-Jolly, & Callahan, 2003). In this context, the teacher employs diverse strategies to overcome language obstacles, including seeking support from teaching assistants and encouraging proficient students to assist their peers outside of class.

Furthermore, research has demonstrated that adjusting the teaching pace and employing simpler language can be advantageous for students who are not proficient in the instructional language (Abedi & Lord, 2001). Nonetheless, this strategy could curtail the extent of the subject matter covered within a specific timeframe, potentially impacting students' academic performance during examinations.

Language of instruction can have a significant impact on academic performance, as evidenced by previous research (Benson, 2004; Adanu & Kekessi, 2013; Dearden et al.,

2015). The theory of language immersion education suggests that using a student's native language can facilitate the transfer of knowledge and skills to a second language (Swain & Lapkin, 2000). Nevertheless, it is crucial to acknowledge that academic achievement is influenced by more than just language. Factors such as teaching methodologies, curriculum design, and the calibre of instruction also contribute to the equation (Fernández & Yoshida, 2010).

This study provides further evidence that the language of instruction impacts students' academic performance, specifically in mathematics. The results imply that both language competency and the incorporation of the native language in teaching can impact educational achievements (Cummins, 2000; Thomas & Collier, 2002). Additionally, a bilingual approach to instruction may be beneficial in diverse linguistic contexts.

## Conclusion

From the details presented, it is evident that the choice of instructional language holds substantial sway over students' mathematical achievements. Employing a student's mother tongue as the medium of instruction can yield more favourable academic results. In addition, curriculum developers should contemplate the incorporation of students' mother tongue as the instructional medium. The findings indicate that using students' native language can enhance academic achievements, particularly in subjects demanding rigorous cognitive engagement like mathematics. Consequently, educational establishments should consider integrating students' native language into instruction, particularly for subjects with intricate cognitive demands such as mathematics.

Additionally, it is recommended to pursue further research to delve into the influence of other variables like the calibre of educators, student drive, and curriculum substance on students' mathematical accomplishments. Teachers should be mindful of students' language proficiency and use appropriate strategies to address language barriers in their classrooms.

Conversely, it is essential to note that other variables such as teaching strategies, curriculum, and quality of instruction can also influence academic achievement. Therefore, it is important to consider a range of factors when designing educational programmes to optimise student learning outcomes. The study's findings also suggest that a bilingual approach to instruction may be beneficial in contexts where students come from diverse linguistic backgrounds.

Curriculum developers should consider the incorporation of students' mother tongue as the instructional medium. The findings indicate that using students' native language can enhance academic achievements, particularly in subjects demanding rigorous cognitive engagement such as mathematics. Consequently, educational establishments should deliberate on integrating students' native language into the instruction, particularly for subjects with intricate cognitive demands such as mathematics. Additionally, it is recommended to pursue further research to delve into the influence of other variables like the calibre of educators, student drive, and curriculum substance on students' mathematical accomplishments.

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