The Effectiveness Of Instructional Medium On Mathematics Achievement Of Senior High School Students In Sulu

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ABSTRACT. This study assessed the effect of instructional medium on mathematics achievement among Grade 11 students at Sulu State College. A quasi-experimental research design was applied, involving a purposive sample of 30 students equally divided into control and experimental groups. The control group received instruction solely in English, while the experimental group was taught using English supplemented with the local Sinug dialect. Both groups were given pre- and post-tests to measure mathematics performance. Pre-test results showed no significant difference between the two groups, confirming similar baseline achievement. However, post-test findings revealed that students taught with the combined English–Sinug approach achieved higher scores, reaching a "Very Satisfactory" level, in contrast to the "Satisfactory" performance of the control group. Statistical analysis using a t-test confirmed the significance of this difference. These results point to the educational value of integrating local dialects into formal instruction to support comprehension and enhance student outcomes in mathematics.

KEYWORDS: Instructional medium, Mathematics performance, Bilingual instruction, Sinug dialect

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INTRODUCTION

Mathematics serves as a foundational discipline that underpins the cultivation of higher-order cognitive skills, including deductive reasoning, analytical precision, and complex problem-solving competencies indispensable for both sustained academic advancement and adept navigation of real-world challenges. Despite its fundamental importance, extensive research consistently highlights persistent challenges in mathematics achievement among Filipino senior high school students. In the realm of curriculum development and educational consultations, institutions in the Philippines have predominantly emphasized the perspectives of professionals regarding language strategies and instructional approaches, particularly in the teaching of the English language (Chavez, 2022). Several interrelated factors contribute to these challenges, including limited comprehension of core mathematical concepts, linguistic barriers, and the efficacy of instructional delivery methods (Emelda et al., 2024). Of particular significance is the medium of instruction, which has been identified as a critical determinant of learning outcomes due to its direct impact on students' engagement and conceptual understanding (Chavez et al., 2023).

In multilingual contexts such as the Philippines, where English and Filipino are interchangeably utilized as mediums of instruction, the language employed during instructional delivery can either facilitate or impede the acquisition of mathematical knowledge (Morallo, 2023). Prior empirical findings suggest that aligning the instructional language with students' linguistic proficiency and familiarity enhances their academic performance (Chavez, 2024). However, a discernible gap remains in the literature regarding how variations in the medium of instruction affect mathematics achievement among senior high school learners in the Bangsamoro region—an area marked by distinct linguistic diversity.

Mathematics education necessitates not only cognitive mastery but also the clear communication of abstract and complex ideas (Tañola & Lomibao, 2024). The accessibility and clarity of instructional language profoundly shape students' interpretation and internalization of mathematical content. Utilizing a medium of instruction that aligns with learners' linguistic strengths can mitigate cognitive load, thereby enabling greater focus on conceptual understanding and mathematical reasoning (van & Sweller, 2025). Conversely, when the language of instruction presents comprehension challenges, students may encounter difficulties in grasping foundational concepts, which can diminish motivation and academic performance. Employing local languages in instruction fosters a supportive learning environment where students feel confident in expressing themselves, ultimately enhancing academic achievement and promoting inclusive educational practices (Phiri et al., 2024).

The Sulu archipelago exemplifies a distinctive educational landscape characterized by the interplay of local dialects, Filipino, and English in formal instruction. As McFarland (2008) emphasized, the Philippines possesses a vast wealth of indigenous languages; although these languages are related, their distinctions are considerable. Senior high school students in this region frequently navigate multiple languages, which directly influences their reception and processing of mathematical content. According to Darking-Hammomd et al. (2023), understanding the impact of the instructional medium on student achievement is critical for designing pedagogical interventions that address the linguistic and cognitive needs of these learners. Such an approach acknowledges the cultural and contextual complexities that shape educational experiences in linguistically diverse settings.

Moreover, effective mathematics instruction transcends mere content knowledge and is significantly influenced by how educators deliver material (Anthony & Wakshaw, 2009). The interplay between instructional delivery, student engagement, and language of instruction creates a dynamic learning environment that can either support or hinder academic success. Vacakarezls et al. (2024) assert that examining the influence of various mediums of instruction on this interaction is essential for identifying pedagogical best practices that foster deep understanding and long-term retention of mathematical concepts. Addressing the imperative to improve mathematics achievement and bridge existing learning gaps, this study offers timely and contextually relevant insights (Madzaro & Dio, 2020). It provides empirical evidence on the role of instructional language in shaping academic performance, which can guide the formulation of responsive teaching strategies and inclusive educational policies (Obah, 2024). Ultimately, the findings of this research aim to support educators and policymakers in cultivating learning environments that are both linguistically responsive and academically effective, particularly for senior high school students in the Bangsamoro region.

This study aims to examine the effectiveness of different mediums of instruction in enhancing mathematics achievement among Grade 11 senior high school students at Sulu State College. Specifically, it investigates student performance across varying instructional mediums through a

quasi-experimental research design. By identifying which instructional medium yields superior achievement outcomes, the research intends to contribute evidence-based insights that can inform pedagogical practices and curriculum development, especially within linguistically diverse educational contexts.

STATEMENT OF THE PROBLEM

This study sought to investigate the effectiveness of different instructional mediums on mathematics achievement among Grade 11 senior high school students at Sulu State College. Specifically, the research addressed the following questions:

1. What are the demographic characteristics of the participants in terms of gender and academic strand?

2. What is the mathematics achievement level of both the control group and the experimental group prior to the intervention (pre-test)?

3. Is there a statistically significant difference in the mathematics achievement levels between the control group and the experimental group before the intervention?

4. What is the mathematics achievement level of both groups following the intervention (post-test)?

5. Is there a statistically significant difference in the mathematics achievement levels between the experimental group and the control group after the intervention?

REVIEW RELATED LITERATURE

The Cognitive Role of Language in Mathematics Instruction

Language shape students' cognitive engagement and academic success in mathematics. As mathematics inherently involves abstract symbols, technical terminologies, and complex logical reasoning, effective communication becomes essential for fostering deep conceptual understanding (Wilkinson et al., 2018). When instructional language matches learners' linguistic proficiency, the delivery of content becomes clearer, thereby reducing misinterpretation and promoting comprehension (Comeros et al., 2024). Conversely, a mismatch between the language of instruction and students' language competence can introduce barriers that hinder cognitive processing and problem-solving efficiency.

Moreover, the relationship between language and cognitive load has been emphasized in prior research. De Jong (2010) underscored that when students face unfamiliar instructional mediums, additional mental resources are diverted to decode language, leaving fewer cognitive resources available for understanding mathematical concepts. Binothman (2023) reinforced this perspective by arguing that students' cognitive load intensifies under such conditions, which can detract from higher-order reasoning tasks. Reducing linguistic barriers through appropriate language selection thus allows students to concentrate more effectively on mathematical reasoning and application.

Instructional Language and Multilingual Educational Settings

In multilingual educational contexts, such as in many regions of the Philippines, the selection of instructional language acquires added complexity. Students often navigate multiple languages—local dialects, Filipino, and English—which can either enhance or disrupt learning depending on fluency and familiarity (Al, 2018). Research indicates that the choice of instructional medium not only affects comprehension but also significantly shapes students' confidence and engagement (Li, 2024). Language-sensitive instruction fosters greater participation, deeper conceptual understanding, and sustained motivation to learn mathematics.

Garil et al. (2024) further argued that the mode of language delivery impacts learning outcomes in much the same way that an instructor's emotional connection with learners influences the effectiveness and retention of knowledge. Instructional language, therefore, should not merely be viewed as a medium but as an active component that shapes students' willingness and ability to engage in mathematical tasks.

Pedagogical Strategies Leveraging Language to Support Mathematics Learning

Instructional effectiveness is amplified when language is employed as a tool to scaffold learning rather than solely as a conduit for information. Ertugruloglu (2023) emphasized that effective instructional delivery integrates language-based scaffolding techniques that facilitate the gradual mastery of complex concepts. Active learning strategies—such as collaborative activities and contextualized explanations—are increasingly promoted in higher education to support student engagement and understanding (Sulaiman et al., 2024).

Bairy (2019) highlighted that educators who skillfully alternate between languages, clarify mathematical terminologies, and situate problems within culturally familiar contexts provide students with multiple entry points to comprehend abstract ideas. These practices enable students to build upon their prior knowledge and integrate new information more effectively. In parallel, students' participation in interactive discussions and collaborative tasks has been shown to foster critical thinking, communication skills, and deeper comprehension (Stanikzai, 2023; Adalia et al., 2025). Mukuka et al. (2023) found that a significant proportion of teachers (53%) actively strive to develop students' mathematical reasoning skills, reflecting widespread recognition of the pedagogical importance of integrating language-sensitive approaches in mathematics instruction.

Implications for Linguistically Diverse Contexts and Research Gap

In regions with marked linguistic diversity, such as Sulu, these considerations are particularly salient. Students in such contexts face not only academic challenges but also sociolinguistic factors that shape how instructional content is perceived and processed. Hornby and Greaves (2022) emphasized that addressing both cognitive and cultural dimensions of learning through language-sensitive strategies is essential for optimizing educational outcomes.

Despite clear evidence supporting the benefits of aligning instructional language with student proficiency, limited empirical studies have examined how variations in instructional medium directly affect mathematics achievement in multilingual settings such as the Bangsamoro region. This gap highlights the necessity for context-specific investigations that inform pedagogical practices and policy development. The present study seeks to address this gap by exploring the effectiveness of different instructional mediums on mathematics achievement among senior high school students at Sulu State College, offering empirical insights to guide linguistically responsive mathematics instruction.

METHODOLOGY

Research Design

This study utilized a quasi-experimental research design to investigate the effectiveness of instructional medium on mathematics achievement among senior high school students. The design facilitated a comparison between two groups: the experimental group, which was exposed to an alternative instructional medium, and the control group, which received instruction through the conventional method (Canilao & Gurat, 2023). The quasi-experimental approach was deemed appropriate as it allowed the observation of cause-and-effect relationships within a naturally occurring educational environment, despite the absence of random assignment. Furthermore, this design provided practical insights applicable to real classroom settings where full randomization is often unattainable (Murro et al., 2023).

Participants and Sampling Technique

The participants comprised 30 Grade 11 students enrolled at Sulu State College Senior High School. A purposive sampling technique was employed to ensure the inclusion of students with comparable academic backgrounds and prior exposure to a similar mathematics curriculum. The selected participants were evenly divided into two groups of 15 students each: the experimental group and the control group. Prior to the intervention, both groups underwent a pre-test to establish baseline data on their mathematics achievement, ensuring equivalence in initial competence levels between groups.

Data Gathering Procedure

Following the administration of the pre-test, the experimental group received instruction using the identified alternative instructional medium over a designated instructional period, while the control group continued to receive instruction through the standard medium. Upon completion of the intervention, both groups undertook a post-test designed to measure mathematics achievement after the instructional period. The pre-test and post-test scores constituted the primary data for assessing student achievement and determining significant differences between the two groups (Boström & Palm, 2023).

Prior to data collection, ethical clearance was obtained by securing informed consent from all participants. The consent form explicitly outlined the objectives and purpose of the study, provisions for confidentiality, details regarding data usage and dissemination, and a voluntary participation clause. Participants were informed that they could withdraw from the study at any point without penalty (Chavez & Cenerico, 2024; Chavez & Culian, 2024).

Statistical Treatment of Data

The collected data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics—including frequency, percentage, and weighted mean—were used to summarize and describe participants' achievement levels (Yellapu, 2018). To examine differences in mathematics achievement between the experimental and control groups, an independent samples t-test was conducted at a 0.05 level of significance. This statistical procedure allowed for the determination of whether observed differences between groups were statistically significant, thus addressing the research objectives.

RESULTS

Table 1 shows the mathematics achievement levels of students in the pre-test for both control and experimental groups. The experimental group obtained a mean score of 8.93, while the control group had a mean of 9.27. Based on the Department of Education's performance criteria, both means fall under the "Fairly Satisfactory" level. This suggests that, prior to the intervention, students in both groups demonstrated low proficiency in mathematics. The similar performance may be attributed to limited mastery of basic mathematical concepts from earlier grades.

Table 1. Students' Mathematics Achievement in the Pre-Test for Control and Experimental Groups

Number of Respondent	Score (Control Group)	Competency Level (Range of Score in Percent Form)	Score (Expt'l Group)	Competency Level (Range of Score in Percent Form)
1	5	Fairly Satisfactory	9	Fairly Satisfactory
2	6	Fairly Satisfactory	12	Satisfactory
3	6	Fairly Satisfactory	7	Fairly Satisfactory
4	10	Fairly Satisfactory	18	Very Satisfactory
5	7	Fairly Satisfactory	10	Fairly Satisfactory
6	9	Fairly Satisfactory	8	Fairly Satisfactory
7	13	Satisfactory	5	Did not meet expectation
8	9	Fairly Satisfactory	12	Satisfactory
9	13	Satisfactory	6	Fairly Satisfactory
10	17	Very Satisfactory	8	Fairly Satisfactory
11	10	Fairly Satisfactory	12	Satisfactory
12	6	Fairly Satisfactory	5	Did not meet expectation
13	11	Satisfactory	9	Fairly Satisfactory
14	8	Fairly Satisfactory	7	Fairly Satisfactory
15	9	Fairly Satisfactory	6	Fairly Satisfactory
Total	**9.27**	**Fairly Satisfactory**	**8.93**	**Fairly Satisfactory**

Table 2 presents the computed t-value to determine if a significant difference exists between the pre-test scores of the control and experimental groups. The computed t-value of 0.2709 is less than the critical t-value of 1.7011 at the 0.05 level of significance. This result supports the acceptance of the null hypothesis, indicating no significant difference between the two groups before the intervention. Thus, both groups started at a comparable level in terms of mathematics achievement.

Table 2. T-Test Comparison of Pre-Test Scores Between Control and Experimental Groups

Group	Mean	Mean Difference	SD	t-Computed Value	t-Critical Value a=0.05	Decision

Control	9.267	0.334	3.262	0.2709	1.7011	H_1 Accepted
Experimental	8.933		3.474			

** P= 0.3942, one-tailed; df = 28*

Table 3 shows the posttest performance of both groups. The experimental group, which was taught using English supplemented with the local Sinug dialect, achieved a mean score of 16.27—classified as "Very Satisfactory." In contrast, the control group, taught using English alone, had a mean score of 12.13, classified as "Satisfactory." This difference suggests that incorporating the native dialect enhanced the learners' comprehension and achievement in mathematics.

Table 3. Posttest Mathematics Achievement of Students in Control and Experimental Groups

Number of Respondent	Score (Control Group)	Competency Level (Range of Score in Percent Form)	Score (Expt'l Group)	Competency Level (Range of Score in Percent Form)
1	10	Fairly Satisfactory	20	Very Satisfactory
2	5	Did not meet expectation	10	Fairly Satisfactory
3	6	Fairly Satisfactory	19	Very Satisfactory
4	14	Satisfactory	22	Outstanding
5	8	Fairly Satisfactory	21	Outstanding
6	4	Did not meet expectation	16	Very Satisfactory
7	16	Very Satisfactory	15	Satisfactory
8	19	Very Satisfactory	18	Very Satisfactory
9	22	Outstanding	13	Satisfactory
10	14	Satisfactory	7	Fairly Satisfactory
11	15	Satisfactory	8	Fairly Satisfactory
12	13	Satisfactory	19	Very Satisfactory
13	7	Fairly Satisfactory	23	Outstanding
14	17	Very Satisfactory	10	Fairly Satisfactory
15	12	Satisfactory	23	Outstanding
Total	**12.13**	**Satisfactory**	**16.27**	**Very Satisfactory**

Table 4 presents the statistical comparison of posttest scores between the control and experimental groups. The computed t-value is 2.0858, which exceeds the critical value of 1.7011 at the 0.05 significance level. This result leads to the rejection of the null hypothesis and confirms a significant difference in mathematics performance between the two groups after the intervention. The data implies that using a combination of English and Sinug as the instructional medium significantly improved students' mathematics achievement compared to using English alone.

Table 4. T-Test Analysis of Posttest Scores Between Control and Experimental Groups
the experimental group in the Posttest

Group	Mean	Mean Difference	SD	t-Computed Value	t-Critical Value a=0.05	Decision
Experimental	16.267	4.134	5.496	2.0858	1.7011	H_2 Rejected
Control	12.133		5.357			

** P= 0.0231, one-tailed; df = 28*

DISCUSSION

The pre-test results show that both the control and experimental groups started at a comparable level of mathematical proficiency. Numerous fields rely on mathematics as an essential tool worldwide. Not only is it a field of research and a subject taught in schools, but it also serves as a playground for learners as a challenging subject that can be regarded as everyone's modern-day survival kit (Cayang & Ursabia, 2024). As presented in Table 1, the experimental group recorded a mean score of 8.93, while the control group scored slightly higher at 9.27. Both scores fall under the "Fairly Satisfactory" performance level based on DepEd's mastery percentage criteria. This suggests that prior to the intervention, students from both groups exhibited similar limitations in foundational mathematics skills, which may stem from gaps in earlier instruction or limited exposure to contextualized mathematics learning. These results are consistent with widespread national concerns about learners' conceptual understanding in mathematics, particularly when instruction is delivered without linguistic scaffolding suited to the learners' backgrounds.

Table 2 confirms that there was no statistically significant difference between the two groups before the intervention. The computed t-value of 0.2709 is less than the critical value of 1.7011 at the 0.05 level of significance. This result supports the acceptance of the null hypothesis (H_1), affirming that both groups possessed equivalent academic readiness at the outset. According to Kane (2010), the absence of significant disparity validates the fairness of comparison and strengthens the reliability of conclusions drawn from post-test results. Establishing baseline equivalence is crucial for the credibility of experimental research, as it provides a sound basis for attributing post-test outcomes to the treatment applied.

After the intervention, the post-test results revealed a substantial improvement in the performance of the experimental group. As shown in Table 3, the experimental group achieved a mean score of 16.27, which corresponds to a "Very Satisfactory" performance level, while the control group obtained a mean of 12.13, categorized as "Satisfactory." This increase in achievement suggests that teaching mathematics using English supplemented with the Sinug dialect contributed to clearer understanding and higher engagement. The ability of students to process mathematical terms in both English and their native language likely facilitated more effective cognitive processing (Anchan & Soylu, 2023). The linguistic familiarity provided by the local dialect likely fostered a more supportive environment for active participation, leading to greater concept retention and skill application.

The findings strongly affirm the core premise of the study: the choice of instructional medium plays a decisive role in shaping mathematics achievement. The superior post-test performance of the experimental group underscores the effectiveness of context-sensitive pedagogy, especially in multilingual environments such as Sulu, where students engage with

academic content across multiple languages. This result directly supports prior literature emphasizing that instruction aligned with students' linguistic backgrounds fosters not only comprehension but also meaningful classroom engagement. More importantly, the data validate the instructional value of integrating local dialects to facilitate access to complex, abstract mathematical concepts. In culturally and linguistically diverse classrooms, such practices are not merely supportive—they are essential to ensuring inclusive, equitable, and effective mathematics education.

CONCLUSION

The results of this study clearly demonstrate that the integration of the local Sinug dialect alongside English significantly enhances mathematics achievement among senior high school students in a multilingual setting. While both the control and experimental groups began at comparable levels of performance, the experimental group—taught using English with Sinug as a supplementary medium—achieved notably higher scores in the post-test, reaching the "Very Satisfactory" level. This contrast, supported by a statistically significant difference in outcomes, affirms that a linguistically responsive instructional approach can bridge comprehension gaps, particularly in subjects involving abstract and technical content such as mathematics. The use of a familiar dialect did not displace the role of English as the formal medium of instruction; rather, it served to reinforce learning by making mathematical concepts more accessible and meaningful to learners. This outcome underscores the educational value of culturally and linguistically aligned pedagogies in improving academic outcomes. In contexts like Sulu, where learners often navigate between multiple languages, adopting bilingual strategies is not only relevant but essential for fostering inclusive, effective, and equitable education. These findings provide concrete evidence to support policy shifts and curriculum designs that reflect the linguistic realities of Filipino learners, particularly in regions within the Bangsamoro Autonomous Region in Muslim Mindanao.

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