

# Ethnomathematical Practices of the Gaddang Community: Input for Instructional Material Development in Teaching Basic Numeracy

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## ABSTRACT

This paper highlights the growing global recognition of the importance of safeguarding cultural knowledge, particularly in the practices of counting and ordering. Its purpose is to explore the ethnomathematical practices of the Gaddang community in Cauayan City, Isabela, as observed in their daily lives. Using an ethnographic study approach, the research examines the counting and ordering methods unique to the Gaddang community. A descriptive-narrative method, along with Outline Cultural Material Coding (OCM), was employed to identify the practices and materials used by key informants. The findings indicate that the Gaddang community has a distinctive numeration system and unique ordering principles, which they apply to various aspects of life, including recording, planting, and harvesting. By integrating these practices into the educational process, this study contributes to the field of mathematics education, enriching the understanding of ethnomathematics and its relevance in preserving cultural traditions.

**Keywords:** Ethnomathematical Practices, counting, ordering

## INTRODUCTION

The Gaddang Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) of Northern Luzon possess a distinct cultural identity, evident in their unique traditions, artistry, and way of life. Their name is believed to originate from the words *ga* (heat) and *dang* (burned), reflecting their geographical and environmental connection. The Gaddang Community people are recognized for their elaborate weaving and beadwork, distinguished by vivid colors and intricate patterns that carry deep symbolic meanings linked to their cultural heritage. Unlike other indigenous groups, they have developed their own techniques and artistic styles, reinforcing their cultural individuality. Education among the Gaddang Community ICCs/IPs, like many other indigenous groups in the Philippines, has traditionally relied on community-based knowledge systems and oral traditions. (<http://www.ethnicgroupsphilippines.com/>). Ethnomathematics serves as a bridge between mathematics and cultural identity, offering an approach that integrates indigenous knowledge into formal education. It acknowledges diverse ways of expressing mathematical concepts, including counting, measuring, inferring, classifying, modelling and ordering (D'Ambrosio & Rosa, 2017; Rosa & Orey, 2016; Rosa & Gavarrete, 2017); (Sirate, 2015). It emphasizes that ethnomathematics should be central to teaching mathematics, ensuring that cultural values are preserved and integrated into learning. By embracing cultural diversity in education, ethnomathematics supports inclusive teaching strategies and contributes to quality education in accordance with sustainable development goals (Putra & Prasetyo, 2022).

Despite the potential benefits, challenges remain in mathematics education, particularly regarding learner diversity. It emphasizes the importance of considering sociocultural backgrounds in the learning process (Rubio, 2016); (Sharma & Neupane, 2016); (Balamurugan, 2015). While numerous studies on ethnomathematics highlight the effectiveness of contextualized instruction, educators still struggle to fully incorporate these concepts into formal education systems.

Furthermore, the implementation of ethnomathematics in mathematics curricula remains limited. According to one officials from the National Commission on Indigenous Peoples (NCIP) Cauayan, no research has been

conducted on the ethnomathematical practices of the Gaddang Community ICCs/IPs. This gap presents an opportunity to explore and document their mathematical traditions, including counting and ordering. This study aims to assess the impact of ethnomathematics on indigenous education and contribute to the preservation of Gaddang Community mathematical practices by developing culturally relevant instructional materials.

By investigating the ethnomathematical traditions of the Gaddang Community ICCs/IPs, it seeks to highlight the significance of integrating cultural knowledge into formal education. Through a deeper understanding of the community's mathematical practices, the researcher can develop instructional material that reflect indigenous knowledge systems, ensuring the preservation of ethnomathematical traditions for future generations.

### **Statement of the Problem**

This study sought to develop instructional materials based from the ethnomathematical practices of the Gaddangs. Specifically, it answered the following questions.

1. What are the ethnomathematical practices of the key informants in terms of:

1.1 Counting techniques; and

1.2 Ordering?

2. Developed Instructional Materials to Integrate the Ethnomathematical Practices of the Gaddang Community in Teaching Basic Numeracy

### **METHODOLOGY**

The researcher used qualitative research specifically the ethnographic research design. It aims to comprehend social customs, cultures, and communities via direct observation and engagement. To acquire deep understanding into the beliefs, customs, and behaviors of the people they are studying, researchers immerse themselves in the community they are researching, frequently living among them, taking part in everyday activities, and conducting interviews. The key informants in this ethnographic research were the elders of the Gaddang community in Guayabal, Cauayan City, Isabela. There were 34 key informants, selected using purposive sampling. The number of respondents was determined based on Creswell (2014) in ethnography. The researcher collected data needed by sending a consent letter to the National Commission on Indigenous Peoples (NCIP) provincial office, followed by presenting the necessary documents and details of the study. Upon approval, the researcher adhered to the guidelines outlined in NCIP Administrative Order No. 1, which led to the creation of the IKSP team and discussions with the community. The researcher used Outline Cultural Material Coding, (Bernard 2011) and Descriptive - Narrative Coding to treat the data.

### **RESULTS AND DISCUSSION**

#### **Ethnomathematical Practices of the Gaddang Community People**

The researcher determined the different mathematical practices. These were counting techniques and ordering.

The Gaddang Community has ethnomathematical practices in counting. The counting includes numeration system.

#### ***Ethnomathematical Practices of Gaddangs in terms of Counting***

As shown in Table 1, the counting practices of the Gaddang Community people in terms of their numeration system reveal a unique terminology. The naming of numbers is based on their native language, Gaddang. The counting numbers in the base-10 system are limited to the tens, hundreds, and thousands. According to informants, there is no direct term in the Gaddang Community language for 'million' since it was rarely used in

earlier times. Additionally, the symbolic representation of Gaddang Community numbers is similar to modern numerals, and there is a distinct cultural writing system for Gaddang Community numbers.

Mathematical symbols for counting numbers often carry profound meanings that vary across cultures. These interpretations shape traditions, superstitions, and belief systems, influenced by historical, religious, and social contexts (Nikzad, 2024). However, the Gaddang Community people did not develop their own distinctive numerical symbols; instead, they adopted numerical systems from neighboring cultural civilizations. As exposure to other cultures leads to changes, societies naturally respond and adapt by incorporating elements from different traditions (Owens & Muke, 2020). Furthermore, the Gaddang Community people follow specific rules in naming their numbers.

Table 1. Counting Practices of Gaddangs Community in terms of their Numeration System .Naming eleven to nineteen

#### Gaddang Number Symbols

Symbol	Gaddang
1	Ta'tta
2	Ad'wa
3	Tal'lu
4	Ap'pat
5	Lima'
6	An'nam
7	Pi'tu
8	Wa'lu
9	I'syam
10	Ta'fulu
100	Ta'tut
1000	Ta'rifu

#### Naming eleven to nineteen

The numbers can be extended by combining the listed numbers from table 1.1 by the base 10. Example, for number eleven (11) this is written in *Gaddang Community* as 10 (*ta'fulu*) plus 1 (*ta'tta*) which is equivalent to *ta'fulu ta'tta*. For number twelve (12), 10(*ta'fulu*) plus 2 (*ad'wa*) equals *ta'fulu ad'wa*. It can be noted that when naming eleven until nineteen, the rule is to add ten (*ta'fulu*) plus the next number ones digit (1,2,3,4,5,6,7,8,9) in *Gaddang*.

#### Naming twenty to ninety-nine

Numbers from twenty to ninety-nine can be named by combining the listed numbers in Table 1 with 'tafulu.' However, when naming tens, the term ends with 'fulu.' For example, twenty is expressed in *Gaddang Community* as 2 (*ad'wa*) times 10 (*ta'fulu*), which is equivalent to 'ad'wafulu.' Similarly, thirty is formed by 3 (*tal'lu*) times 10 (*ta'fulu*), resulting in 'tal'lufulu.' To name numbers like twenty-one, the terms for the tens place and ones digit are combined. For instance, twenty (*ad'wafulu*) plus one (*ta'tta*) becomes 'ad'wafulu ta'tta.' Likewise, thirty-two is formed by combining thirty (*tal'lufulu*) with two (*ad'wa*), resulting in 'tal'lufulu

ad'wa.' It can be observed that numbers from twenty to ninety-nine are named by simply combining the terms for the tens digit with the ones digit.

Naming one hundred one to nine hundred ninety-nine For hundreds, the number 101 is formed by combining one hundred (ta'ttut) and one (ta'tta), resulting in 'ta'ttut ta'tta.' Similarly, one hundred eleven (111) is composed of 100 (ta'ttut), 10 (ta'fulu), and 1 (ta'tta), written as 'ta'ttut ta'fulu ta'tta.' In naming hundreds, the terms for hundreds, tens, and ones are combined. Moreover, when a number includes 10, its name ends with 'fulu,' while 100 ends with 'tut' and 1000 with 'rifu.'

The Gaddang Community base-10 counting system is similar to the Abureni traditional counting system. Studies indicate that translating numbers into the local language helps clarify their meanings, making new numerical systems easier to understand. The number 10 serves as a primary point of synergy, as it appears as a fundamental cyclic unit in both systems (D. Etire, 2021).

In modern education, the numeration system plays a key role in learning mathematics. It enhances understanding and appreciation of essential concepts and skills related to numbers and number sense (DepEd Order No. 021, s. 2019)."

### ***Ethnomathematical Practices of Gaddangs Community in terms of Ordering***

There are also other ethnomathematical practices used by the Gaddang Community. The ordering is the process of placing items in the proper locations while according to guidelines or orders. The researcher views ordering as flow of the tribe's activities and possessions in accordance with particular rules or reasons. The Gaddangs also have their ways in ordering their crops, product and materials in their everyday living. The researcher have found that the community used *kamada* and *badong* in ordering their products. The figure1 shows the *kamada* and *ba'dong* of the key informants.

The figure above shows the *ba'dong* used by the Gaddang Community people. The *ba'dong* is where they arrange and store tobacco after harvesting the leaves. Informants identified this as an ethnomathematical practice in organizing tobacco, which is one of their primary products.

Furthermore, the Gaddang Community also use the *kamada*, which is described as a method for arranging sacks of grain and corn. The *kamalig* serves as a storage area. The *kamada* is primarily used to organize crops such as grain and corn. The Gaddang Community use this system to layer their products, making it easier to count the harvested sacks.

There is no specific number of layers required, as long as the sacks are arranged in a way that allows for easy counting. However, due to the concept of 'kariada,' they often use a base-10 system for stacking, as it facilitates counting. The number of layers depends on the available space in the *kamalig*. This practice enables the Gaddang Community to count their harvest efficiently.

### **Instructional Material Developed to Integrate the Ethnomathematical Practices of the Gaddang Community in Teaching Basic Numeracy**

To address problems of ethnomathematical practices, educational material have been developed to integrate in the high school math lessons while highlighting the ethnomathematical traditions of the Gaddang Community tribe in Guayabal, Cauayan City. The goal is to provide educational resources that actively engage students in meaningful and relevant activities, aligning with the government's 'Education for All' initiative. To support this idea, it is noted that the curriculum should align with students' cultural backgrounds to foster effective learning. Additionally, students' cultural foundations are already sufficient to develop mathematical concepts and provide opportunities for enrichment (Bishop, 1988). This considers a development of teaching guides, specifically a pamphlet, that incorporates the ethnomathematical practices of the Gaddang Community in counting and ordering. The material may serve as one of the resources for teachers and the community, allowing learners to acknowledge the existence of ethnomathematical practices within their community. Teachers may use this material to integrate in the teaching and learning process





**Figure 1. Ethnomathematical Practices in Ordering. Ba'dong. Practices of Gaddang Community in ordering Tobacco**

## CONCLUSIONS

In line with the foregoing findings, a conclusion had been drawn and encapsulated by the researcher.

The ethnomathematical traditions of the *Gaddang Community* people serve as a testament to the enduring relationship between mathematical reasoning and cultural heritage. Through counting and ordering, they have seamlessly integrated mathematical concepts into essential aspects of their daily lives, including farming, commerce, and social interactions. These practices not only demonstrate their practical problem-solving skills but also highlight the sophistication of their indigenous knowledge systems. The continued preservation and application of these mathematical traditions reinforce the importance of cultural identity and adaptive resilience. As modern influences interact with traditional ways, the *Gaddang Community* people's ethnomathematical practices remain a crucial link between past wisdom and contemporary realities. Recognizing and valuing these traditions contributes to broader discussions on the significance of indigenous knowledge in shaping sustainable development, education, and community cohesion.

## RECOMMENDATIONS

Based on the findings and conclusions presented in this study, the following recommendations are suggested:

1. Community leaders to foster intergenerational dialogues where elders can share their ethnomathematical knowledge and practices with the younger generation.
2. Elders to share personal experiences and stories related to traditional practices, fostering a sense of pride and appreciation for their cultural roots.
3. Teachers to integrate Gaddang Community ethnomathematical practices into the math curriculum to give students a practical and culturally relevant understanding of mathematical concepts.
4. School Administrators to include ethnomathematics in the school's educational programs to promote cultural awareness and appreciation among students.
5. Curriculum Developers to develop culturally relevant curricula that incorporate Gaddang Community ethnomathematical practices, ensuring they are aligned with IPED standards.

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