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Exploring Numeration Systems through an Ethnomathematical Lens: A Study of the Mee Indigenous People

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ABSTRACT

This study aims at documenting and analyzing the traditional number system of the Mee tribe in Papua within an ethnomathematics framework. Papua is a cultural well with the numeral system reflecting the values of the culture and the social structure of the society. Such integration of culturally based mathematical concepts with the help of the ethnometematic approach might be theoretically expected to enhance mathematical learning, relevant from a cultural point of view. Qualitative research with participatory observation, in-depth interviews, and artifact analysis was carried out in Sentani-Sereh. From the research, it can be said that the uniqueness of the combination between single and decimal numbers can indicate the structure of the Mee Tribe culture. This system shows a possibility for implementation in culture-based learning. This documentation leans more towards cultural preservation efforts, enriching the literature of ethno-mathematics and recognizing traditional knowledge, which is part of cultural heritage and needs to be preserved in the wave of modernization.

INTRODUCTION

Central Papua is known to have a cultural richness that includes various forms of traditional knowledge, including the numeracy system used by the indigenous Mee Tribe. This numeracy system not only functions for calculation needs, but also reflects aspects of social structure, symbolism, and the practical needs of its people. The ethnomathematics approach, in the context of education, as expressed by (D'Ambrosio, 2016), allows for the understanding and teaching of mathematics from a cultural perspective. The integration of mathematics in the context of local culture has the potential to make multicultural education more relevant, because it can connect abstract mathematical concepts with students' real experiences in their communities (Abi, 2017; Hidayat, 2018; McGee Banks & Banks, 1995; Rosa & Orey, 2011); McGee & Banks, 1995; Abi 2016).

Ethnomathematics, popularized by (D'Ambrosio, 1985), offers a perspective in which each community, including indigenous communities, develops mathematical concepts that are closely related to their culture. Several previous studies have analyzed the numeracy systems of indigenous communities from various parts of the world and found that these systems are not only different from Western mathematical systems, but also have unique logic that is in accordance with the basic orientation of their culture. For example, the numeracy system of the Baduy Tribe in West Java by (Karnilah, 2013) and the

Kowai community in Papua New Guinea by (Hendrawati et al., 2019)differ in various aspects, reflecting the social and economic structures of their respective communities. However, there is a gap in the available literature, especially regarding the documentation and analysis of the numeracy system of the Mee community in Papua, which can be integrated into the local education curriculum.

Previous research has shown that different groups around the world have unique numeracy logics that correspond to their cultural views and values. Studies on numeracy among the Baduy and Kowai tribes, for example, show how different numeracy patterns reflect the perspectives and needs of their respective communities. However, very little serious effort has been made to document the numeracy system of the Mee Tribe in Papua or its application in formal education. Moreover, this lack of documentation risks making the traditional knowledge of the Mee people lose its relevance due to the rapid process of modernization (Bishop, 1988).

This study aims to document and analyze the Mee Tribe's numeracy system as part of an ethnomathematics study, with the hope of bridging the gap in understanding between formal mathematics and cultural contexts. This study also proposes a culture-based learning approach that can increase student engagement through a culturally relevant curriculum. This step is important to preserve and appreciate the Mee Tribe's cultural heritage, while supporting diversity in formal education in Indonesia.

METHODS

This research was conducted in Kampung Sereh, Sentani, Papua, with the main participants selected from members of the Mee Tribe community who have a deep understanding of the traditional numeracy system. Purposive sampling technique was used in selecting informants who met the criteria of deep knowledge of numeracy traditions and their roles in the community, as suggested by Patton (2002), who recommends purposive sampling in qualitative research to explore the knowledge of participants who represent the domain.

The selection of participants was based on their understanding of indigenous numeracy, traditional skills, and deep insight into these cultural practices. Semi-structured interviews were conducted to explore broader and deeper information from the participants' perspectives, providing flexibility and dynamics in the conversation, as described in qualitative methodology by (Spradley, 1980).

Data were collected through participant observation, in-depth interviews, and documentation of related artifacts, such as counting aids in traditional practices. Observations were conducted using data triangulation techniques that combine data from various sources to increase the credibility of the findings. Semi-structured interviews allowed participants to express their views in detail, while method triangulation compared data from observations, interviews, and secondary data to ensure consistency of findings.

Triangulation of sources and methods was applied to ensure the validity of the data, including member checking as part of the data validation process. Member checking techniques allow participants to review the results or interpretations obtained, providing objective validation of the research results to ensure they are consistent with their original experiences and understandings.

The data were analyzed using a domain analysis and taxonomy approach based on (Spradley, 1980), which allows for the grouping of patterns in the numeracy system to understand the relationships between elements. Domain analysis identified major categories such as unit patterns, tens, and symbolic counting techniques, while taxonomy analysis established a hierarchy between patterns, providing a comprehensive understanding of the numeracy structure of the Mee Tribe.

Research ethics were addressed in obtaining permission from local authorities and participant consent to participate. Referring to the AAA Principles of Professional Responsibility, informant consent was documented to ensure the research respected the rights and cultural integrity of indigenous peoples. This ethical aspect is also an effort to protect cultural sensitivity in the documentation of potentially sensitive local knowledge.

RESULTS AND DISCUSSION

A. Research result

The Mee Tribe indigenous people use a numeracy system in their daily lives, including in buying and selling activities and other social interactions. This finding shows that the basic numbers they use include units and tens, with a logically arranged number pattern in their numeracy system. The use of this numeracy system supports the view that mathematics developed in response to the cultural needs of a society (Bishop, 1988). This traditional numeracy system is not only used for calculations but also reflects cultural values, as stated by (Ascher, 1991; Zaslavsky, 1999).

The Mee Tribe's numeral structure, which combines units with tens, shows a unique pattern. In the context of ethnomathematics, this supports (D'Ambrosio, 1985) view that mathematics in a culture can be very diverse and influenced by the local environment and culture. For example, the numbers 11–19 are formed by combining the numbers 1–9 with 10, and the same pattern is applied for the next tens, indicating that the Mee Tribe has a numerical logic that is different from the common decimal system, but remains logical and orderly. This finding enriches the ethnomathematics literature and the understanding of the diversity of numeral systems in Indonesia.

This numeration system has great potential to be integrated into culture-based mathematics learning in Papuan schools, supporting the culturally relevant learning theory by (Alexon & Sukmadinata, 2010), which emphasizes that culture-based learning can increase student understanding and engagement. By studying the numeration systems they encounter in everyday life, students can understand mathematical concepts in a context that is more real and close to their experience, in accordance with Vygotsky's contextual learning theory. This can help students understand mathematical concepts while maintaining their cultural identity amidst globalization.

In addition, as part of ethnomathematics, the documentation of the Mee Tribe's numeracy system plays a role in preserving local culture. Furthermore (D'Ambrosio, 1985; Rosa & Orey, 2011; Rosida et al., 2018) noted that ethnomathematics not only functions as an approach to learning mathematics, but also as an effort to preserve cultural knowledge that is at risk of being lost due to modernization. Documentation and application of this system in education can help the younger generation to understand and appreciate their cultural traditions, strengthening the position of traditional numeracy as part of an important cultural heritage.

Furthermore, the results of this study indicate that the Mee Tribe's numeracy system can be further developed by exploring more complex mathematical operations such as addition and multiplication in a traditional context. In addition, comparisons with numeracy systems from other tribes in Indonesia or the world can enrich the understanding of variations and similarities among indigenous numeracy systems. Through this approach, this study fills a gap in the ethnomathematics literature, especially those related to indigenous Papuans, and contributes to a broader understanding of the relationship between mathematics and culture.

B. Discussion

The results of this study highlight that the Mee numeral system has unique

characteristics that differ from the common decimal system, where the base numbers up to tens are arranged in a special combination. For example, the tens number is obtained by combining the base number with the nearest tens using the word "tambah," as in "Ena ma Gaati" for the number eleven (1+10). This pattern not only meets the practical calculation needs of the Mee people but also reflects their cultural and linguistic aspects.

From a scientific standpoint, this structure provides empirical evidence supporting the theory of ethnomathematics (D'Ambrosio, 1985; Nasir et al., 2008; Zhang & Seah, n.d.) which conceptualizes mathematics as a sociocultural construct. The internal logic of the Mee numeral system reveals a consistent syntactic and semantic pattern that is comparable in complexity to formal mathematical systems, thereby offering an alternative lens through which to study numerical cognition and linguistic-mathematical integration.

The numeral systems of indigenous peoples in Indonesia and the world often show significant differences. For example, the numeral system of the Baduy Tribe in West Java uses a tens pattern that reflects their social structure even with a different linguistic approach, while the numeral system of the Kowai Tribe in Papua New Guinea uses basic numbers without complex combination patterns. These differences illustrate the cognitive universality and cultural specificity of numeracy, highlighting the epistemological importance of documenting how mathematical logic is embedded in local languages and knowledge systems. This reflects the scientific principle that knowledge is constructed through interaction between cognitive structures and socio-cultural contexts.

This research enriches the ethnomathematics literature by documenting and analyzing the Mee Tribe's numeration system, which has not been widely researched. The study contributes to the body of scientific knowledge by offering a systematic and linguistic-based analysis of a native numeracy structure, reinforcing the notion that indigenous mathematical systems possess internal consistency and symbolic logic. By presenting a typical numeracy structure that can be applied in culture-based education, this study fills the gap in ethnomathematics studies in Indonesia, especially in Papua. The novelty of this research lies in the documentation of distinctive linguistic-based numerical patterns, which have not been found in previous studies of the numeration system in Indonesia. This research is also relevant in cultural preservation efforts that support the cultural identity of the Mee people amidst the influence of modernization.

The educational implications of this study are that the Mee Tribe's numeracy system can be integrated into mathematics learning in Papuan schools. This approach supports (Gay, 2010) theory of culturally responsive pedagogy, which states that culturally based teaching helps students understand abstract mathematical concepts in the context of their lives. Vygotsky's contextual learning theory is also supported by this traditional numeracy approach, which allows students to appreciate mathematics in their own cultural context. From a pedagogical science perspective, this localization of learning materials is aligned with constructivist theories and promotes meta-cognitive engagement, helping students transfer knowledge from local contexts to formal education settings.

Furthermore, this study shows that ethnomathematics is not only a tool for understanding variations in numeracy systems, but also encourages the preservation of cultural heritage amidst globalization. (Rosa & Orey, 2011) and (Kusuma et al., 2024) emphasized that one of the main goals of ethnomathematics is to preserve traditional knowledge that is at risk of being lost due to modernization. Thus, this study encourages formal education that

integrates traditional numeracy systems, so that the younger generation in Papua has the opportunity to learn mathematics in their cultural context.

This research also opens up opportunities for further scientific exploration in analyzing more complex mathematical operations, such as addition and multiplication in the traditional context of the Mee community. These investigations can contribute to the field of comparative cognitive mathematics and cultural semiotics, offering insight into the universality of mathematical reasoning. Moreover, comparison with the numeracy systems of other tribes in Indonesia can broaden the understanding of diversity and similarities in ethnomathematics, making a significant contribution to this field of study in Indonesia and the world.

CONCLUSION AND SUGGESTION

A. Conclusion

This study has successfully uncovered the unique numeral system pattern of the Mee Tribe in Papua, where the units to tens numbers have a specific combination pattern based on local terms, such as the use of the word "tambah" in mentioning the numbers in the tens and tens. This numeral system reflects a deep integration between mathematics and culture, where the number structure from one to one hundred is arranged in a different way. This study broadens insights into ethnomathematics, showing how traditional numerals can be implemented in the context of modern education. The Mee Tribe's number system enriches the understanding of non-universal mathematical concepts based on local culture, showing that each community has a unique mathematical way that can be applied in culture-based mathematics learning. Thus, ethnomathematics can be increasingly recognized as an important tool for appreciating cultural diversity in education.

B. Suggestion

For future research, it is recommended that further exploration be conducted on the Suku Mee numeral system for numbers above 100. This in-depth study can provide more comprehensive teaching materials for primary school students and support cultural preservation. In addition, it is important to promote and document this system as part of cultural heritage, especially considering the risk of extinction of traditional systems due to the influence of other dominant cultures.

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AUTHOR CONTRIBUTIONS

All authors have made significant contributions to the preparation of this article. The first author was responsible for formulating the research idea and objectives, developing the theoretical framework, and conducting data collection and analysis. The second author contributed to the research methodology design, instrument validation, and provided supervision throughout the data analysis process. The third author was involved in interpreting the research findings, composing the discussion section, and integrating relevant references and supporting literature. Meanwhile, the fourth author performed the final editing of the manuscript, ensured compliance with the journal’s formatting and writing style, and was responsible for the article submission process and correspondence with the publisher. All authors reviewed and approved the final version of the manuscript prior to submission for publication.

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