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# Ethno-Mathematics in a Weaving Community

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**ABSTRACT**

Ethno-mathematics examines the relationship between mathematics and culture it explores mathematical concepts, practices, and problem-solving approaches are influence by and rooted in specific cultural traditions and perspective. This study uses a qualitative approach with ethnographic approach. Data collection was conducted using unstructured interviews and collection of patterns or artifacts including photos. Results of the study describe the mathematical ideas that emerged in the weaving activity such as counting and measuring which are important for creating accurate and symmetrical designs, geometric and mathematical shape.

**Keywords**: *Ethnomathematics, Kalinga weaving, Indigenous knowledge, Mabilong weavers, Cultural heritage preservation, Geometric patterns, Social Cognitive Theory, Mathematical concepts, Knowledge transmission, Qualitative ethnography.*

## INTRODUCTION

Ethno-mathematics examines the relationship between mathematics and culture. It explores mathematical concepts, practices, and problem-solving approaches are influence by and rooted in specific cultural traditions and perspectives. This discipline highlights that mathematics extends beyond formal academic settings, existing in the everyday activities and practices of various communities worldwide.

Mabilong weaving, deeply rooted in the ancient traditions of the Kalinga people, originates from the careful extraction of Buteg fibers and the cultivation of Sag-ut cotton balls and Isut trees. Mabilong weavers perfected these techniques, replicating designs and crafting newfound color combinations and blending traditional patterns of such designs. By replicating and blending these designs they developed consistency and accuracy in making such pattern or designs in the future generations to come, preserving their culture and heritage.

Scholars worldwide have acknowledged the importance of ethno-mathematics in exploring how mathematical knowledge is developed and shared within various cultural contexts. Appelbaum and Stathopoulou (2023) explored the historical development of ethno-mathematics, showcasing its growth as a discipline that highlights the cultural roots of mathematical practices. Their exploration builds on foundational contributions, including those by Appelbaum, stressing the importance of a comprehensive approach to mathematics education that recognizes and values the diversity of mathematical systems within various cultural communities. By analysing historical developments, they highlight the significance of integrating ethno-mathematical perspectives into teaching practices, fostering a more inclusive and culturally responsive approach to mathematics education. This underscores the ongoing discourse within the field about the role of ethno-mathematics in enhancing understanding and appreciation of the cultural aspects of mathematics.

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Nationally, interest in ethno-mathematics has grown in recent years, especially among indigenous communities where traditional knowledge systems continue to thrive. A significant contribution to this field is Pradhan's (2020) study, which explored the mathematical concepts inherent in weaving traditions. Pradhan's study uncovered the advanced mathematical reasoning used by elder weavers to create intricate patterns, emphasizing the importance of traditional knowledge in preserving cultural heritage and strengthening community resilience.

Although interest in mathematics is growing, there is still significant gap in understanding the specific practices and perspectives of elder weavers in indigenous communities, especially in the Philippines. While existing studies offer valuable insights into the mathematical principles embedded in traditions, Widada et. al. (2019) found out that there is a clear need for more in-depth research that explores the firsthand perspectives and experiences of elder weavers. This study seeks to bridge the gap by directly engaging with elder weavers, examining their knowledge, techniques, and methods of knowledge transmission. In doing so, it aims to contribute significantly to a deeper understanding of ethno-mathematical practices within the weaving community.

**Research Objectives**

1. To document and analyse the weaving designs and investigate the elders perceptions of mathematical concepts and principles;
2. To identify the specific techniques used by elder weavers to ensure consistency and accuracy in their designs; and
3. To investigate the methods by which elder weavers pass on mathematical knowledge and skills to younger generations within the community.

**Significance of the Study**

This study is beneficial across multiple stakeholders, weavers, educators, students and younger generations, within the fields of ethno-mathematics, cultural preservation, education and community development. This study also empowers weavers by validating their expertise as guardians of indigenous knowledge, thereby enhancing their pride and self-worth within the community. it provides transformative opportunities for educators to incorporate ethno-mathematical perspectives into curricula, fostering culturally relevant and engaging learning experiences that enhance student's mathematical understanding while promoting cultural appreciation and diversity in the classroom.

**Underpinning Theory**

Social Cognitive Theory (SCT) proposed by Bandura (1986) emphasizes the dynamic interaction between personal factors, environmental influences, and behaviour, particularly in the context of learning and behaviour change. In a weaving community SCT and ethno-mathematics work together to demonstrate how learning mathematical concepts is not just a cognitive process but a social one. A young weaver might learn the technique of creating intricate geometric patterns not through formal schooling but through hands-on experience, guided by the observation of the elder weavers, peer mentoring and the cultural significance of the patterns they weave.

In summary, using SCT and cultural mathematics allows for a holistic view of how mathematical concepts are lived and experienced within a weaving community, emphasizing the social, cultural and cognitive dimensions of learning and application.

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## Literature Review

### Ethno-Mathematics in Cultural Contexts

Ethno-mathematics, the study of mathematical concepts as they relate to cultural contexts, emphasizes the integration of indigenous mathematical practices with formal mathematical education, fostering a more culturally relevant and inclusive learning environment. Research by Mosimege and Egara (2022) highlights that while the ethno-mathematics approach can bridge the gap between indigenous and Euro-centric mathematics, it is currently underutilized by mathematics teachers due to a lack of familiarity and training in these methods. Similarly, Astriani, Utaminingsih, and Surachmi (2021) found a significant need for the development of ethno-mathematics-based teaching materials, particularly in elementary education, to help students connect mathematical concepts with their cultural backgrounds and everyday lives. Jacob and Dike (2023) further argue that incorporating culturally relevant pedagogical materials in mathematics instruction can enhance student engagement and understanding, making learning more meaningful and stimulating. These studies collectively underscore the importance of recognizing and integrating cultural contexts within mathematics education to improve student outcomes and preserve cultural heritage.

Ethno-mathematics, as an interdisciplinary field, explores the deep interconnections between cultural practices and mathematical concepts, demonstrating how mathematical knowledge is embedded within various cultural traditions. Rosa and Orey (2023) emphasize the importance of understanding these interrelations through ethnomodelling, which combines sociocultural perspectives of mathematical modelling with ethnomathematics. This approach enables students to connect mathematical procedures to their daily lives, fostering a broader appreciation of mathematics beyond traditional academic settings. Similarly, Hendriyanto et al. (2023) highlight the growing interest in ethnomathematics for teaching mathematics in schools, categorizing research into cultural forms such as ideas, activities, and artifacts. Their systematic review underscores the predominance of geometry in ethnomathematics research, reflecting the rich geometric knowledge embedded in cultural artifacts and practices. Marzal et al. (2021) further illustrate the application of ethno-mathematics in the context of traditional ceremonies, examining the mathematical aspects of the Jambi traditional wedding ceremony. Their ethnographic study reveals various mathematical concepts, including counting, measuring, and designing, thus showcasing how cultural practices can serve as a valuable resource for mathematical education and cultural preservation. Collectively, these studies underscore the significant role of ethno-mathematics in revealing the intricate ways in which mathematical knowledge is interwoven with cultural heritage and everyday practices.

Finally, Ethno-mathematics, a field that examines the mathematical practices inherent in various cultural traditions, offers a unique perspective on how different communities incorporate mathematical concepts into their daily lives and traditional practices. Umar and Muawiya (2019) demonstrated the effectiveness of the ethno-mathematics teaching approach in enhancing performance and retention among secondary school students in Nigeria, highlighting how culturally contextualized mathematics education can lead to better educational outcomes. Similarly, James and Tertsea (2021) found that students taught geometry using ethno-mathematical methods showed significant improvement in both achievement and retention compared to those taught with conventional methods, suggesting that embedding mathematical education within cultural contexts can be particularly beneficial during the challenging circumstances of the COVID-19 pandemic. Moreover, Mania and Alam (2021) reported that teachers perceive the ethno-mathematics approach positively, noting that it helps students understand mathematical concepts more easily by relating them to familiar cultural practices and thus supports the inclusion of such approaches in the mathematics curriculum. Furthermore, Rosa and Orey (2012) discussed ethnomodeling as a pedagogical action within ethno-mathematics, emphasizing the importance of translating and elaborating real-world problems to reflect diverse cultural ways of understanding mathematics. These studies collectively

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underscore the significant role that cultural context plays in shaping mathematical understanding and education, advocating for a more inclusive and culturally responsive approach to teaching mathematics.

**Mathematical Principles in Artisanal Practices**

In the exploration of mathematical principles within artisanal practices, it becomes evident that these principles are deeply embedded in the craftsmanship and knowledge culture of various communities. Kilburn-Toppin (2021) delves into the intricate relationship between practical experience and theoretical knowledge among early modern London artisans, illustrating how master craftsmen, such as masons and goldsmiths, documented their processes and assessments of material quality through collaboratively produced texts. These texts highlight the intertwined nature of experiential and propositional knowledge, and the social negotiations involved in defining material quality within civic spaces. Similarly, Beeley (2019) discusses the cohesive community of mathematical practitioners in later seventeenth-century London, who not only authored practical mathematical books for a growing numerate audience but also taught and collaborated closely with artisans like instrument-makers. This collaboration underscored a shared knowledge culture where mathematical principles were applied and disseminated through both formal and informal networks. Fernandes, Pimentel, and de Deus (2022) further extend this understanding by examining ethnomodelling in the Tocantins region of Brazil, where local artisanal practices, such as the crafting of gold filigree jewelry, are integrated with academic mathematical knowledge. Their research underscores the value of recognizing and respecting local cultural procedures and techniques, demonstrating that artisanal practices are rich with mathematical concepts that bridge cultural and academic domains. Collectively, these studies reveal the profound and multifaceted ways in which mathematical principles are woven into the fabric of artisanal practices, emphasizing the importance of both preserving traditional knowledge and fostering its integration with broader mathematical frameworks.

Ethnomathematics investigates the intricate ways mathematical principles manifest within various cultural practices, particularly in artisanal crafts, demonstrating the universality and diversity of mathematical applications. Albanese (2022) highlights the presence of sophisticated mathematical techniques in handicrafts across different cultures, underscoring that these techniques often mirror those found in more formal mathematical contexts, despite originating in vastly different environments. This reflection on the contextualization of mathematical concepts in daily activities emphasizes the significance of cultural context in understanding and teaching mathematics. In the Aritapera region of Pará et al., (2020) document how women artisans employ mathematical reasoning in the creation of decorated gourds, bridging traditional knowledge with classroom practices to enhance educational outcomes. This connection between local artisanal practices and educational curriculum not only enriches the learning experience but also validates the mathematical expertise embedded in these cultural activities. Similarly, Silva et al., (2022) explore the mathematical knowledge inherent in the ceramic crafting practices of the Maruanum quilombola community in Amapá, Brazil. Their research illustrates how the practical application of mathematical concepts in ceramic production reinforces the cultural and economic roles of women in the community while providing a relevant and contextual framework for teaching mathematics in local schools. These studies collectively underscore the profound and often underappreciated mathematical knowledge embedded in artisanal practices, highlighting its potential to inform and transform educational practices.

Lastly, Ethnomathematics reveals the profound interconnections between mathematical principles and artisanal practices, showcasing how traditional crafts embody complex mathematical concepts. Rodríguez-Nieto and Alsina (2022) highlight the mathematical connections in daily practices, such as kite-making and masonry, through intra-disciplinary and interdisciplinary linkages that integrate cultural mathematics with globalized institutional knowledge. This synthesis of local practices and formal mathematics underscores the mathematical richness inherent in everyday artisanal activities. D'Ambrosio (2020) reflects on the historical evolution of ethnomathematics, emphasizing how various cultures have developed unique mathematical systems in response to their environments and social needs, contributing

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to the broader understanding of mathematics as a culturally situated practice. Chahine (2022) discusses the pedagogical value of indigenous mathematical knowledge systems, arguing that the mathematical principles embedded in everyday life, such as those found in weaving or other crafts, provide a more grounded and contextualized understanding of mathematics, essential for fostering deeper learning and cultural appreciation. Repiyan et al. (2023) further illustrate this by exploring the mathematical concepts in Yogyakarta's hand-drawn batik, identifying geometric patterns and algebraic processes in the motifs and methods, which exemplify how traditional crafts serve as a repository of mathematical knowledge, linking cultural heritage with educational practices. These studies collectively demonstrate that mathematical principles are not isolated abstract concepts but are deeply woven into the fabric of artisanal practices, enriching both the cultural and educational landscapes.

**Transmission of Knowledge and Skills**

The transmission of ethno-mathematical knowledge and skills within cultural contexts is a multifaceted process observed across various indigenous communities and educational settings. Bhuda and Saurombe (2022) delve into the mechanisms of knowledge transmission among AmaNdebele women, highlighting how ethno-mathematical practices such as beadwork and mural art are passed down from mothers to daughters. Their study underscores the significance of oral traditions, observations, and participatory learning in preparing young women for cultural responsibilities, such as decorating their first homes, known as iqathana, thus ensuring the continuity of these traditions across generations. Similarly, Ristanti and Murdiyani (2021) contribute insights from an educational perspective, developing ethno-mathematics-based learning tools for junior high school students in Central Java. Their research emphasizes the practical application of ethno-mathematical principles in enhancing students' mathematical literacy, showcasing how educational initiatives can integrate indigenous knowledge to foster learning outcomes. Ergene and Ergene (2020) extend this theme by examining ethno-mathematics activities designed by pre-service teachers, illustrating how these activities promote cultural awareness and engagement among students. Their findings reveal that such initiatives not only increase teachers' and students' awareness of cultural influences on mathematics but also inspire future educators to incorporate ethno-mathematical practices into their professional teaching methodologies.

Moreover, Ethnomathematics research underscores the crucial role of transmitting mathematical knowledge and skills within cultural contexts, exemplified by studies across diverse settings. Cortes and Orey (2020) highlight the dialogic approach of ethnomodelling, which facilitated the redefinition of function concepts among high school students through interactions with a local farmer in Brazil. This approach not only integrated emic and etic mathematical knowledge but also emphasized the cultural significance embedded in mathematical practices, contributing to pedagogical innovations in classroom settings. Rosa and Orey (2021) extend this perspective by advocating for an ethnomathematical-based curriculum in STEM education, emphasizing the integration of daily mathematical practices with critical thinking and problem-solving skills essential for students to navigate globalized environments. Similarly, Nurjanah et al., (2021) delve into the Minangkabau tribe's ethnomathematical practices in traditional trading, revealing how mathematical representations embedded in nonverbal communication and specific gestures transmit numerical concepts and calculation methods across generations. These studies collectively illustrate how ethnomathematics facilitates the transmission of mathematical knowledge and skills, enriching educational practices and preserving cultural heritage.

Finally, diverse approaches to understanding the transmission of mathematical knowledge and skills within cultural contexts, exemplified across different communities and educational settings. Lestari and Murtafiah (2020) highlight the ethno-mathematical activities among tobacco farmers in Jember, East Java, where traditional practices such as land allocation, seeding, and harvesting involve mathematical concepts like non-standard units, arithmetic operations, geometry, and statistics, passed down through generations via observation and informal education. Similarly, Widada et al. (2019) explore the influence

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of an ethnomathematics-oriented inquiry learning model on mathematical representation abilities among high school students in South Bengkulu, emphasizing the role of community-based knowledge in enhancing mathematical connections. Ramadhani et al., (2022) extend this exploration into kinship patterns of the Nias tribe, demonstrating how cultural elements embedded in kinship structures serve as foundational concepts for learning set theory, reflecting the intergenerational transmission of mathematical understanding through cultural practices. Fitrianawati et al. (2020) contribute by examining the pedagogical content knowledge of student-teachers developing ethnomathematics-based lesson plans in Yogyakarta, underscoring the evolving levels of pedagogical competence in integrating ethnomathematics with cultural heritage sites like Prambanan and Borobudur temples. Together, these studies underscore the significance of ethno-mathematical transmission in preserving cultural heritage, fostering community cohesion, and enriching mathematical education through contextualized learning experiences.

**Cultural Heritage and Community Cohesion**

Cultural heritage plays a pivotal role in fostering community cohesion through the integration of ethno-mathematics into educational and societal frameworks. Massarwe (2023) advocates for a multicultural perspective in education that embraces diverse narratives beyond Western-centric views, aiming to overcome prejudices and stereotypes through inclusive curricula. This approach resonates with Hayati et al. (2024), who emphasize the importance of integrating cultural values into mathematics education using ethno-mathematics. By incorporating culturally relevant mathematical examples and problems, educators can create a more inclusive learning environment that acknowledges and respects students' cultural backgrounds. Additionally, Fauzi et al. (2022) illustrate how traditional architectural practices among the Sasak community embody mathematical principles and educational values, contributing to the preservation of cultural heritage. Their qualitative study underscores the potential of ethno-mathematical insights in designing contextually grounded educational initiatives that honor cultural diversity while promoting mathematical understanding. Thus, integrating ethno-mathematics not only enriches educational experiences but also strengthens community cohesion by valuing and perpetuating cultural heritage through mathematical practices.

Ethno-mathematics reveals profound intersections between mathematical practices and cultural heritage, emphasizing their pivotal role in fostering community cohesion. Long and Chik (2020) explore the intricate relationship between mathematics and the daily life of the Melanau Tellian community in Mukah, Sarawak, highlighting how numerical foundations permeate cultural beliefs, social structures, and traditional practices. Their study underscores how understanding ethno-mathematical principles enhances the preservation of Melanau Tellian cultural heritage, illustrating the integration of mathematics into broader cultural contexts. Chahine (2020) extends this discussion by advocating for ethno-mathematics as a means to honor diverse cultural heritages, particularly in African contexts, thereby promoting cultural identity through mathematical practices rooted in authentic cultural experiences. Similarly, Deda and Disnawati (2024) investigate traditional games within the Indonesia-Timor Leste Border Area (ITLBA), revealing how these games embed mathematical concepts such as geometry and numerical reasoning. Their findings suggest that these games not only transmit mathematical knowledge but also foster social interaction, cooperation, and kinship ties among community members, thereby contributing to community cohesion. Together, these studies underscore the importance of ethno-mathematics in preserving cultural heritage and enhancing community cohesion through the integration of mathematical practices within diverse cultural contexts.

Finally, Ethno-mathematics, situated at the intersection of cultural heritage and mathematical practice, plays a crucial role in fostering community cohesion and preserving cultural identity. Araiku and Pratiwi (2020) illustrate how prospective teachers in South Sumatra creatively engage with local cultural contexts to develop mathematical problems, enhancing their fluency and understanding of geometric concepts within traditional weaving designs. Mansion (2022) extends this notion by exploring how ethno-

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mathematics enriches students' cultural and historical literacies, particularly among Black students in virtual classrooms, where mathematics is integrated with cultural activities to bridge classroom learning with real-world applications. Sharma, Sharma, and Orey (2020) further emphasize the transformative potential of ethno-mathematics through math trail activities at Nepal's Patan Durbar Square, demonstrating how cultural artifacts and experiential learning deepen students' mathematical skills while nurturing moral behavior and cultural appreciation. Wildfeuer (2022) underscores the role of ethno-mathematics in early childhood and elementary education, advocating for culturally responsive pedagogical choices that empower teachers to support students' mathematical identities and equitable learning outcomes. Together, these studies highlight ethno-mathematics as a powerful tool for promoting cultural heritage, community cohesion, and inclusive educational practices through the integration of mathematics with diverse cultural contexts.

In exploring methodologies for studying ethno-mathematics, various approaches have been employed to understand how cultural contexts influence mathematical learning and understanding. Adamu (2022) and Garba (2024) both conducted quasi-experimental studies in Nigerian secondary schools, examining the effects of ethno-mathematics instructional approaches on students' achievement, interest, and retention in geometry. Adamu's research indicated a non-significant negative effect on students' achievement but found significant positive effects on both interest and retention when compared to conventional teaching methods. Similarly, Garba's study revealed significant improvements in students' interest, achievement, and retention when using ethno-mathematics instructional approaches and problem-based learning strategies. These studies underscore the importance of context-specific teaching methods rooted in cultural practices to enhance mathematical learning outcomes. Widada et al. (2019) contributed qualitative insights by studying high school students in Indonesia using ethno-mathematics, highlighting how the approach facilitated the development of thematic linkages in mathematical problem-solving. Meanwhile, Werdiningsih et al. (2019) utilized a mixed-methods approach to analyze students' mathematical communication abilities within an ethno-mathematics framework, revealing varying levels of proficiency and highlighting the effectiveness of Thinking Aloud Pairs Problem Solving (TAPPS) as a structured learning strategy. Together, these studies demonstrate the diverse methodological approaches employed to investigate ethno-mathematics, from experimental designs assessing educational outcomes to qualitative analyses of cognitive processes and communication strategies, thereby enriching our understanding of how cultural contexts shape mathematical learning experiences.

Methodologies for studying ethno-mathematics encompass diverse approaches aimed at understanding the cultural embeddedness of mathematical practices within specific communities. Herawaty et al. (2020) emphasize the cognitive processes involved in ethnomathematics learning, particularly in the context of understanding geometric axioms through cultural artifacts like the bubu in Bengkulu, Indonesia. Khalil (2023) explores mathematics teachers' attitudes towards integrating ethno-mathematics in school curricula, employing a mixed methods approach to reveal both positive perceptions and existing barriers, such as students' perceptions of mathematics' relevance. Indriati et al. (2022) contribute insights on the effectiveness of an ethnomathematics-based visual thinking approach in enhancing mathematics literacy and cultural motivation among junior high school students in Siak, Riau Province, Indonesia, utilizing a mix-method experiment with ethnographic elements. Iji and Andortan (2019) examine the application of ethno-mathematics in improving upper basic education students' interest and achievement in number and numeration concepts in Obudu, Nigeria, employing a quasi-experimental design across multiple schools. These studies collectively illustrate the methodological diversity in ethno-mathematics research, ranging from qualitative analyses of cognitive processes to quantitative assessments of educational outcomes, thereby enriching our understanding of how cultural contexts shape mathematical learning and teaching practices.

Lastly, Purniati et al. (2020) highlight the integration of ethno-mathematics into mathematics education, emphasizing its role in developing students' attitudes towards mathematics and fostering an appreciation for cultural heritage. Their study employed a questionnaire-based approach to assess student

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perceptions and behavioral changes following ethno-mathematics-based lessons, demonstrating a practical method for evaluating the impact of cultural context on mathematical learning. Sulasteri et al., (2020) extend this perspective by focusing on the exploration of geometry learning through historical objects at Fort Rotterdam, Makassar. Their research utilizes a field study approach combining exploration, observation, and documentation to uncover ethno-mathematical concepts embedded in cultural artifacts, thus illustrating how historical and cultural contexts can serve as effective educational tools. Utete, Ilukena, and Sindano (2019) contribute to this discourse by examining how modern sciences have influenced the preservation and utilization of indigenous knowledge (IK), including ethno-mathematics. Their theoretical framework underscores the challenges IK faces in the shadow of dominant scientific paradigms, highlighting the importance of documenting and integrating traditional knowledge systems into contemporary educational frameworks. Furthermore, Fauzan et al., (2020) offer a practical example through their exploration of ethno-mathematics in Rumah Gadang Minangkabau architecture. Employing ethnographic and design research methodologies, they integrate ethno-mathematical principles into realistic mathematics education (RME), illustrating a methodological framework for developing culturally relevant mathematics learning tools. Together, these studies underscore diverse methodologies—from questionnaire surveys and ethnographic fieldwork to theoretical analyses and design-based research—that contribute to a comprehensive understanding of ethno-mathematics and its educational implications.

## METHODS

### Research Design

This study uses a descriptive ethnographic approach, interview and documentary analysis.

### Participants of the Study

The participants of this study were the elder weavers of the weavers village Mabilong, Lubuagan.

### Instrumentation

A combination of qualitative data collection and documentation were used in this study in gathering the necessary information about the ethno-mathematics in a weaving community of Lubuagan.

### Data Gathering Procedures

The data gathering procedures for this research study will involve a combination of qualitative methods designed to capture the intricate relationship between traditional weaving practices and mathematical concepts among elder weavers within the indigenous community. Firstly, semi-structured interviews will be conducted with elder weavers in their local environment, allowing for open-ended discussions to explore their perceptions, experiences, and knowledge regarding ethno-mathematical practices. These interviews will be guided by a flexible interview protocol developed based on the research questions and objectives, ensuring consistency while allowing for adaptability to the dynamics of each interview session. Through in-depth interviews, the researcher aims to gain insights into the mathematical principles embedded within traditional weaving designs, the techniques employed for design consistency, and the intergenerational transmission of mathematical knowledge.

### Data Analysis

The data gathered were analyzed using conducted interviews and documentation from the different answers of oldfolks or elders.

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Through this rigorous and transparent approach to data analysis, the study aims to generate valuable insights that contribute to the existing body of knowledge on ethnomathematics and cultural heritage preservation.

## RESULTS AND DISCUSSIONS

This part contains the presentation and discussion of the findings on the Ethno-mathematics on a Weaving Community. It was found out that there are many mathematical ideas practiced by elder weavers and culture attach on their fabrics or crafts. This study is supported with the study of Tuguic, L. (2009) since she stated in her studies that many hand woven fabrics are related to elements of everyday life, ceremonies, nature or cosmology. The fabrics woven by artisans or weavers are rich in mathematical concepts and cultural symbolism, creating a meaningful connection to their ancestors.

The mathematical and cultural ideas that prevailed include the following:

1. *Counting*

The weavers count the number of thread used to produce woven fabric.

E1: Ha bilang chi kapos un mause si lilaga ked depende si design la. Lu chilayuschus, kasapuyan chi opat cones un silulid. (The number of thread used in weaving such fabric depends on its design. Chilayuschus design needs 4 cones of thread and the other colour is 1 cone.

E2: Depende bilang chi kapos un miyuse si lilaga, lu chuwa un cone si red ya wayu'n cone si black ked teyu un bye-e makwaala. ( The number of thread used in weaving depends on the woven fabric that will be produce, 2 cones of red, ten cones of black and the other colour is 1 cone is equivalent to 3 woven g-string)

The statements of the weavers above could be represented in the following model as:

Chilayusyus – 3(cones of red thread) + 1 cone (black thread) + 1 cone of other colours = 5 cones of thread

G-string – 2(cones of red thread) + 8(cones of black thread) + 1 more (other colours of thread) = more than 10 cones of thread.

Both models illustrate that the number of threads used in weaving depends on the designs of the fabric that will be weaved by the weavers.

2. *Measurement*

Getting the width and length of fabric.

E1: Si sin-egew ha usayon mi un man-isong ked changan/ima. Ngim si sala ha usayon un man-isong si tela ked tape measure. Ha kaewan chi osaan un tela ked chuwanpuyu ya chuwa'n inches ked ha kaanchu la ked olom un yarda. (Before, we use our palm/hand in getting the measurement of the fabric. But for now we use measuring tools like tape measure in getting the width and length of the fabric. The width of a tela is 22 inches and the length is 6 yards.

Before Weavers measure their fabric using non-standard unit of measurement like their palm or hands they also mentioned that they even use their feet in getting the measurement of the fabric. But for now they use standard measurement like tape measures in getting the measurement of the fabric.

Idi chaan umusu cha tape measure changalon mi chi kaewan chi lilaga ked lu kilaanchu la bo usayon mi chi chapan mi un mangaya si kila-anchu'n chi lilaga…( Before measuring tools was not popular yet in weaving like tape measure we use our palm in getting the width of the fabric and our feet in getting the length of the fabric…)

3. *Geometric and mathematical shape*

Designs are adjusted based on geometric proportions, ensuring the accuracy. Weavers often used geometric shapes like squares, diamonds, and stars.

Below is the different woven designs with several motif or geometric and mathematical shape and culture attach on it.

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Figure 1. *Bilallikted*

The figure above is called bilallikted. A double sided design that has colorful scattered square motif, connected triangles, kites, and parallel lines. It was described by E1 as bilallikted from the word "byalikted"- to reverse. it is usually use as clothings.

Figure 2. *Silaksakaw Design*

The figure above is called silaksakaw. It has parallel lines, intersecting lines, quadrilateral and kite. The design has 8 kites. It was described by E.1 as silaksakaw which comes from the word "sakaw" a woven rattan or wood attach to a wall where kitchen wares were place/displayed.

Figure 3. *Bilangyan*

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The bilangyan design has many geometrical patterns such as parallel lines, kites, reflection of a kites, quadrilateral, rectangle and lines. It comes from the word “bangyan” (black trunk tree). The bangyan tree as pointed by E2 was used by the ancestors as foundation to build their sigey (nipa hut) in their farms. It was also mentioned by Shanandoah Diaz in her study that the design is used as canopy during bodong (peacepact) celebration; as “bulig” and as oben(baby carrier) because this kind of blanket is durable and not easily torn.

Figure 4. *Kayaw*

The kayaw design has triangular shape, vertical lines, horizontal lines, spear and a woman figure. The design is described by E3 as kayaw which is used as blanket and table runner. It portrays a woman figure crying a pot on her head while dancing. It was also described by E4 that the woman figure portrays a woman carrying a pot to fetch water. The pot was use by the ancestors to store water and cook their food. From the word “kayaw” – Head hunt. It depicts the Kalinga warriors/ancestors protecting their homeland.

Figure 5. *Lilusu-lusung*

The design has aparallel lines, the lusung which is like two inverted triangles meet at a certain point called a vertex. The lusung shape was formed by picking up thread with a certain configuration of 6-5-4-3-4-5-6 and the diamond or kite shape 1-2-3-2-1. The order of the thread forming the shapes also formed palindromic numbers namely 6543456 and 12321. It has a six sided polygon called hexagon. Aside from the lusung shape there is a rhombus shape. Rhombus is a type of quadrilateral which has 4 equal sides, and four right angles.

The two inverted triangles as represent “lusung (traditional mortar”. Lusung as pointed by E4 is used by our ancestors to pound rice and it was used today to pound coffee beans and other kinds of beans. It was given before as “Lilay” (token) until today.

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Figure 6. *Kilamkam*

The kilamkam design has parallel segments, it has a collinear points. This design is described by E4 as kilamkam as seen in the picture there is “kamkam” (to pick up).

Figure 7. *Silanbituwon*

The silanbituwon design as being depicted has six triangular in shape connected to for a star/silanbituwon. The star shape was formed by picking up the thread with a certain configuration 1-2-5-4-3-4-5-2-1. It has 12 sides which is called dodecagon. There is an inscribed kite. As pointed by E5 the star shape represents stars that lighten the path of our ancestors as they travel at night.

Figure 8. *Pilagpagen*

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The pilagpagen design as being depicted has vertical lines, 2 inverted triangles with a kite or diamond shape at the center, it has also many connected kites or diamond shapes. The pilagpagen design is worn by men during festivals and occassions as pointed by E6.

Figure 9. *Chilayuschus*

This plain fabric is called chilayuschus. The design has vertical and parallel lines. This design is used as blanket, kain and used as lilay (giveaway) as described by E6.

*4. Transmission of Mathematical Knowledge*

E1:Idi pion chi apuk un man ache si laga, insuyuk un umula chi ilon chi manbilang si kapos, sumarunu un insuyuk ked ha miling cha design ked asiot ku isuyu chi ilon chi manlaga. Isun kuma chi achin silan bituwon design. Ha achin bituwon ked siya chi manpa-pacha si chayan cha ap-apu si sin-egew lu labi. (When my granddaughter is eager to learn on how to weave, I taught her first how to count threads accurately, after which I explained to her the meaning behind each pattern or design. For instance: the meaning of the star-shape on the silanbituwon design is the star that lightens up the way of our ancestors at night.)

E2: Chipun ku insuyu chi ilon chi manlaga si alak ku, ha ilolan langammu un manlaga ked bilubuya la laing sakon un chon-o manlaga. (I didn't teach my daughter about weaving or how to weave. She learned it by herself through observing me while weaving.)

E3: Pasuyu pu alak ku si ilon chi manlaga inpablos ku chi chon ok laga-on kan siya ilegew. Lu gumatong siyan mepu iswilaan bensola bo chi lagak. Ilegew un kadchi chon o la koon asila ot laaya chi in-ilon chi manlaga. (When my daughter asks me to teach her on how to weave, I handed her my work (weave). Every day she will do the weaving until she perfected the crafts.)

Elder weavers pass down mathematical concepts to younger generations through hands-on learning, one-on-one mentorship and daily practice with the guidance of elders. They provide direct, hands-on experience by guiding their daughters or grandchildren through the weaving process. This transmission emphasizes the importance of accuracy, symmetry, and cultural context in weaving practices. By passing down these mathematical concepts through weaving, the elders ensure that the younger generations not only learn to create textiles but also maintain the cultural significance of these patterns.

## CONCLUSIONS

Based from the data collected, the following are concluded:

The result shows that there are many mathematical ideas and culture attach on the weaving of Mabilong, Lubuagan. The mathematical ideas that were used in the weaving process are counting, measurements which are important for creating accurate and symmetrical designs, geometric and mathematical shape. The geometrical shape that was found on these designs includes: triangle, inverted triangle, rectangle, and other shapes like kite or diamond shape, star, and a woman figure. The star shape represents the stars that lighten up the path of our ancestors as they travel at night. And as for the woman figure it represents a woman or our ancestors that carry a pot to fetch water. They also use these fabrics as

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canopy during bodong celebration and were given before as "lilay" (token to the partner-tribe after a peacepact celebration). As for the intergenerational transfer of knowledge, elders often mentor younger generations through one-on-one guidance. They provide direct, hands-on experience by guiding their daughters or grandchildren through the weaving process. This transmission emphasizes the importance of accuracy, symmetry, and cultural context in weaving practices. By passing down these mathematical concepts through weaving, the elders ensure that the younger generations not only learn to create textiles but also maintain the cultural significance of these patterns.

## Recommendations

The weaving activity can serve as a learning context for teaching mathematics concepts. Mathematics educators should use this woven designs or fabrics as a springboard in teaching their subjects for the students or learners to examine the cultural contexts of mathematics concepts.

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