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Applying Ethnomathematics in Understanding Mathematical Junior High School Teachers

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ABSTRACT

This study explores the application of ethnomathematics in teaching mathematical concepts in Indigenous Peoples (IP)-dominated schools in the 2nd Congressional District of the Province of Cotabato. Utilizing a qualitative phenomenological approach, the research examines how IP students engage with mathematical concepts when contextualized through their cultural landscapes. Data were collected through in-depth interviews with teachers and observations in classrooms, focusing on how cultural integration, real-life applications, and hands-on learning methods influenced student participation, motivation, and understanding. The findings indicate that students demonstrated increased engagement and a deeper connection to mathematical content when it was linked to their cultural practices and local community contexts. The integration of community knowledge, collaborative learning, and culturally relevant resources enhanced students' interest and understanding, fostering an inclusive learning environment. Teachers can improve student participation and motivation by incorporating culturally relevant resources and context in their lessons, creating a more engaging and relatable learning environment. Future research could explore the long-term impact of ethnomathematics on student performance and the potential challenges in implementing this approach across diverse communities. Additionally, investigating how ethnomathematics can be scaled to other regions with different cultural contexts would be valuable. Ethnomathematics provides a promising pedagogical approach that bridges the gap between traditional mathematics education and cultural relevance. By embracing local knowledge, it not only enhances mathematical understanding but also promotes a sense of cultural pride and identity among students.

INTRODUCTION

The appreciation of mathematics lies from the hands of teachers. Employing different activities enable students to have the deepest appreciation of mathematical competencies needed to understand the ways of life. To the learners, teaching them in the contexts of their culture will strengthen their love towards learning and their identities as part of this major ethnolinguistic group of Mindanao. Mathematics seems to be difficult when it is not applied to the cultural perspectives of learners.

Linking mathematics in the cultural practice of learners demystifies the complexities of lessons. Fouze and Amit (2023) affirmed that culture has been standing in the pedestal of human life and society which greatly affect norms in economic, social, religious, and educational activities. The main goal of teaching mathematics is to allow the students understands its concept (Fahrudin et al., 2018) to help them solve mathematical problems (Juniantari et al., 2019).

As a matter of fact, ethnomathematical approaches make learning meaningful to students. It engaged them into a healthy learning experience which maintains their identities while successfully learning (Rosa & Orey, 2011; Nur & Waluya, 2021). Albeit, failure to use it may result to poor abilities of students in answering mathematical literacy problems (Runtu et al., 2023). Thus, it was suggested to apply this as resources for learning (Anriana et al., 2023) especially in measurements.

Moreover, this study found out that ethnomathematics is not yet explored to underscore how learners grasp mathematical perspectives using their culture. For example, Alangui (2017) conducted a similar study among the Mangyan of Mindoro and Ifugao and its application in Oyster Farming for K-12 Mathematics (Borbon, 2023). The existence of this gap may lead to understanding the rich mathematical knowledge of the Obo-Manobo learners in expanding their horizons in mathematics.

Understanding ethnomathematics from the landscapes of the students will provide better opportunities to navigate their learning strategies into the culture of their learners. This will answer their decade-long problems on poor skills in mathematics. Bringing the topics into their culture will eventually increase classroom participation and making independent learners.

Research Questions

Ethnomathematics plays a pivotal role in understanding mathematical problems through the cultural perspectives of the learners. Hence, this study provides the following research questions:

1. What mathematical concepts and practices within the culture integrated by teachers in teaching mathematical problems;
2. How do teachers apply ethnomathematics in teaching mathematical problems among the learners;
3. How do learners engage with mathematical concepts within their cultural landscape;

Research Design

The occurrence of the phenomenon can be described through words, pictures, and other necessary data. It is within this context that qualitative research is bounded. Qualitative research pays close attention to the context in which the data is collected. It seeks to understand how social, cultural, and environmental factors influence the phenomenon under study (Creswell & Poth, 2018).

Phenomenology places a strong emphasis on the subjective experiences of individuals, aiming to delve into how people interpret and understand around them. The collection of the data often involved in-depth interview with open-ended questioning with people who have first-hand experiences of the phenomenon under the field of interest. Interviews involve the capture of thick descriptions of the experiences (Van Manen, 2023).

In this manner, the researcher will utilize phenomenology to understand importance of ethnomathematics on students' quest to understand mathematical problems. It is phenomenology since it will interview them to how the approach played a crucial role in making mathematics classes fun and exciting. The analysis of the data will be done through thematic analysis.

Locale of the Study

This study was conducted in the Municipality of President Roxas, Province of Cotabato. The municipality has a land area of 618.25 square kilometers or 238.71 square miles which constitutes 6.64% of Cotabato's total area. Its population as determined by the 2020 Census was 52,512. This represented 3.52% of the total population of Cotabato province, or 1.07% of the overall population of the SOCCSKSARGEN region. Based on these figures, the population density is computed at 85 inhabitants per square kilometer or 220 inhabitants per square mile.

In the same manner, this study was conducted in the Municipality of Antipas. This town was created because of the influx of the Christian migrants from the Island of Panay. Antipas is combined term of Antique and Passi where majority of the inhabitants originated.

The Municipality of Arakan is one of the towns which constituted the Arakan Valley Complex. It is home to the Tinonanon-Manobo and other ethnolinguistic groups. It is bounded by the Province of Bukidnon and Davao City.

The Municipality of Magpet is located in the eastern part of Cotabato Province and at the foothills of Mt. Apo. The municipality is home to the Obo-Monovu and Kidapawan sub-tribes.

Research Instrument

The data gathering instrument involves the interview guides, recorder, and the consent-to-participate form. These provide structure to the data collection process. They help ensure that the researcher asks relevant questions in order to capture specific observations.

Research Participants

The participants of this study was divided into two. First, the Key Informant Interview (KII) (Allen & Bashir, 2023) will be made up of 25 individuals. The same number of teachers in the IPED schools will take part in the Focus Group Discussion (Mulyono, 2023). Captivating the number of individuals to participate in interviews is the major ground of qualitative research. Samples are limited to 5-25 as mentioned by Creswell and Poth (2018). Purposive sampling is guided by the research objectives and the need to obtain information that is most relevant to the study. Here, the researcher selects informants who can provide valuable insights about ethnomathematics. A criterion sampling will be established to select specific characteristics that potential informants must meet to be included. As such, they must be mathematics teachers in IPED schools in the towns of President Roxas, Magpet, Antipas, and Arakan.

Data Analysis

Data analysis in qualitative research is the process of systematically examining and interpreting qualitative data to identify patterns, themes, meanings, and insights that can address the research questions. The researcher starts by applying open codes to the data. This involves generating descriptive labels that capture the essence of specific sections. Then, codes are grouped, categorized, and linked to identify relationships and patterns.

After which, the research selected the most relevant and significant codes to develop overarching themes or categories. This was followed with the development of themes.

RESULTS AND DISCUSSIONS

Mathematical concepts and practices within the culture integrated by teachers in teaching mathematical problems

Cultural Integration in Mathematics Teaching. Cultural integration in mathematics teaching helps students connect mathematical concepts to their daily lives and traditions. By using local language and community examples, teachers make math more relatable and engaging. This approach encourages students to see the relevance of mathematics in their cultural context. It also strengthens their understanding by linking abstract concepts to familiar experiences.

The implication of integrating Manobo language and community-based scenarios into math lessons is that it can enhance students' understanding and relevance of the subject, but it requires careful consideration and effort to effectively bridge cultural and educational gaps. As stated:

As a Bisaya teacher teaching here in the IP community, who aims to bring the spirit of the Manobo people into my class, I really considered my way of teaching to assure that math should be part of our everyday living. I integrate Manobo words to make math more familiar and fun. I also use real scenarios in the community, especially those related to the Manobo community that connect to our topic. It's difficult to integrate, though. (Informant 2 RQ 1.1 L 7-18)

Cultural integration in mathematics teaching involves connecting mathematical concepts to the cultural practices and experiences of students. This approach makes learning more relevant and engaging by incorporating familiar cultural contexts. It helps bridge the gap between abstract mathematical ideas and the students' everyday lives. Teachers who use cultural integration create an environment where students feel their cultural identity is valued while enhancing their understanding of mathematics (Lidinillah et al., 2022).

Real-Life Application and Contextualization. Real-life application in mathematics brings abstract concepts into practical situations that students can relate to. When teachers use scenarios from students' everyday lives, it deepens their understanding of mathematical principles. Contextualization makes the learning process more engaging and accessible. Students are more likely to see the value of math when it is connected to real-world experiences.

Incorporating culturally relevant practices into math instruction allows students to see the practical applications of math in their daily lives, making learning more meaningful and relatable.

To effectively teach mathematics to the IP community, we can incorporate culturally relevant practices that resonate with their backgrounds. For example, about their natural resources, in measurements and area, like those in their hunting grounds or fishing grounds. (Informant 3 RQ 1.1 L 19-25)

Real-life application and contextualization in teaching mathematics as stated by Hidayati and Prahmana (2022) involve connecting abstract concepts to the students' cultural practices and everyday experiences. When teachers use real-world scenarios, students are able to see the relevance of math in their lives. Incorporating cultural contexts into lessons makes mathematical concepts more accessible and meaningful. This approach not only enhances understanding but also strengthens the students' connection to the subject matter.

***Collaborative Learning and Student Participation*.** This approach helps them develop a deeper understanding through discussion and teamwork. Active participation allows students to engage with the material and each other, promoting a more interactive classroom environment. It also empowers students to learn from diverse perspectives and strengthens their problem-solving skills.

This will be done by encouraging participation from all students, regardless of their culture, promotes an inclusive learning environment that enhances collaboration and problem-solving skills.

In my everyday experience, I believe in using collaborative learning by encouraging them to participate regardless of their culture. I always encourage them to participate in solving math problems. (Informant 14 RQ 1.1 L 139-144)

Similarly, collaborative learning is a teaching method that emphasizes interaction and teamwork among students to solve problems and share knowledge. This approach allows students to learn from each other, enhancing their understanding through peer discussions and collective problem-solving. Student participation plays a vital role in this process, as it encourages active engagement with the lesson and promotes a deeper connection to the material. Research suggests that when students are involved in collaborative activities, their critical thinking and communication skills improve, creating a more dynamic and supportive learning environment (Turmuzi et al., 2023).

***Language and Terminology*.** The use of familiar language and terminology in teaching mathematics helps students grasp concepts more effectively. When teachers incorporate terms from students' own cultural contexts, it bridges the gap between abstract ideas and their lived experiences. This approach enhances comprehension by ensuring that mathematical vocabulary resonates with the students' everyday language. It also creates a more inclusive classroom environment where students feel comfortable engaging with the subject matter.

It in this regard that contextualizing math problems to align with students' cultural backgrounds enhances their engagement and understanding, as it connects mathematical concepts to their real-life experiences.

For me, ma'am, it's effective to contextualize math problems within their familiar cultural contexts. I use terms they can relate to and have the Monobo students translate the lesson for the day. As a teacher, we can use math problems that reflect their community, like calculating costs in the local market or using recipes that introduce proportions. (Is my answer okay, ma'am?). (Informant 12 RQ 1.1 L 110-120)

Language and technology play significant roles in the integration of cultural practices in mathematics teaching. It bridges the gap between abstract mathematical concepts and students' everyday experiences, making the material more accessible. Technology enhances this process by providing interactive tools that can bring cultural contexts to life, offering dynamic visualizations and resources that support learning (D'Ambrósio & Knijnik, 2020). The combination of culturally relevant language and technology creates an engaging environment where students can.

Community and Environment as Learning Resources. The community and environment serve as valuable resources for teaching mathematical concepts by providing real-world examples students can relate to. Teachers can use local landmarks, cultural practices, and natural surroundings to make math lessons more relevant. This approach helps students see the practical application of math in their everyday lives. When students connect math to their environment, they are more likely to engage with the material and retain the concepts.

This approach highlights the importance of connecting mathematical concepts to students' cultural practices, making the subject more engaging and relevant to their daily lives.

In teaching mathematics to the Manobo community, I incorporate traditional counting methods, such as how they count objects and measure things, using available resources like trees, stones, seeds, and relate grouping in math. This connects math to the natural world, which they really enjoy. (Informant 19 RQ 1.1 L 190-200)

The community and environment are rich sources of learning resources for teaching mathematical concepts. Teachers can use local surroundings, cultural practices, and everyday experiences to make math more relevant to students. This approach helps students connect abstract mathematical ideas to their daily lives, enhancing their understanding. When teachers integrate real-world contexts from the community, students are more likely to engage and retain the concepts being taught (Mania & Alam, 2021).

Teachers' application of ethnomathematics in teaching mathematical problems among learners

Engagement and Interest in Learning. It significantly enhanced when teachers apply ethnomathematics in their teaching. By incorporating students' cultural practices, traditions, and local knowledge into mathematical lessons, teachers make the content more relatable and engaging. This approach captures students' attention as it connects abstract mathematical concepts to their everyday lives and cultural experiences. As a result, students are more likely to participate actively, show enthusiasm, and develop a deeper understanding of mathematical ideas.

This method bridges the gap between abstract mathematical concepts and real-world applications, helping students see the relevance of math in their everyday lives.

Contextualizing Math through Local Knowledge: I begin lessons by connecting math concepts to daily practices and experiences in the community. For example, when teaching measurements, I refer to methods traditionally used to measure land, such as pacing or natural markers. (Informant 17 RQ 2.1 L 258-266)

Teachers' application of ethnomathematics in teaching mathematical problems has been shown to increase student engagement and interest in learning. When mathematical concepts are connected to students' cultural practices and local knowledge, the learning experience becomes more relevant and exciting as stated by Munthahana et al. (2023). This approach helps bridge the gap between abstract mathematical ideas and real-world applications. Research indicates that students are more motivated to participate when the content reflects their own culture and lived experiences.

***Culturally Relevant Resources and Contextualization*.** Teachers' application of ethnomathematics in teaching mathematical problems using culturally relevant resources and contextualization has significant implications for student learning. It helps bridge the gap between abstract mathematical concepts and real-world applications, making lessons more relatable and engaging for students. This approach encourages students to connect what they learn in class to their own cultural practices and daily experiences, promoting deeper understanding and long-term retention. Additionally, integrating local traditions and knowledge empowers students to see the value of their cultural heritage while enhancing problem-solving skills and fostering a sense of belonging in the classroom.

Through this, students develop a more meaningful connection to the content, as it aligns with their own lived experiences and cultural practices.

Integrate local cultural contexts into math lessons to make concepts more relatable. For example, use traditional games, crafts, or community activities to illustrate mathematical ideas like geometry. This helps students construct understanding based on their experiences and cultural knowledge. (Informant 6 RQ 2.1 L 98-106)

Teachers' application of ethnomathematics in teaching mathematical problems enhances learning by incorporating culturally relevant resources and contextualizing lessons within students' cultural backgrounds. This approach allows students to connect mathematical concepts with their everyday lives, making learning more meaningful and engaging. Integrating local knowledge, traditions, and practices into lessons helps bridge the gap between abstract mathematical concepts and real-world applications. Research indicates that contextualizing math within cultural contexts supports deeper understanding and encourages active participation in the learning (Nur et al., 2020).

***Hands-On and Experiential Learning*.** It allows students to directly interact with the mathematical concepts they are learning, making abstract ideas more tangible and relevant. By incorporating real-life cultural practices, such as using traditional crafts or community-based activities, students can see how math applies to their daily lives. This approach promotes active learning and critical thinking, as students engage with the material in a meaningful context. Additionally, experiential learning encourages students to value their cultural heritage while developing problem-solving skills that are applicable in both academic and real-world settings.

For example,

Allowing the learners to use the indigenous materials present in the community in learning about measurement. (Soft broom making) (Informant 4 RQ 2.1 L 61-65)

Hands-on and experiential learning in the application of ethnomathematics provides students with tangible connections to mathematical concepts through real-world activities. This approach allows learners to engage with math in a more interactive and meaningful way by using materials and methods from their own cultural contexts. Studies show that incorporating hands-on learning not only enhances conceptual understanding but also helps students see the relevance of math in their everyday lives (Nur et al., 2020). Experiential activities like using local tools, resources, or cultural practices to solve math problems enable students to directly apply their knowledge, leading to greater retention and engagement (Turmuzi et al., 2023).

Student Participation and Collaborative Learning. Student participation and collaborative learning in the context of ethnomathematics offer valuable implications for enhancing the learning experience. Teachers create opportunities for them to share cultural perspectives, which enriches their understanding of mathematical concepts. This approach promotes a sense of community and respect for diverse backgrounds, allowing students to learn from one another and see the practical applications of math in their daily lives. Collaborative learning also helps students develop critical thinking and problem-solving skills while making mathematical concepts more relatable and accessible through shared experiences.

Collaborative group work is also emphasized, allowing students to share their cultural perspectives and problem-solving strategies. This approach not only deepens understanding of mathematical concepts but also builds a sense of community and respect for diverse backgrounds within the classroom. Informant 13 RQ 2.1 L 207-215)

Student participation and collaborative learning are key components in the successful integration of ethnomathematics into the classroom. By working together, students share their cultural perspectives, which deepens their understanding of mathematical concepts within their own contexts. Collaborative learning also promotes critical thinking and problem-solving, as students use their diverse backgrounds to approach math in ways that are meaningful and relevant to their experiences (Nur et al., 2020)

Real-World and Problem-Solving Approach. The real-world and problem-solving approach in teaching ethnomathematics enables students to apply mathematical concepts to their everyday lives and local contexts. This approach not only enhances their problem-solving skills but also makes learning more relevant by connecting academic content to tangible, community-based challenges. Moreover, this method cultivates students' ability to think analytically and use mathematics as a tool for addressing real-world issues in their own communities.

This approach highlights the significance of integrating cultural perspectives into mathematical learning, enabling students to see the practical application of math within their own cultural contexts.

Project-based learning allows students to explore mathematical concepts through cultural lenses, such as creating art based on traditional patterns or conducting community surveys. (Informant 3 RQ 2.1 L 38-48)

A real-world and problem-solving approach in ethnomathematics allows students to apply mathematical concepts to situations they encounter in their daily lives. Teachers who incorporate community-based scenarios enable students to relate lessons to their cultural practices and environments. This approach enhances student engagement and helps them see the practical value of mathematics. Research suggests that when math problems are connected to real-life experiences, students are more likely to find the subject relevant and engaging (Munthahana et al., 2023).

Learners engagement with mathematical concepts within their cultural landscap

***Positive Student Engagement and Participation*.** When students engage with mathematical concepts within their cultural landscape, they become more motivated to participate. Their active involvement increases as they see the relevance of math in their daily lives. This connection enhances their understanding of abstract concepts by relating them to familiar cultural practices. As a result, students develop a greater sense of ownership over their learning and show more enthusiasm in class activities.

The positive interaction and communication among learners highlight the effectiveness of engaging them with mathematical concepts through their cultural landscape, making the learning process more relatable and interactive.

The learners show positive interaction and communication to the teaching-learning activity. (Informant 1 RQ 3.1 L 1-3)

Research shows that when students can relate mathematical concepts to their cultural background, they are more likely to engage in class activities. This connection increases their willingness to participate in discussions and problem-solving tasks. Engaging with culturally relevant content makes students feel valued and respected in the learning environment. As a result, they become more active participants in their education and demonstrate higher levels of enthusiasm as reiterated by Baker (2023).

Increased Motivation and Interest. As learners connect mathematical concepts to their cultural landscape, their motivation to learn increases. The integration of familiar cultural contexts makes the subject more interesting and relatable. Students are more likely to engage with the material because they see its relevance to their lives. This heightened interest leads to a deeper understanding of mathematical ideas and greater participation in classroom activities.

The learners' happiness and excitement during discussions and activities suggest that when they feel valued and their cultural backgrounds are acknowledged, their engagement with mathematical concepts becomes more meaningful and active.

They were happy and excited to listen and participate during the discussion and activity because they felt valued and important. (Informant 2 RQ 3.1 L 7-10)

Studies have found that students' motivation and interest in mathematics increase when lessons incorporate their cultural experiences. Relating math to familiar contexts makes the content more appealing and accessible. Students feel more connected to the subject matter when it aligns with their daily lives and cultural practices. This approach encourages students to actively engage with the material, leading to greater enthusiasm for learning (Roza et al., 2020).

***Relatability and Understanding*.** Students can draw on their own experiences and knowledge, which helps them better understand abstract mathematical ideas. This connection makes learning more accessible and meaningful. Thus, learners are more confident in applying mathematical concepts to real-world situations.

When learners are able to apply their cultural understanding to mathematical concepts, it enhances their ability to solve problems and actively participate in the learning process.

They respond to it by applying what they had understood from that translation, and they can now answer correctly our activity. (Informant 5 RQ 3.1 L 63-66)

When mathematical concepts are connected to students' cultural contexts, they find the material more relatable and easier to understand. Using examples from their everyday lives helps students see the relevance of math in their own world. This approach allows learners to grasp abstract concepts through familiar and meaningful experiences. As a result, they develop a deeper understanding and greater confidence in applying math in real-world situations (Nur & Waluya, 2021; Supriyadi et al., 2022).

Cultural Relevance and Connection. This approach bridges the gap between abstract math and their everyday lives. Students feel a stronger sense of connection to the material, as it aligns with their cultural knowledge and practices. They are more motivated to engage in lessons and apply the concepts to real-life situations.

Integrating cultural landscapes into math education enhances students' connection to the subject, boosting their motivation and fostering greater participation in learning activities.

Learners generally respond positively to the integration of cultural landscapes into mathematics education, as it makes math more relevant to their lives. This approach increases motivation and interest, leading to more active participation in discussions and activities. (Informant 3 RQ 3.1 L 26-33)

Cultural relevance in mathematics education helps students connect mathematical concepts to their own cultural backgrounds. When teachers incorporate local traditions, practices, and familiar contexts, students are more likely to see the value of math in their lives. This connection strengthens their engagement and promotes a sense of belonging in the classroom. As students relate math to their culture, they develop a deeper appreciation for the subject and its practical uses (Nur & Waluya, 2021).

Implications for Practice

Integrating ethnomathematics into the classroom offers practical benefits for both teachers and students. Teachers can enhance student engagement by linking mathematical concepts to students' cultural backgrounds. When students see how math is relevant to their daily lives and cultural practices, they are more likely to participate actively in lessons. This approach encourages critical thinking as students draw from their own experiences and knowledge. Teachers also gain the opportunity to diversify their teaching methods and enrich their instructional strategies.

Another significant implication is that ethnomathematics promotes inclusivity within the educational system. Incorporating diverse cultural perspectives allows students from various backgrounds to feel valued and recognized in the learning process. This practice helps bridge gaps in mathematical understanding, particularly for students who might struggle with traditional methods. Through culturally relevant examples, students relate better to abstract mathematical ideas and apply them in real-world contexts. Such practices create an environment where all students, regardless of their cultural background, succeed.

Ethnomathematics also strengthens community involvement in education. Schools that embrace local knowledge and collaborate with community members create authentic learning experiences for students. This collaboration ensures that mathematical concepts taught are not only academically sound but also rooted in students' heritage. As students work with real-world problems, they gain a deeper appreciation for both their culture and the practical uses of mathematics. This connection to community and culture enriches the learning experience and prepares students to apply their knowledge beyond the classroom.

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