

Exploring Student Perceptions and Challenges of English as a Medium of Instruction in Mathematics: A Mixed-Method Study on Problem-Solving Skills

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Abstract

This study examined Senior High School students' perceptions, challenges, and lived experiences in using English as a Medium of Instruction (EMI) in mathematics at Holy Cross of Mintal, Inc. (HCMI). Grounded in a Pragmatic Worldview, Vygotsky's Sociocultural Theory, and the Content and Language Integrated Learning (CLIL) framework, the research employed a mixed-methods approach using a convergent parallel design. Quantitative data were collected through a modified 20-item survey instrument, while qualitative data were gathered using open-ended questionnaires and unstructured interviews with purposively selected participants. Descriptive statistics and stepwise discriminant analysis were used to analyze quantitative data, while thematic analysis was applied to qualitative responses. Findings revealed a high level of positive perception toward EMI, particularly in its role in enhancing analytical thinking, confidence, and problem-solving skills. However, an average level of linguistic challenges was identified, particularly in understanding technical vocabulary and decoding complex word problems, indicating a perceptual-practical gap. The discriminant analysis showed that the perceived impact of EMI on problem-solving skills was the strongest predictor of students' perception levels. Qualitative findings further highlighted linguistic-cognitive barriers, as well as the importance of scaffolding strategies such as visual aids, bilingual support, and digital tools. The integration of findings demonstrated convergence between quantitative trends and lived experiences, emphasizing the need for adaptive instructional approaches. The study concludes that EMI can be effective when supported by multimodal and techno-linguistic scaffolding strategies and recommends institutional, instructional, and learner-level interventions to enhance comprehension and engagement. This study aligns with SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities) by addressing inclusive and equitable learning in multilingual classrooms. It contributes to educational, socio-economic, and institutional sustainability by promoting adaptive teaching practices, improving learners' problem-solving competencies, and informing context-responsive language policies.

Keywords: English Instruction, Mathematical Problem-Solving, Mixed Methods, Multilingual Education, Sociocultural Theory

1. Introduction

The use of English as a Medium of Instruction (EMI) in mathematics plays a critical role in shaping students' cognitive development, problem-solving abilities, and classroom engagement. While EMI is intended to enhance global competitiveness, its implementation in multilingual contexts such as the Philippines presents significant linguistic and pedagogical challenges. This study examines Senior High School students' perceptions, challenges, and lived experiences in using EMI in mathematics at Holy Cross of Mintal, Inc. (HCMI), integrating quantitative and qualitative insights to inform responsive instructional strategies and policy recommendations.

1.1 Background of EMI in Mathematics Learning among Multilingual Senior High School Students

Language is essential for internalizing abstract concepts, enabling higher-order thinking, and supporting complex problem-solving (Krashen, 2021). In mathematics education, proficiency in the Medium of Instruction (MOI) determines students' ability to move beyond computation toward understanding mathematical logic. In the Philippine context, English as MOI functions either as a bridge or a barrier depending on learner proficiency. Despite the global push toward EMI for internationalization, its implementation remains contested. Studies highlight linguistic challenges such as limited understanding of technical vocabulary, gaps in instructor proficiency, and reliance on code-switching that may weaken immersion (Hoang et al., 2023; Yıldız et al., 2017). Additionally, EMI may negatively affect students' psychological well-being and academic performance when adequate linguistic support is lacking (Al Zumor, 2019). The Philippine Bilingual Education Policy (DepEd Order No. 25, s. 1974) mandates EMI in mathematics to promote global competitiveness.

However, this policy often increases cognitive load for non-native English speakers who must process both language and mathematical concepts simultaneously.

1.2 Themes and Insights on Students' Perception, Challenges, and Problem-Solving under EMI

Existing literature emphasizes that students' perception of EMI significantly influences their engagement and learning outcomes in mathematics. Challenges commonly include difficulty interpreting word problems, limited comprehension of mathematical language, and reduced confidence in problem-solving tasks. The dual burden of learning both mathematical content and English language structures contributes to cognitive overload, affecting comprehension and performance. At the same time, adaptive practices such as code-switching and translanguaging emerge as coping mechanisms that support understanding but may also signal gaps in EMI effectiveness (Hoang et al., 2023; Yıldız et al., 2017). These dynamics highlight the complex interaction between language proficiency, perception, and problem-solving skills.

1.3 Local, National, and Global Context of EMI in Mathematics Education

Globally, EMI is promoted as a strategy for academic internationalization, yet it presents challenges in multilingual settings. International studies report linguistic barriers, reduced comprehension, and emotional strain among learners using EMI (Al Zumor, 2019; Hoang et al., 2023; Yıldız et al., 2017). Nationally, the Philippine education system institutionalizes EMI through the Bilingual Education Policy (DepEd Order No. 25, s. 1974). However, this top-down implementation often overlooks regional linguistic diversity. Locally, in Davao City, Cebuano and indigenous languages dominate daily communication. This linguistic context creates barriers for students learning mathematics through English, particularly in decoding word problems (Jordan, 2018). At Holy Cross of Mintal, Inc. (HCMi), teachers employ translanguaging strategies to support comprehension, reflecting a gap between policy expectations and classroom realities.

1.4 Theoretical and Conceptual Basis for EMI, Cognition, and Multilingual Learning

This study is grounded in a Pragmatic Worldview, emphasizing practical solutions derived from both quantitative and qualitative data to address real classroom challenges. It integrates Vygotsky's Sociocultural Theory, which positions language as a critical tool in cognitive development and as a bridge to the Zone of Proximal Development (ZPD), where learning occurs through guided interaction. Within this framework, English serves as a mediating tool that can either facilitate or hinder learning depending on the level of support provided. Difficulties in language processing may limit students' participation, confidence, and engagement in collaborative learning environments. The study also adopts the Content and Language Integrated Learning (CLIL) Framework, which addresses the dual demands of content mastery and language acquisition. Through its four dimensions—Content, Communication, Cognition, and Culture—the framework provides a structured approach to analyzing EMI in mathematics and guiding the development of an integrated intervention program.

1.5 Research Gaps on EMI Challenges in Multilingual Mindanao Contexts

Although international and national studies have examined EMI, there is limited research focusing on the specific linguistic challenges faced by students in multilingual regions such as Mindanao. Existing literature does not sufficiently capture how local languages, cultural context, and classroom practices influence students' perceptions and problem-solving abilities under EMI. Furthermore, there is a lack of studies that integrate both quantitative and qualitative data to examine learners' lived experiences alongside measurable outcomes. This gap underscores the need for context-specific research that informs responsive instructional strategies and policy adjustments.

1.6 Alignment with Relevant Sustainable Development Goals (SDGs)

This study aligns with SDG 4: Quality Education, which promotes inclusive and equitable education and lifelong learning opportunities. By examining the effectiveness of EMI in mathematics, the research contributes to improving instructional practices and ensuring that language does not become a barrier to learning. It also supports SDG 10: Reduced Inequalities by addressing linguistic disparities among students in multilingual settings, ensuring that learners from diverse linguistic backgrounds have equitable access to quality education.

1.7 Importance of the Study to Multidisciplinary Sustainability

This research contributes to educational sustainability by promoting adaptive and inclusive teaching strategies that respond to learners' linguistic needs. It supports socio-economic sustainability by enhancing students' problem-solving skills and academic performance, which are essential for future employment and global competitiveness. Additionally, the study advances cultural and community sustainability by recognizing and valuing multilingualism in the learning process, ensuring that local languages and identities are not marginalized. It also contributes to policy and institutional sustainability by providing evidence-based insights that can guide the Department of Education (DepEd) in developing more responsive and context-sensitive language policies.

2. Material and methods

2.1 Research Design

The study utilized a Mixed-Methods Research Design to capture the complex interaction between language proficiency and mathematical problem-solving. By integrating quantitative and qualitative approaches, the design enabled a comprehensive understanding of both measurable outcomes and lived experiences (Li et al., 2015). Specifically, a Convergent Parallel (Concurrent Triangulation) Design was employed, wherein both data types were collected simultaneously but analyzed independently before integration. This design facilitated triangulation by comparing statistical findings with narrative accounts, enhancing the validity and depth of the results (Wilson, 2014; Bell et al., 2022). The quantitative component focused on identifying patterns in student perceptions and performance, while the qualitative component provided detailed descriptions of students' linguistic challenges. Integration occurred during interpretation, allowing the convergence of statistical trends and experiential insights to form a coherent basis for instructional intervention.

2.2 Locale of the Study

The study was conducted at Holy Cross of Mintal, Inc. (HCMI) in Davao City, a multilingual context where Cebuano and other local languages dominate daily communication. This linguistic environment presents unique challenges for students required to learn mathematics through English as the Medium of Instruction. The locale is significant as it reflects the realities of multilingual classrooms where language proficiency directly influences comprehension and problem-solving.

2.3 Respondents of the Study

The respondents consisted of Senior High School students at HCMI who are actively engaged in learning mathematics through EMI. These learners were selected because they are directly experiencing the linguistic and cognitive demands associated with English-based instruction in mathematics. Their participation enabled the study to capture both general trends and individual experiences related to EMI.

2.4 Sample and Sampling Procedure

The study employed purposive sampling for the qualitative component, selecting fifteen participants to provide in-depth insights into their experiences. These participants were chosen based on their ability to articulate challenges related to EMI. Data collection in the qualitative phase followed a two-step process. First, participants completed an open-ended questionnaire that allowed them to freely describe their difficulties in interpreting mathematical problems in English. Second, unstructured clarificatory interviews were conducted to validate and expand upon their responses. This sequential approach ensured the authenticity and depth of the qualitative data by combining written and spoken narratives. For the quantitative component, a broader group of students participated in the survey, allowing for the analysis of patterns and relationships between language proficiency and mathematical performance.

2.5 Research Instrument

The primary quantitative instrument was a modified 20-item survey adapted from Bukhari and Awan (2018), designed to measure students' perceptions of EMI and its impact on problem-solving. To ensure contextual relevance, the instrument underwent content validation by experts and was tested for internal reliability using Cronbach's Alpha, with a minimum acceptable coefficient of 0.70. The qualitative instruments included open-ended questionnaires and unstructured interviews. These tools were designed to capture students' lived experiences, including linguistic difficulties, emotional responses such as language anxiety, and coping mechanisms such as translanguaging. The combination of structured measurement and open-ended inquiry enabled a comprehensive assessment of EMI's effects.

2.6 Data Gathering Procedure

Data collection was conducted concurrently for both quantitative and qualitative components. Survey questionnaires were administered to gather numerical data on students' perceptions and performance, while qualitative data were collected through open-ended responses and follow-up interviews. The qualitative process began with the completion of open-ended questionnaires, followed by clarificatory interviews to explore emerging themes and verify participants' responses. This dialogic approach ensured that students' perspectives were accurately represented and deeply contextualized. The simultaneous collection of both data types supported the convergent design of the study and facilitated later integration.

2.7 Data Analysis Techniques

Data analysis followed a convergent parallel approach, where quantitative and qualitative data were analyzed separately and then integrated. Quantitative data were processed using statistical software. Descriptive statistics, including weighted mean and standard deviation, were used to determine central tendencies in students' perceptions and performance. Stepwise Discriminant Analysis was then applied to identify linguistic variables that significantly differentiate levels of problem-solving proficiency. Qualitative data were analyzed using Thematic Analysis based on the framework of Braun and Clarke (2006). This involved transcription, familiarization with the data, coding of recurring patterns, and the development of

themes such as language anxiety, translanguaging practices, and conceptual decoding challenges. The final stage involved data integration through side-by-side comparison. Quantitative findings were compared with qualitative themes to identify convergence or divergence. This process led to the development of meta-inferences that synthesize statistical results and lived experiences into a unified explanation. These integrated findings served as the empirical foundation for the proposed instructional intervention at HCMI.

3. Results and Discussion

3.1 Learners' Perception, Challenges, and Predictors of EMI Effectiveness

3.1.1 Overall Perception and Challenges in Using EMI

The results revealed an overall high level of perception toward EMI, with a mean of 3.78, indicating that students generally recognize its importance in mathematics learning. High ratings were observed in perception and importance, impact on problem-solving skills, and preferences for EMI-supported strategies, while challenges in learning mathematics through EMI were rated at an average level. Students reported strong agreement that EMI enhances understanding, confidence, and critical thinking, but also indicated moderate difficulty in understanding mathematical terminology, translating problems, and coping with limited English fluency. These findings indicate a perceptual-practical gap in which students value EMI but experience linguistic barriers in its application. This aligns with the notion that EMI fosters instrumental motivation while simultaneously imposing cognitive demands, particularly in decoding complex language structures (Curle et al., 2020). The presence of moderate challenges suggests that without sufficient scaffolding, students may struggle to transition from basic comprehension to deeper conceptual understanding. This supports the need for targeted instructional strategies to develop Cognitive Academic Language Proficiency (Macaro et al., 2019; Thompson et al., 2022; Pérez-Cañado, 2022).

3.1.2 Distribution of Learners by EMI Perception Level

The findings showed that the majority of learners were clustered within the high perception category, accounting for 57.50% of the respondents, followed by those in the very high and average groups, while only a small proportion exhibited low perception. This indicates that most students hold positive attitudes toward EMI, with mean scores ranging widely across groups, reflecting variability in perception levels. This distribution suggests a strong language-positive culture within the institution, where students generally accept and value EMI. However, the presence of learners in the average to low categories highlights a subgroup experiencing linguistic challenges that may hinder their academic performance. This supports findings that EMI effectiveness depends on students' baseline language proficiency and may lead to unequal learning outcomes if not supported (Rose et al., 2021; Uchihara & Harada, 2021; Pivovarova et al., 2022). The variation in perception underscores the need for differentiated instruction to address diverse learner needs and prevent marginalization (Sierens et al., 2020).

3.1.3 Discriminant Factors Influencing EMI Perception

The results of the discriminant analysis indicated a significant model with strong discriminatory power, identifying the impact of EMI on problem-solving skills as the most influential factor separating perception groups. Preferences and recommendations, challenges, and perception of EMI also contributed significantly to the model, with a high canonical correlation indicating a strong relationship between these variables and group classification. The model demonstrated high classification accuracy, correctly identifying a large proportion of cases and maintaining stability through cross-validation. These findings suggest that students' perception of EMI is largely driven by its perceived cognitive utility, particularly its role in enhancing analytical thinking. This supports the idea that instrumental utility is a key determinant of engagement in EMI contexts (Jiang et al., 2023). The inclusion of challenges and preferences as significant predictors further indicates that linguistic difficulties and instructional supports are interconnected factors influencing learning outcomes. The high predictive accuracy of the model reinforces the importance of addressing both cognitive and linguistic dimensions to improve student performance and perception (Rose et al., 2021; Thompson et al., 2022).

3.2 Lived Experiences and Challenges in EMI-Based Mathematics Learning

The qualitative findings revealed that students experience linguistic-cognitive barriers, particularly in understanding unfamiliar vocabulary and interpreting complex mathematical expressions in English. Learners described slow comprehension and difficulty decoding word problems, which often required additional effort in translation before solving. At the same time, students acknowledged that EMI enhances their ability to understand mathematical concepts and prepares them for global academic standards. They also emphasized the importance of instructional support, including pre-teaching vocabulary, using visual aids, and integrating digital tools such as Generative AI to facilitate understanding. These results reflect the dual nature of EMI as both a barrier and a facilitator of learning. From the perspective of Sociocultural Theory, language functions as a mediating tool, but when not fully mastered, it can hinder cognitive development within the Zone of Proximal Development (Vygotsky, 1978; Hoang et al., 2023). The students' reliance on scaffolding strategies supports the CLIL framework, which emphasizes the integration of content and language learning to reduce cognitive load (Pérez-Cañado, 2022). The emergence of technology-based solutions highlights the evolving role of digital tools in addressing linguistic challenges and enhancing comprehension (Thompson et al., 2022; Jiang et al., 2023).

3.3 Integration of Quantitative and Qualitative Findings

The integration of findings demonstrated strong convergence between quantitative results and qualitative themes. The statistical identification of the impact of EMI on problem-solving as a key predictor was supported by students' experiences of improved understanding once language barriers were overcome. Similarly, the moderate level of challenges identified quantitatively was explained qualitatively as difficulties in decoding terminology and interpreting problem statements. The findings also revealed a convergence in pedagogical preferences, with both data sources emphasizing the importance of visual aids, bilingual support, and digital tools in facilitating learning. This convergence highlights a decoding paradox in which students are motivated by the benefits of EMI but are hindered by linguistic complexity. The alignment of findings supports the CLIL framework, emphasizing the synergy between language and content learning (Pérez-Cañado, 2022). It also reflects Sociocultural Theory, where language acts as both a tool and a barrier depending on the level of support provided (Vygotsky, 1978; Hoang et al., 2023). The integration further underscores the necessity of adopting technolinguistic scaffolding approaches to enhance student engagement and performance, particularly through the use of multimodal and digital resources (Jiang et al., 2023; Rose et al., 2021).

4. Conclusion & Recommendations

The study concludes that Junior High School learners at Holy Cross of Mintal, Inc. demonstrate a high level of positive perception toward English as a Medium of Instruction (EMI), largely due to its perceived role in enhancing analytical thinking and global academic readiness. However, a perceptual-practical gap persists, as students simultaneously experience moderate linguistic challenges, particularly in understanding mathematical terminology and complex language structures. The findings show that students' perceptions are strongly influenced by the perceived impact of EMI on problem-solving, indicating that motivation remains high when learners recognize its cognitive value despite existing difficulties. Qualitative insights further reveal that these linguistic barriers contribute to delays in comprehension, prompting students to rely on scaffolding strategies such as digital tools and visual aids. Overall, the effectiveness of EMI depends on adopting an adaptive pedagogical approach that integrates linguistic support and instructional innovations to ensure that language facilitates rather than hinders mathematical understanding.

It is recommended that learners adopt language-focused study habits by utilizing glossaries and translation tools to better understand mathematical problems before solving them. Teachers should implement multimodal instructional strategies, incorporating visual aids and other supportive resources to address linguistic challenges. The school administration should institutionalize a structured intervention program that integrates digital tools and supports English-mediated instruction within the curriculum. Parents are encouraged to provide a supportive learning environment by reinforcing the use of English and educational resources at home. Future researchers should extend this study by examining the predictive relationships of language and problem-solving across different educational contexts and levels.

The study is limited to Junior High School learners at Holy Cross of Mintal, Inc., which may restrict the generalizability of the findings to other contexts or populations. The use of self-reported data may also introduce subjectivity in measuring perceptions and challenges. Additionally, the study focuses primarily on the relationship between language and problem-solving within a specific instructional setting, which may not fully capture other external factors influencing student performance.

Compliance with ethical standards

The authors declare no conflict of interest, and this study received no external funding. The researchers express gratitude to the Junior High School learners and the administration of Holy Cross of Mintal, Inc. for their participation and support. Participation was voluntary, and informed consent was obtained from all participants prior to data collection, which was conducted using non-invasive methods. All data were treated with strict confidentiality, and no identifying information of the participants was disclosed.

REFERENCES

- Al Zumor, A. W. Q. (2019). Challenges of using English as a medium of instruction in higher education. *Arab World English Journal*, 10(2), 122–135.
- Baheiraei, A., Mirghafourvand, M., Mohammadi, E., & Charandabi, S. M. A. (2011). Facilitators and barriers to health research participation: A qualitative study. *Journal of Multidisciplinary Healthcare*, 4, 47–54.
- Bell, E., Bryman, A., & Harley, B. (2022). *Business research methods* (6th ed.). Oxford University Press.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Bukhari, S. F., & Awan, M. S. (2018). Students' perceptions of English as a medium of instruction in mathematics. *Journal of Education and Practice*, 9(15), 10–18.
- Coyle, D., Hood, P., & Marsh, D. (2010). *CLIL: Content and language integrated learning*. Cambridge University Press.
- Curle, S., Elias, N., & Al-Adnani, S. (2020). English medium instruction in higher education: The role of English proficiency in student beliefs and performance. *International Journal of Applied Linguistics*, 30(2), 279–291.
- Hoang, G., & Lin, A. M. (2023). Exploring the impact of EMI on mathematical conceptualization in multilingual settings. *Journal of Language, Identity & Education*, 22(4), 312–328.
- Jiang, X., & Zhang, L. J. (2023). Predictors of success in English-medium instruction: A discriminant analysis of linguistic and affective factors. *Applied Linguistics Review*, 14(3), 455–478.
- Jordan, N. C. (2018). Early language and mathematics development: The role of language in learning mathematics. *Developmental Psychology*, 54(1), 1–12.
- Krashen, S. D. (2021). *Second language acquisition and second language learning* (Updated ed.). Cambridge University Press.
- Li, S., Zhu, Y., & Ellis, R. (2015). The effects of task-based language teaching on language learning outcomes. *Applied Linguistics*, 36(3), 1–25.
- Macaro, E., Curle, S., Pun, J., An, J., & Dearden, J. (2019). A systematic review of English medium instruction in higher education. *Language Teaching*, 51(1), 36–76.
- Pérez-Cañado, M. L. (2022). CLIL and EMI: Different names for the same thing? *Applied Linguistics Review*, 13(5), 725–751.
- Pivovarova, M., & Powers, J. M. (2022). Language proficiency and the academic achievement of students in EMI programs. *International Journal of Bilingual Education and Bilingualism*, 25(6), 2110–2124.
- Rose, H., McKinley, J., & Galloway, N. (2021). The role of proficiency in EMI: A study of student self-efficacy and language challenges. *System*, 96, 102554.
- Sierens, S., & Van Avermaet, P. (2020). Bilingualism and mathematical performance: The mediating role of language proficiency. *Journal of Educational Psychology*, 112(7), 1345–1360.
- Thompson, G. L., & Khawaja, A. J. (2022). Linguistic barriers and student success in English-mediated STEM education. *Journal of Multilingual and Multicultural Development*, 43(5), 389–405.
- Uchihara, T., & Harada, T. (2021). Roles of English proficiency and vocabulary knowledge in EMI student academic success. *Journal of Multilingual and Multicultural Development*, 42(6), 543–558.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wilson, J. (2014). *Essentials of business research: A guide to doing your research project*. SAGE Publications.
- Yıldız, M., & Yeşilyurt, S. (2017). The effect of English medium instruction on students' academic achievement: A meta-analysis study. *Journal of Language and Linguistic Studies*, 13(2), 1–17.