Ethnomathematical Practices of Junior High School Teachers in a Waray-Speaking Rural Municipality in Leyte

Angel E. Buena

angeledizabuena@gmail.com
Leyte Normal University, Tacloban City 6500, Philippines

Abstract

Despite growing recognition of ethnomathematics as a culturally responsive approach to mathematics education, its integration into classrooms remains largely informal and inadequately documented, particularly in minority language communities. In the Philippines, Waray-speaking communities in Leyte remain underexplored in ethnomathematics literature, leaving a significant gap in culturally responsive mathematics education. Using a single case study design, this study examined the ethnomathematical practices of junior high school mathematics teachers in a rural municipality in Leyte. Data were collected through semi-structured interviews with eleven teachers and lesson plan analysis. Findings revealed that teachers employ culturally grounded instructional practices by drawing on the Waray language, local livelihoods, community spaces, and social practices as mathematical contexts. However, these practices are only selectively reflected in formal lesson documentation. Cultural contexts appear in limited lesson plan components, while the Waray language is entirely absent despite its extensive use in classroom instruction. Teachers viewed sociocultural resources positively, identifying the Waray language as a tool for facilitating mathematical understanding and engagement and cultural relevance as a driver of student participation. However, while teachers view ethnomathematics as a pathway to more transformative mathematics instruction, structural, curricular, and student-level constraints continue to hinder its sustained integration. These findings highlight the need for institutional frameworks that formally recognize and support the integration of culturally responsive practices in mathematics instruction.

Keywords: ethnomathematics, culturally responsive mathematics education, Waray language, Leyte, case study

1. Introduction

Mathematics has long been regarded as a universal language and is often seen as abstract and detached from real life. It is frequently taught through formal processes with normative and dogmatic principles far from society's socio-cultural realities (Hendriyanto et al., 2023). However, this view overlooks how the processes of teaching and learning are deeply influenced by culture, language, and context. Ethnomathematics, a term coined by D'Ambrosio (1985), explores this relationship by looking at how mathematical concepts are ingrained in the customs, artifacts, and day-to-day activities of different cultural groups. In culturally diversified societies, recognizing the role of ethnomathematics is crucial in making mathematics more relevant and meaningful to learners.

In the Philippines, the Department of Education (DepEd) promotes culturally relevant instruction through the MATATAG curriculum or the Revised K-10 Curriculum (DepEd, 2024). Moreover, the implementation of the Mother Tongue-Based Multilingual Education (MTB-MLE), in its recent adjustment, promotes the use of mother tongue as a medium of instruction in early grades in monolingual classes (DepEd, 2025). Furthermore, in the Indigenous Peoples Education (IPEd) curriculum, mathematics education aims to tailor formal mathematics instruction to the cultural norms of Indigenous Peoples (IP) communities in the country (DepEd, 2015). These initiatives reflect DepEd's commitment towards making education culturally relevant and meaningful.

However, despite DepEd's efforts, implementing culturally relevant instruction remains a challenge among educators. According to Pepano (2019) and Cubillas et al. (2021), the unavailability of resources is the primary challenge in the implementation of contextualized instruction in the Philippines. Moreover, Alabat and Oledan (2024) suggested that teachers struggle to incorporate culturally diverse lessons into instruction due to differing cultural and teaching methods, lack of necessary skills, insufficient resources, lack of culturally relevant teaching materials, resistance to change among teachers, language barriers, and reliance on traditional teaching methods.

The struggle in implementing culturally relevant mathematics education is a challenge that is also experienced by educators in Waray-speaking communities. Despite being the fourth largest ethnolinguistic group in the Philippines who inhabit the islands of Samar and Leyte in the Eastern Visayas Region, Waray is less

explored and less documented in existing literature (Madeja et al., 2017). The dearth of literature on the Waray context challenges the implementation of ethnomathematical practices in classrooms within Waray communities. Additionally, the differing demographic composition of students in Waray classrooms may shape how learners engage with ethnomathematics.

Moreover, the challenge in incorporating culturally relevant mathematics education is further compounded in junior high school (JHS) classrooms. As a pivotal stage in Philippine education, JHS learners transition from concrete mathematical ideas taught in primary education to more abstract mathematical reasoning, as stipulated in DepEd's Most Essential Learning Competencies (MELCs) and MATATAG Mathematics Curriculum (Teach Pinas, 2025; DepEd, 2024). As students deal with mathematical concepts of increasing complexity, they may face greater challenges in engaging with and grasping mathematical lessons if these are taught in a way that is completely disconnected from their culture. Exploring how Waray-speaking classrooms integrate cultural knowledge and practices into mathematics teaching and learning can therefore provide valuable insights towards enhancing culturally relevant mathematics education and promoting better mathematical understanding.

Thus, this study examined the ethnomathematical practices of junior high school mathematics teachers in a Waray-speaking rural municipality in Leyte, Philippines. Specifically, it aimed to document and describe the ethnomathematical practices employed in mathematics instruction, determine how these practices are reflected in formal lesson plans, explore teachers' perceptions on the role of Waray language, cultural artifacts, and local practices as mediators of mathematical understanding, and identify the challenges and opportunities teachers encountered in integrating ethnomathematical practices into mathematics instruction. The findings of this study seek to contribute to the Sustainable Development Goals (SGD), particularly SGD 4: Quality Education, by enriching the growing body of ethnomathematics literature in the Philippine context and informing teachers, curriculum developers, and education policymakers in promoting more inclusive and culturally grounded mathematics instruction.

1.1 Statement of the Problem

Grounded on Vygotsky's Sociocultural Theory (SCT), this study aims to fill the gap in lack of literatures focusing on how JHS mathematics teachers in Waray-speaking classrooms incorporate ethnomathematical practices in teaching mathematics concepts. Specifically, the study aims to answer the following research questions:

1. What ethnomathematical practices do junior high school mathematics teachers report using in their classrooms in a Waray-speaking rural municipality?
2. How are ethnomathematical practices reflected in the lesson plans of junior high school mathematics teachers?
3. How do teachers perceive the use of the Waray language, cultural artifacts, and local practices as mediators of students' mathematical understanding?
4. What challenges and opportunities do teachers report encountering in integrating ethnomathematical practices into their mathematics instruction?

2. Methodology

This section of the study encompasses the design, locale, respondents, instruments used, data gathering process, statistical analysis procedures, and ethical considerations of the study.

2.1 Research Design

This study used a single case study design. Yin (2018) states that this design is appropriate when the case is revelatory or representative, among others. The case, which consists of JHS mathematics teachers in a Waray speaking rural municipality in Leyte, is revelatory since no prior study has systematically documented their ethnomathematical practices, and representative since it reflects the day-to-day realities of rural mathematics instruction in Waray speaking communities in Leyte. This design allowed the researcher to explore and understand the ethnomathematical practices of JHS mathematics teachers in depth.

2.2 Study Locale and Participants

This study was conducted in four public high schools in a Waray-speaking rural municipality in Leyte. The community is predominantly composed of Waray speakers whose culture, traditions, and local practices are embedded in daily life. Learners in these schools are mostly children of farmers, fisherfolk, and small-scale workers, reflecting the rural socio-economic conditions of the area. The Waray language serves as the main

medium of communication in both community and educational settings, giving the locale a strong linguistic and cultural identity. This locale was selected because it provides a meaningful cultural context where ethnomathematical practices naturally emerge in mathematics teaching and learning. The participants were 11 public JHS mathematics teachers in the research locale who were actively engaged in classroom instruction during the data collection period, which is consistent with Creswell and Creswell's (2018) recommendation of at least 10 participants for qualitative studies to achieve data saturation. The study used purposive sampling, a technique in which participants are deliberately selected based on their knowledge and relevance to the research topic (Hassan, 2024). Teachers were selected on the condition that they are handling mathematics at the JHS level during the data gathering period, integrating real life or culturally relevant examples in their instruction, and willing to participate in the study. The schools, on the other hand, were selected on the condition that they are located within the identified Waray speaking rural municipality in Leyte and must have granted research permission within the study's time constraints.

2.3 Research Instrument

The interview guide and document analysis guide were both researcher-made. To ensure content validity, these were submitted for expert validation by four specialists consisting of one language expert and three mathematics experts. The instruments were then pilot tested and the results served as the basis for revisions before the actual data collection.

2.4 Data Gathering Procedure

Prior to data collection, the researcher coordinated with the DepEd Division Office and school administrators to seek permission. A formal courtesy call was made to the school heads and teacher participants to explain the objectives, methods, and expected outcomes of the study, followed by securing informed consent from all participants. The researcher then conducted a 30 to 45-minute semi-structured interview with each participant to gather data on their ethnomathematical practices, their perceptions of student engagement with ethnomathematical content, and the challenges and opportunities they encounter in integrating ethnomathematics in the classroom. Prior to recording, permission was asked from each participant and they were informed of their right to skip questions or withdraw at any time without penalty. To complement the interview data, the researcher also collected and reviewed the lesson plans of the participants to understand how they incorporate Waray culture in planning lessons and to confirm their reported ethnomathematical practices. The confidentiality of all participants' identity was protected throughout the entire data collection process.

2.5 Data Analysis

The data gathered in this study were systematically analyzed. The semi-structured interview recordings were transcribed verbatim to ensure accuracy in data interpretation, while notes were taken and relevant contents were highlighted from the lesson plans to identify ethnomathematical practices. The researcher then employed Braun and Clarke's (2014) thematic analysis, following six phases: familiarization with the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up. Triangulation was conducted by comparing and cross-validating data from both sources to enhance the credibility and trustworthiness of the findings, with emerging themes interpreted relative to the research questions of the study.

To further establish trustworthiness, member checking was conducted by presenting the interpreted data and initial findings to the teacher participants through Messenger for feedback, clarification, and validation. An audit trail was also maintained, documenting the research design, data collection procedures, and analysis steps to ensure the stability and consistency of the data over time. To ensure that the findings were grounded in the participants' experiences rather than the researcher's own bias, triangulated sources and direct quotations from the participants were used in data interpretation. Reflexive journaling was likewise practiced throughout the study, wherein the researcher recorded personal thoughts, biases, and decisions made during data collection and analysis.

2.6 Ethical Considerations

This study observed strict ethical standards throughout its conduct. Prior to data collection, approval was secured from the Research Ethics Committee of Leyte Normal University, followed by permission from the DepEd Leyte Division Schools Superintendent and the principals of the concerned schools. Informed consent was then secured from the teacher participants, who were properly informed about the purpose of the study, data collection procedures, their right to withdraw at any time without penalty, the minimal risks and benefits, and the confidentiality provisions of the study. Permission was also explicitly asked before conducting audio recordings and collecting lesson plans. To address minimal risks such as minor physical or emotional discomfort, interviews

were conducted in a private and comfortable environment, questions were framed with sensitivity, and participants were given the option to skip any question they were not comfortable answering. Data collection activities were also scheduled during the participants' free time to minimize inconvenience. Throughout the study, the participants' identities were protected through the use of pseudonyms and all data gathered were properly stored and secured to ensure confidentiality and data privacy.

3. Results and Discussion

This section presents the findings of the study along with the analysis and interpretation of the data gathered. The thematic analysis of the semi-structured interview and document analysis yielded four major themes as summarized in Table 1.

Table 1. Summary of Themes and Sub-themes

	Themes	Sub-themes
1.	Culturally grounded instructional practices	1.1 Use of Waray language as an instructional strategy 1.2 Integration of local livelihood 1.3 Utilization of local spaces 1.4 Incorporation of community's social practices
2.	Selective and informal documentation of ethnomathematical practices	2.1 Partial presence of cultural contexts in lesson plan components 2.2 Absence of Waray language in formal lesson documentation
3.	Perceived role of sociocultural resources in mediating mathematical understanding	3.1 Waray language as a medium for mathematical understanding 3.2 Waray language as a tool for engagement 3.3 Cultural relevance as a motivator for participation
4.	Perceived opportunities and challenges in culturally grounded teaching	4.1 Structural and curricular barriers 4.2 Student-level challenges 4.3 Opportunities for transformative mathematics instruction

3.1 Culturally Grounded Instructional Practices

The first theme captures the various ethnomathematical practices employed in the classroom by junior high school mathematics teachers in a Waray-speaking rural municipality in Leyte. This theme is composed of four sub-themes: the use of Waray language as an instructional strategy, the integration of local livelihood, utilization of local spaces, and incorporation of community's social practices. Together, these sub-themes reveal how the participants weave the Waray language and the cultural fabric of their community into formal mathematics teaching at the junior high school level.

3.1.1 Use of Waray Language as an Instructional Strategy

Despite English being the mandated medium of instruction in mathematics, all participants reported a heavy and consistent reliance on the Waray language during classroom instruction. Notably, all participants indicated that they regularly translate mathematical ideas, concepts, and instructions into Waray at various points throughout their lessons. As Participant 1 candidly noted, "sometimes, not only sometimes. I think that is 99%, I am translating it into Waray." This sentiment was echoed by Participant 6, who emphasized the need to adapt instruction to where learners actually are: "You need to adjust so you can meet them where your students are. So, you will really need to use Waray language in almost every lesson just so they will understand."

This heavy reliance on Waray is not merely habitual but constitutes a deliberate pedagogical strategy aimed at delivering more effective mathematics instruction. As Participant 7 explained, "if I will keep on talking in English, the students will not understand. There are some who will, but most of the students don't understand it quickly. So, I really try to translate to Waray, especially the rules and during giving examples." Several participants further shared that they tend to shift from English to Waray when providing in-depth explanations of mathematical concepts, particularly when students appear confused or are visibly struggling to grasp the lesson. Participant 3illustrated this, noting that, "if I see that the students did not really understand the concept by looking at their facial expressions, I really have to switch to speaking in Waray in explaining the concepts."

Beyond concept explanation, teachers also draw on Waray when relaying activity instructions and translating word problems. Participant 5 elaborated on this practice: "I usually incorporate the use of Waray language in given word problems where students often struggle with comprehension. So, I really need to translate what the English phrases and words mean. I also further explain the instructions in Waray because if they fail to understand the instructions, they will not be able to answer the problems given to them." Additionally, some participants reported allowing students to respond and express their ideas in Waray during classroom interactions.

As Participant 9 noted, "students are allowed to use or speak in Waray for them to express their ideas and answers because they sometimes struggle to communicate their thoughts in English."

Taken together, these practices illustrate how teachers strategically integrate the Waray language into formal instruction to bridge the communicative gap between the learners and the mathematical content being taught. These findings resonate with a broader body of literature affirming the role of mother tongue and familiar language in mathematics learning. Simbre and Cabigas (2025) demonstrate that when teachers use the learners' vernacular, it facilitates a stronger grasp of discussions, leading to improved learning outcomes in mathematics. These findings further affirm Vygotsky's (1987) SCT, which underscores the central role of language as a mediating tool in the process of knowledge acquisition. In this context, Waray functions not as a deviation from formal instruction but as an essential scaffold that connects learners to mathematical understanding.

3.1.2 Integration of Local Livelihood

Another prominent ethnomathematical practice reported by the participants is the deliberate integration of local livelihood into mathematics instruction. Situated in a community whose economic life revolves primarily around fishing and farming, the teachers draw from these familiar experiences when constructing examples, illustrations, and problems related to the mathematical topics being discussed.

Several participants reported substituting textbook examples with locally recognizable ones to avoid confusion and to make mathematical content more accessible. As Participant 7 shared, she ensures that the examples she uses are those familiar to her students: "for instance, I use *bayabas* (guava) instead of dragon fruit in my examples because the students are more familiar with it and to avoid confusion among students in using unfamiliar examples."

This practice extends further into the integration of common trading and livelihood practices in the community. Participant 5 described how he incorporates non-standard units of measurement used by local fishermen and farmers as an entry point into discussing formal standard units of measurement. He explained that community members typically sell their produce using locally recognized non-standard measures rather than standard ones. For instance, fish is sold by plates rather than by kilograms, a practice locally referred to as *plinato*, while firewood is sold in cylindrical bundles known as *binuto*k. Similarly, Participant 10 noted that he introduces the concept of measurement through locally practiced units such as *dangaw*, a hand-span-based measure, and *ganta*, a traditional unit commonly used for measuring rice which is composed of 6 tin cans of rice and is roughly equivalent to 2.5 kilograms. From these culturally grounded entry points, both participants transition into the formal academic discussion of the topic.

(a) (b)

Fig. 1. (a) fish sold by plinato; (b) firewood sold by binutok

Fig. 2. rice measured in ganta

Local commercial practices are also drawn upon when teaching concepts related to commerce and percentage. Participant 5 incorporated the community practice of giving *suhol*, a form of commission given to individuals who go around the community selling products, a practice known as *sudoy*, when teaching the concept of commission. He noted that many learners are familiar with this practice, either as buyers from local sellers called *paragsudoy* or as sellers themselves of everyday goods like *pandesal* (a staple bread roll commonly eaten for breakfast). Meanwhile, Participant 9 drew from the common practice of negotiating for a discount, or *tawad*, when purchasing goods, using this as a relatable context for teaching the concepts of percentage and discount. She also shared that she incorporates demonstrations of how to convince sellers to give discounts, conducted in Waray, as part of this discussion.

An equally compelling integration was described by Participant 6, who uses the local livelihood of collecting coconut sap, known as *pananganggot*, as a context for teaching angles of elevation and depression. Rather than relying on the conventional example of airplane travel, she draws from this culturally familiar activity: "instead of using the experience of riding on an airplane, I use the concept of pananganggot in discussing the difference between angle of elevation and depression. I ask the students if they know someone who does pananganggot or if they personally do it since some students are also involved in this practice." From this, she guides students in identifying what type of angle is formed when looking downward from the top of a coconut tree while collecting coconut sap.

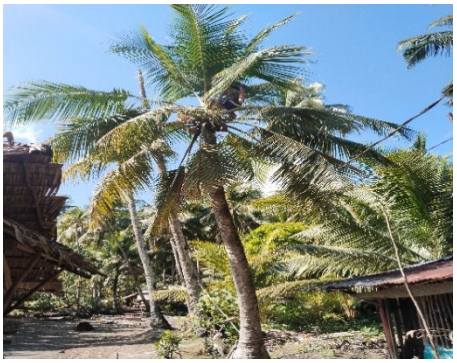

Fig. 3. pananganggot

These practices collectively demonstrate how the teachers ground abstract mathematical concepts in the cultural realities of their learners, transforming formal instruction into a more contextualized and meaningful learning experience. This culturally responsive approach is well-supported in existing literature on culturally-responsive teaching (CRT) in mathematics education. Rigney et al. (2020) argued that the integration of learners' cultural experiences in the curriculum can promote mathematical engagement, develop sense of academic identity among learners, and boost academic success. This is further reinforced by Padang and Lubis (2023), who noted that the incorporation of traditional farming and local economic practices in mathematical examples and problems help students connect classroom learning with their cultural environment.

3.1.3 Utilization of Local Spaces

In incorporating ethnomathematics into their instruction, the participants draw from the immediate physical environment rather than from distant or unfamiliar contexts. Seven out of eleven participants reported using local places as venues or reference points for mathematical exploration. For instance, Participant 1 described bringing her class to the covered court near the school to explore the properties of circles: "I let them explore the different parts and properties of a circle by asking them to describe the jump ball area. I ask them what they notice and how it differs from any type of polygon."

Other participants made use of well-known local landmarks and tourist destinations within the municipality to contextualize mathematical concepts. Participant 8, for example, described asking students to determine the number of ways they could visit the local tourist destinations within the municipality when teaching combinations and permutations. The different barangays within the municipality also served as contextual anchors in some mathematical problems. Participant 11 shared an example she uses when teaching arithmetic sequences, presenting a scenario involving passengers disembarking at successive barangays from a bus operated by a locally operating transport cooperative. Meanwhile, Participant 6 described an activity for teaching distance and coordinate geometry where students map their own barangay on a Cartesian plane and locate their own homes on it.

These examples illustrate how participants draw upon their learners' immediate physical environment to make mathematics instruction more engaging and contextually meaningful. This practice is supported by Moyano and Andrade (2025), who found that connecting mathematics learning to the actual locations familiar to teachers

and students is associated with better mathematical understanding, as evidenced by improved problem-solving skills. This further aligns with Suh et al.'s (2021) assertion that equitable and culturally responsive mathematics teaching builds upon the resources available within the community.

3.1.4 Incorporation of Community's Social Practices

Beyond physical spaces, participants also drew from the social practices common in the community. Participant 1 incorporated the cultural practice of sharing a meal as a family around a circular table as a context for teaching circular permutations. She also used the structure of local barangay governance, specifically, the selection of council members accompanying the barangay captain to a training as a situation for teaching combinations. Other participants integrated local fiesta celebrations, referred to in the community as *Patron*, into their instruction. Participant 8 used the practice of attending fiestas across different barangays, known locally as *pamamatron*, as a basis for a survey activity that allowed students to explore and differentiate sampling techniques. Participant 6, on the other hand, used the preparation of food and estimation of expenses during fiestas as a practical context for teaching cost computation.

Meanwhile, Participant 4 described using the cultural familiarity with *tuba*, a locally produced coconut wine from fermented coconut sap, to help students who struggle with fraction operations. He noted that framing abstract fraction problems within the context of tuba drinking culture, such as determining how much remains after a portion is consumed from a full gallon, enabled students to answer correctly and with greater ease, as the scenario resonated with their lived experiences. Locally familiar games were also utilized as instructional tools. Participant 3 described adapting the game of Bingo as an activity format for reviewing basic operations on integers, providing students with Bingo cards containing answers to integer operation problems. Playing cards distributed by DepEd were similarly used to introduce concepts of probability.

These examples illustrate how the participants draw upon the richness of their learners' immediate social environment as a resource for making mathematics instruction more engaging and contextually meaningful which aligns with the study of Fatmawati et al. (2025) which highlighted how grounding mathematics education in local cultural practices creates a learning experience that is both meaningful and relevant to students' lived realities. This further supports Vygotsky's (1987) assertion in his SCT that learning develops through interaction with meaningful and socially situated tasks.

3.2 Selective and Informal Documentation of Ethnomathematical Practices

This theme captures how the ethnomathematical practices of junior high school mathematics teachers are reflected, or notably absent, in their formal lesson plans. It is composed of two sub-themes: the partial presence of cultural contexts in lesson plan components, and the absence of Waray language in formal lesson documentation

3.2.1 Partial Presence of Cultural Contexts in Lesson Plan Components

An analysis of the participants' lesson plans revealed that while teachers reported a wide range of cultural integration in their actual classroom instruction, these practices are only selectively and partially reflected in their formal lesson documentation. When cultural context does appear in lesson plans, it is most commonly found in the abstraction and assessment components. For instance, Participant 11 used a scenario involving passengers disembarking at successive barangays from a local bus company to illustrate the concept of arithmetic sequence, while Participant 5 incorporated real-life situations relevant to the community's livelihood, such as purchasing fishing nets, farm tools, rice sacks, or boat motors, to contextualize problems involving percentages. Participant 1, on the other hand, assessed learners' understanding of circle properties by tasking them with photographing circular objects in their environment and identifying at least four parts of a circle within each photo. Participants 5 and 6 similarly designed assessment tasks using real-life word problems drawn from the local context, covering topics on percentages and inverse variation, respectively.

Beyond abstraction and assessment, traces of ethnomathematical integration were also found in the motivation and application components of some participants' lesson plans. Participant 8 incorporated the names of local public figures and familiar sports such as badminton and basketball into the problems used during the motivation part of a lesson on combinations. Participant 5 likewise drew from farming and fishing, the community's primary livelihoods, in the application component of his lesson plan on solving money problems involving percentages.

However, while some participants were able to partially evidence their reported ethnomathematical practices in their submitted lesson plans, it was apparent that these documents fall considerably short of capturing the full richness of cultural integration described during the interviews. Seven out of eleven participants submitted lesson plans that contained no examples, word problems, or materials reflecting local practices, Waray language, or cultural artifacts, while the remaining participants' lesson plans, although containing some degree of

ethnomathematical integration, still demonstrated limited and surface-level documentation of such practices. This disparity suggests that ethnomathematical integration in actual classroom instruction is largely carried out spontaneously and impromptu, without deliberate documentation in formal lesson plans. This observation was further confirmed by Participants 6, 7, and 8, who shared that ethnomathematics is usually only formally documented in lesson plans prepared specifically for scheduled classroom observations by school administrators. These findings align with previous studies which found that teachers often struggle to design high-quality contextualized tasks with many mainly relying on teaching aids and textbook examples that fail to connect with students' experiences (Legarde, 2026; Ashari & Alimuddin, 2024).

3.2.2 Absence of Waray Language in Formal Lesson Documentation

While participants reported a heavy and consistent reliance on the Waray language during actual mathematics instruction, the opposite is strikingly evident in their formal lesson documentation. Across all participants' lesson plans, there was a complete absence of Waray language. No local translations, no bilingual instructions, and no Waray-medium examples or problems were documented in any of the submitted plans.

According to all participants, this absence is a direct consequence of compliance with the mandated medium of instruction for mathematics in junior high school. As Participant 7, a Master Teacher II, explained, "we do not use Waray language in our lesson plans because we need to adhere to the formal medium of instruction in mathematics education that is mandated by DepEd, which is English. But in the delivery of lessons, we use Waray together with English." This statement captures a significant disconnect between what is officially required and what is practically necessary in the classroom.

This disjunction points to a broader structural reality in mathematics education: the written lesson plan, shaped by standardized and English-medium curriculum frameworks, does not yet provide adequate space for the documentation of culturally and linguistically responsive teaching practices. The use of Waray language in mathematics instruction, while widespread and purposeful in practice, remains an informal, spontaneous, and in-the-moment pedagogical decision rather than a deliberately planned and formally documented teaching strategy. As such, its value and frequency in actual instruction remain largely invisible in the official paper trail of teachers' work. This affirms the argument of Villarin et. al. (2024), there are various challenges and considerations inherent in the implementation of Ethnomathematics in the curriculum, including curricular mandate on official medium of instruction in mathematics. The absence of formal documentation of ethnomathematics practices such as the integration ow Waray language in lesson plans in the context of Waray-speaking communities further affirms Balacuit and Oledan's (2024) assertion that there is limited literature discussing the state in which ethnomathematics is effectively integrated into secondary schools. This shows that on the linguistic aspect, teaching in different regional languages and overcoming language barriers is a real challenge (Alabat & Oledan, 2024).

3.3 Perceived Role of Sociocultural Resources in Mediating Mathematical Understanding

The third theme captures the teachers' perceptions of the role that the Waray language, cultural artifacts, and local practices play as mediators of students' mathematical understanding. This theme is composed of three sub-themes: Waray language as a medium for mathematical understanding, Waray language as a tool for engagement, and cultural relevance as a motivator for participation. Together, these sub-themes capture the consistently positive perceptions of the participants regarding ethnomathematics integration and its influence on the cognitive and affective dimensions of students' learning.

3.3.1 Waray Language as a Medium for Mathematical Understanding

The participants consistently identified the use of Waray language as a significant factor in improving students' comprehension of mathematical concepts. Across all interviews, teachers expressed that delivering instruction purely in English poses a persistent communicative challenge, particularly in a community where learners are more fluent in their mother tongue than in the formal medium of instruction.

Drawing from his years of experience teaching mathematics in a Waray-speaking community, Participant 2 identified that one of the persistent challenges he encountered in his teaching is the learners' limited ability to understand the formal medium of instruction. As he noted, "there are times that students really can't comprehend English. So, I need to use our local language, the Waray, so that students will be able to understand and internalize what is being taught." Building on this, Participant 4 described that the use of Waray inside the classroom removes the language barrier that arises when teaching using pure English, thereby reducing, if not eliminating, the struggle students experience when mathematical instruction is delivered in a language less familiar to them. Participant 1 further expressed confidence that students achieve full comprehension when Waray is used during discussion.

These findings underscore the critical role of linguistically familiar instruction in making mathematical content accessible to learners. The Waray language, in this context, functions not as a deviation from formal instruction but as an essential bridge that connects students to mathematical content. This is consistent with Vygotsky's (1987) Sociocultural Learning Theory, which positions language as the primary mediating tool through which learners internalize and construct knowledge. When instruction is delivered in the language most meaningful to learners, the conditions for deeper understanding are more readily established. This is likewise congruent with the study conducted by Englis and Boholano (2021), which found that the utilization of mother tongue-based instruction in teaching mathematics has substantially increased learners' retention skills and performance in mathematics.

3.3.2 Waray Language as a Tool for Engagement

Beyond comprehension, the participants also observed that the use of Waray language plays a significant role in fostering student engagement during mathematics instruction. Teachers noted a visible and consistent shift in classroom dynamics whenever they transitioned from English to Waray, with students becoming noticeably more active, participatory, and willing to express their ideas.

Participant 1 observed that when she begins using Waray in class, students become noticeably more comfortable sharing their ideas and asking questions, which in turn increases engagement and promotes meaningful dialogue between students and teacher. Participant 11 described a similar experience: "When I start speaking in Waray, the students become more active and get excited in volunteering to share their ideas to the class, as compared to when I speak in English, where I can see that students really can't comprehend based on their facial expressions." The remaining participants expressed the same perception, reinforcing the consistency of this finding across the data set.

These observations highlight the role of linguistically meaningful interaction in creating a more open and communicative learning environment. When students are addressed in a language they are most comfortable with, the affective barriers to participation are significantly lowered, encouraging them to engage more freely with the lesson and with their teacher. This aligns with Vygotsky's (1987) Sociocultural Learning Theory, which emphasizes that learning is not merely a cognitive process but a socially situated one, where meaningful interaction and dialogue are central to knowledge construction. The use of Waray, therefore, does not only aid in understanding but also creates the social conditions necessary for active and meaningful mathematical learning.

3.3.3 Cultural Relevance as a Motivator for Participation

Mathematics is often perceived as a subject that is abstract and far removed from the realities of everyday life. However, as reported by the participants of this study, this perception is challenged, if not significantly diminished, when teachers deliberately connect mathematical concepts to the culture and lived experiences of their learners. Nine out of eleven participants observed that integrating the cultural context of the community into mathematics instruction makes mathematical concepts more relatable and accessible to students.

Participant 5 articulated this clearly: "when I start contextualizing my instructional materials and examples to the cultural context of my learners, they start to realize the connection of the mathematical concepts I teach them to their day-to-day life and they start to take an interest in class." This view was shared by Participant 2, who noted that when examples are drawn from students' daily lives, they become more responsive and engaged during instruction. Participant 6 elaborated further on this dynamic: "when problems and examples given to the learners are taken from their cultural context, they are able to visualize and imagine what you give. This is really important in capturing learners' interest and promoting participation, as if you do otherwise, students become lost, they cannot imagine, they cannot understand, and their attention will start to drift away." These accounts collectively suggest that cultural grounding in mathematics instruction does not merely add contextual flavor but actively sustains students' attention and willingness to participate.

Furthermore, when mathematical instruction is connected to the cultural context of the learners, students become more participative and are more inclined to draw from and share their own experiences as these relate to the concepts being discussed. Grounding mathematical examples, problems, and activities in the cultural and everyday experiences of learners is thus perceived to positively impact student participation by making abstract concepts more meaningful, imaginable, and relatable. This aligns with the study of Villarin et al. (2024) which found that the integration of ethnomathematics in the curriculum enhances student engagement and motivation, and deepens conceptual understanding by connecting mathematical concepts to students' cultural backgrounds and lived experiences. Indicating that culturally responsive mathematics instruction, by situating learning within familiar and meaningful contexts, transforms students from passive recipients of knowledge into active and engaged participants in the learning process. By incorporating ethnomathematics, educators can spark students' interest and motivation in mathematics. Learning about how mathematical concepts are used and applied in different cultural settings can make the subject more relatable and intriguing (Alabat & Oledan, 2024; Canlog,

2025). This affirms the study of Nur et al. (2020) which found that contextualizing mathematics instruction within the cultural context of the learners supports deeper understanding and promotes active participation among them.

3.4 Perceived Opportunities and Challenges in Culturally Grounded Teaching

The fourth and final theme encapsulates the challenges and opportunities that teachers encounter in integrating ethnomathematical practices into their mathematics instruction. This theme is comprised of three sub-themes: structural and curricular barriers, student-level challenges, and opportunities for transformative mathematics instruction. Together, these sub-themes articulate the factors that make ethnomathematics integration a challenging endeavor, as well as the opportunities it presents for more meaningful and effective mathematics education in the context of Waray-speaking communities.

3.4.1 Structural and Curricular Barriers

While participants reported positive perceptions of the role that ethnomathematics plays in mediating mathematical understanding, they also shared that they face various constraints that make its integration into mathematics instruction a challenging undertaking. The data reveal that the primary challenge teachers encounter in incorporating ethnomathematics into their teaching is deeply rooted in the structural and curricular landscape of mathematics education in the country.

All participants identified the language aspect as the foremost challenge in ethnomathematics integration. Specifically, teachers highlighted the disparity between the language used in the community, which is Waray, and the mandated medium of mathematics instruction, which is English. As Participant 10 described, teachers find themselves torn between adhering to the official medium of instruction and using the language that students can more readily comprehend: "We cannot really use straight English when teaching mathematics despite it being the medium of instruction because the learners could hardly understand the language." Participant 9 expressed a similar concern, noting that effective teaching of mathematical skills becomes difficult when students cannot understand the language of instruction in the first place.

The participants further shared that this language disparity significantly affects learners' performance during formal assessments. Participant 6 observed that "during class discussions where Waray language is used, students learn and are able to correctly answer mathematical questions given to them. However, during tests, where questions are written in English, students often get low scores as they cannot fully comprehend the English questions and instructions." Participant 7 acknowledged that the use of Waray during instruction limits students' opportunities to develop English language fluency and comprehension which are skills that are critical for success in formal and standardized assessments. Nevertheless, as she noted, teachers are left with little choice but to rely on Waray during mathematics instruction, as it remains the language through which students are most able to understand and engage with the content.

Beyond the language challenge, most participants also reported a lack of ethnomathematics resources specific to the cultural context of Waray-speaking communities as a significant barrier. This scarcity is closely tied to the centralized learning materials provided by the Department of Education, which Participant 1 described as materials that use examples and problems often drawn from the context of other regions. As Participant 5 expressed, "these resources often incorporate cultural contexts and experiences detached from those actually experienced by the students that we have." Consequently, teachers reported difficulty in identifying appropriate techniques for connecting more complex mathematical concepts to the cultural context and everyday life of their learners. Participant 4 noted that "when it comes to teaching higher mathematics, relating the lesson to the culture and daily experiences of learners is really a challenge since we don't have a guide on how to effectively integrate ethnomathematics in teaching more complex mathematics topics like radicals." Participant 5 further pointed out that the challenge of scarce ethnomathematics resources is compounded by the frequent changes in curriculum that have occurred over the years. As he explained, each curriculum change alters the mathematical topics assigned to each grade level, requiring teachers to develop new sets of culturally relevant instructional materials and lesson plans which is a task made considerably more difficult by the absence of ethnomathematics literature and resources specific to the Waray-speaking context.

Time constraint emerged as another significant challenge, affecting both the planning and implementation stages of instruction. Participant 6 described the demands of constructing a lesson plan with meaningful ethnomathematics integration, noting that identifying the most appropriate culturally relevant activities, techniques, and examples for a single lesson can take considerable time. She further noted that teachers seldom have the luxury of dedicating sufficient time to lesson planning, given the administrative tasks and other teaching-related responsibilities that compete for their attention. In terms of implementation, Participant 8 shared that the 45-minute daily instructional period is often insufficient to fully carry out a lesson with active cultural integration, particularly given the additional time required for translation and for providing culturally relevant examples and exercises. Some participants added that the pace of the mathematics curriculum, with its specific

competencies targeted within fixed timeframes, makes meaningful ethnomathematics integration difficult to sustain. As Participant 5 described, "since we have target competencies that we need to achieve for each week, we don't have the time to integrate ethnomathematical practices, which significantly consumes time, into our teaching. Sometimes we are even forced to proceed to the next lesson even though the students haven't mastered yet the previous lesson as we are working against time and numerous competencies."

Taken together, the experiences shared by the participants suggest that structural and curricular barriers constitute the most significant constraints they face in implementing a culturally responsive and contextually grounded mathematics education. The findings are congruent with the results of the study of Legarde (2026) which indicated "while teachers recognize the value of culturally responsive pedagogy that the lack of ready-made, high-quality localized materials that could support its systematic and efficient delivery, the challenge of time intensiveness since designing contextualized tasks requires more preparation compared to conventional lesson planning, a challenge further compounded by the pressure to meet curriculum coverage and national standards, and misalignment between contextualized instruction and standardized assessment." These also affirms Alabat and Oledan's (2024) study which asserted that Filipino teachers faces significant challenges in integrating ethnomathematics into the Philippine mathematics curriculum due to lack of necessary skills, insufficient resources, lack of culturally relevant teaching materials, language barrier and reliance on traditional teaching methods.

3.4.2 Student-Level Challenges

The data reveal that the challenges in ethnomathematics integration extend beyond structural and curricular barriers and are also significantly shaped by student-level factors. One of the primary student-level challenges reported by the participants is the weak foundational skills of many learners in mathematics. Since mastery of fundamental mathematical operations is a prerequisite for understanding more advanced topics, teachers find it difficult to incorporate culturally relevant activities and examples when students have not yet attained the necessary foundational competencies. As Participant 2 noted, "some high school students still struggle with the four basic mathematical operations, particularly when it comes to signed integers and fractions." This gap in foundational skills poses a significant challenge to ethnomathematics integration in subsequent topics, as teachers find themselves needing to revisit basic concepts and meet students where they currently are, as Participant 5 described. As a result, teachers tend to prioritize the development of fundamental and prerequisite skills over the provision of culturally responsive instruction.

A second student-level challenge identified by the participants is the negative fixed mindset that many students hold toward mathematics. According to Participant 3, students often come into class already convinced that mathematics is difficult. This preconceived notion leads to disengagement even before instruction begins. As Participant 6 expressed, "it is difficult because students are preconditioned that math is difficult even if you haven't started teaching them yet." This ingrained perception of mathematics as an inherently difficult subject creates an affective barrier that makes it more challenging for teachers to cultivate the kind of open and participative learning environment that ethnomathematics integration aims to foster.

The third student-level challenge raised by the participants is the diversity of students' backgrounds and experiences within the same classroom. Participant 5 noted that students vary considerably in their levels of mathematical competence and cultural backgrounds, making it difficult to identify a single culturally relevant teaching strategy that all students can equally relate to and benefit from. Participant 1 further observed that students from different barangays within the same municipality may still hold varying cultural experiences and practices, which adds another layer of complexity to ethnomathematics integration.

These challenges collectively suggest that student-level factors play a considerable role in shaping the feasibility and effectiveness of ethnomathematics integration in the classroom. As Xu et al. (2023) asserted, foundational mathematical skills support success in more advanced topics, underscoring why the absence of these competencies among learners makes culturally responsive integration considerably more difficult to implement. Compounding this is the longstanding challenge of negative perceptions toward mathematics, which Erasmo (2024) identified as contributing to a lack of enthusiasm and engagement among learners who often view the subject as difficult and irrelevant. These findings are further consistent with previous studies which found that teachers struggle to incorporate culturally diverse lessons into instruction when learners come from differing cultural contexts and backgrounds (Alabat & Oledan, 2024; Kyeremeh et al., 2025). Addressing these student-level challenges is therefore as critical as resolving structural and curricular barriers if ethnomathematics integration is to be meaningfully and sustainably implemented in mathematics classrooms.

3.4.3 Opportunities for Transformative Mathematics Instruction

Despite the challenges discussed in the preceding sub-themes, the participants expressed a broadly optimistic outlook on the potential of ethnomathematics integration to bring about meaningful improvements in

mathematics education. Nine out of eleven participants indicated that effective ethnomathematics integration has the potential to enhance students' mathematical comprehension and long-term knowledge retention. As Participant 2 articulated, ethnomathematics integration presents a valuable opportunity for learners to better understand mathematics, given that instruction becomes culturally relevant and students are able to relate more readily to topics connected to their own cultural context. Participants 4 and 10 similarly observed that learners are likely to retain mathematical knowledge more effectively when their first-hand experiences are woven into the lessons, and that students will be better able to internalize mathematical concepts when the examples, problems, and activities provided to them are drawn from familiar contexts.

Beyond the cognitive dimension, participants also perceived ethnomathematics integration as having the potential to positively influence the affective aspects of learning, particularly in terms of boosting students' confidence, interest, and participation. Participant 1 noted that the use of Waray language in mathematics instruction, as part of a broader ethnomathematical approach, can help students feel more confident in sharing their ideas and thoughts in class, as they are able to understand the discussion and respond using the language most familiar to them. This increased sense of comfort and confidence, as Participant 5 observed, translates into greater engagement and participation during classes.

Participants also expressed the belief that ethnomathematics integration holds significant promise for improving the quality and effectiveness of their own teaching practices. Participant 7 noted that the active integration and formal documentation of ethnomathematics in the classroom could facilitate the sharing and acquisition of culturally relevant teaching techniques and resources among teachers, which would in turn provide more structured guidance for addressing complex mathematical topics. As Participant 4 added, having such a guide would greatly help teachers in more effectively teaching mathematical concepts, particularly the more advanced ones. Participant 11 further shared that teaching through Waray would reduce the need for repeated explanations, as students are able to grasp concepts more quickly in the language they understand best. She also noted that this approach would benefit her own teaching, as her confidence and fluency in English are limited.

These perceptions collectively suggest that the participants view ethnomathematics integration not merely as an instructional enhancement but as a potentially transformative practice that could meaningfully improve both the teaching and learning of mathematics in Waray-speaking communities. This optimistic outlook is consistent with previous ethnomathematics studies, where culturally relevant mathematics instruction has been found to enhance students' comprehension of mathematical concepts, improve retention, increase interest and participation, lessen self-doubt, and reduce fears toward learning mathematics (Legarde, 2024; Indriati et al., 2022; Suryonegoro & Hidayah, 2023). When local tools, resources, or cultural practices are used to solve mathematical problems, students are able to directly apply their knowledge, leading to greater retention and engagement (Turmuzi et al., 2023). Moreover, these findings affirm the assertion of Mania and Alam (2021) that ethnomathematics integration leads to a deeper understanding of learners' mathematical thinking, which makes it easier for teachers to determine the most appropriate learning approach for their students' cultural and contextual needs.

Summary and Conclusions

This study revealed that the ethnomathematical practices of junior high school mathematics teachers in a Waray-speaking rural municipality in Leyte are manifested through Waray-rooted and community-based instructional practices, namely the use of Waray language as an instructional strategy, the integration of local livelihood, utilization of local spaces, and incorporation of community’s social practices. These findings resonate with Vygotsky's (1987) Sociocultural Theory, which holds that language and cultural context serve as the primary channels through which mathematical understanding is developed, and with D'Ambrosio's (1985) Ethnomathematics framework, which recognizes mathematical knowledge as something that emerges from and is shaped by the cultural life of a community. Taken together, these theoretical lenses help explain how the teachers in this study naturally drew upon their community's sociocultural resources as a foundation for meaningful mathematics instruction. However, these ethnomathematical practices are not fully reflected in the teachers' formal lesson documentation. The lesson plans of the participants reveal only a partial presence of cultural contexts in select components, while the Waray language, despite its extensive use in actual classroom instruction, is entirely absent from formal lesson plans, pointing to a pattern of selective and informal documentation of ethnomathematical practices. The integration of ethnomathematics in mathematics instruction is viewed positively among teachers, who regard it as a culturally responsive learning experience in which language serves as a tool for engagement and comprehension, and cultural relevance acts as a motivator for participation. Meanwhile, its integration is not without challenges, as teachers encounter structural and curricular barriers as well as various student-level constraints that make the implementation of culturally relevant instruction a challenging endeavor. Despite these challenges, teachers assert that ethnomathematics integration brings about a range of opportunities for transformative teaching. These findings are consistent with prior studies indicating that, while ethnomathematics integration improves mathematics comprehension and students' engagement and participation,

its implementation remains an in-the-moment pedagogical choice not yet fully reflected in formal lesson documentation. Thus, while ethnomathematics integration is already present in practice, it still requires formal documentation and institutional recognition for its role in mathematics instruction to be fully acknowledged and sustained. Finally, the findings suggest that the current curricular landscape of mathematics education in the country is not yet fully ready for the efficient integration of ethnomathematics in mathematics instruction.

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