

Linking Mathematics and Community: The Ethnomathematics of Bubo Fishing in the Coastal Town of Barbaza, Antique, Philippines

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Abstract. In the Philippines, connecting pedagogy to local experiences, interests, and aspirations of the wider school community is an essential feature in the new educational curriculum. Traditionally, however, the relevance of cultural contexts has been inadequate in mathematics classrooms. The study of ethnomathematics offers insight into how and why mathematics remains integral to the various activities of an artistic community. Bridging the gap between mathematics and the real world may introduce learners to learn in a culturally responsive way. Thus, exploring various opportunities for interconnecting mathematics and culture is essential to enhance teaching and learning. This rapid ethnographic research aimed to investigate the ethnomathematical aspects of *bubo* fishing, one of the traditional fishing methods in the town of Barbaza, Antique. This study aimed to gather data on the diverse ethnomathematical practices, skills, and knowledge of the local fisherfolk. Five key informants were chosen through purposive sampling. The data for this study were collected through participant observation and ethnographic interviews. Data triangulation, member checking, and audit trail were used to establish the validity of the data. Spradley's four-part ethnographic analysis revealed that ethnomathematics is embedded in the *bubo* fishing activities of the local fisherfolk. This study demonstrates that the local fishing community is rich in ethnomathematical knowledge, providing valuable mathematical information that may inspire and guide educators in developing and designing context-based curriculum content and teaching-learning materials. By making mathematics more relatable and demonstrating its practical value, educators can inspire a generation of learners who appreciate the power of mathematical concepts and their relevance in the real world. Further research is recommended to document the local mathematization of other cultural communities.

Keywords: Bubo fishing; Culture; Ethnography; Ethnomathematics; Fisherfolks; Livelihood

1.0 Introduction

Ethnomathematics encompasses the cultural beliefs and values exhibited by different groups of people within their respective societies or environments, which have a direct impact on or influence effective mathematics instruction (Orok, 2013). Community involvement is crucial for the successful integration and contextualization of cultural components into mathematical activities (d'Entremont, 2015). This provides an opportunity for the learners to explore the mathematics of various cultural groups (D'Ambrosio, 2017). Li (2016) believed that mathematics is a culture for humans. Therefore, ethnomathematical approaches aim to enhance the quality of learning and make mathematics more relevant and meaningful for learners (Rosa & Orey, 2011).

Mathematics is everywhere, but it is not adequately documented. Everything people can do and the materials they use every day are opportunities to explain the power of mathematics (Colli et al., 2014). According to Zayyadi (2015), even without formal education, mathematical concepts can be developed through cultural activities within the local community. Hence, mathematics exists in many different communities (Shafer, 2016). The Tchokwe people of Angola traditionally used sand drawings as a form of storytelling. These drawings, passed down through generations, represent mathematical concepts like patterns, symmetry, and spatial reasoning (Larson, 2007). Similarly, the Marshall Islanders, skilled navigators of the Pacific Ocean, developed a profound understanding of wave patterns and celestial navigation, enabling them to travel between islands, demonstrating a profound grasp of geometry, physics, and spatial relationships (Genz et al., 2019). Accordingly, this highlights the role of life contexts, authentic activities, and collaborative groups in understanding acquired knowledge within the community's cultural context (Fraihat et al., 2022).

According to Simeonov (2016), each learner brings a unique background to the classroom and experiences from a cultural perspective. Through integration and contextualization, learners' knowledge can be leveraged by bringing mathematical concepts from their home and community and connecting them to classroom situations (Paris, 2011). Contextualizing the curriculum makes the lesson more meaningful and relevant to students, as it helps them relate the mathematical content taught in school to their context (Reyes et al., 2019). It also helps the learners make connections between different subject areas, what they are learning in school, and the world around them (Llego, 2022).

Designing and developing contextualized teaching and learning strategies begin with understanding the nature and background of the learners. Hence, the Department of Education empowers educators to modify and explore the unique contexts of a cultural community (DepEd Order No. 35, s. 2016). Learner diversity requires teachers to adapt their teaching strategies to accommodate the varied learning styles, backgrounds, and needs of all the learners. This includes creating an inclusive classroom environment, providing differentiated instruction, and utilizing diverse teaching materials and assessment methods to ensure the relevance of educational processes for all learners.

There has been a community paradigm of ethnomathematics in the fishing industry. Given its geographical location on the seacoast, fishing is considered one of the most important economic sources of livelihood for the Barbazeños. In the fishing community, the use of fish traps is culturally universal, and one of the most common devices used is the *bubo*, also known as a bamboo fish trap (Zayas, 2022). The fisherfolks call it *bubo* or *bobo*, a Filipino term which means "dumb," to describe the captured fish (Rosas, 2015). These kinds of fish traps are simple, and the primary materials used are locally available bamboo or *kawayan*. According to Sulatra (2023), fish traps contain a wealth of ethnomathematical information that can be utilized in classroom instruction. Therefore, it is of great importance to conduct ethnomathematical studies to reflect and embrace the multicultural views of the learners in mathematics.

In this regard, pedagogies in mathematics should reflect and embrace the cultural diversity of the learners (Brandt & Chernoff, 2014). Strong social relations within the fishing community facilitate the effective implementation of various mathematical activities in a continuous and ongoing process (Albanese & Mesquita, 2023). This study examines the significance of integrating and promoting local cultural practices in mathematics education. The primary objective of this study is to explore and determine the ethnomathematical practices, skills, and knowledge associated with *bubo* fishing in order to establish and embrace a more relatable and culturally grounded approach to mathematics.

2.0 Methodology

2.1 Research Design

This study utilized a qualitative-descriptive research methodology with a rapid ethnographic research design. Rapid ethnography involves data collection from various sources over a relatively short period (Baines & Cunningham, 2013). Unlike traditional ethnography, rapid ethnography has a shorter and more compressed timeframe for field activities (Reeves et al., 2008); it aims to gather rich and contextual data about a specific situation or community within a limited period, often to address urgent research needs and specific questions (Millen, 2000). This approach is beneficial, as the study requires a timely understanding of the key informants'

experiences and cultural contexts. Thus, only the data relevant to the research objectives have been collected. Rapid ethnography was an appropriate approach in this study for gaining a deep understanding of the ethnomathematical aspects of *bubo* fishing, allowing the researcher to gather, collect, and analyze data within a compressed timeline.

2.2 Research Locale

This study was conducted among the local fisherfolk of Bahuyan, Barbaza, Antique. Barbaza is a coastal municipality in the province of Antique. The town of Barbaza has a land area of approximately 154.36 square kilometers, or 59.60 square miles, which constitutes 5.65% of Antique's total area. The municipality of Barbaza comprises a total of 39 barangays. Bahuyan is one of the barangays and is situated in the southernmost part of the municipality.

2.3 Research Participants

The research subjects in this study consisted of five key informants who were purposively selected for their expertise in the field. Using the general characteristics in selecting a good informant presented by Spradley (1980), the selection of the research subjects were based on the following criteria: (1) the informants are residents of Bahuyan, Barbaza, Antique; (2) informants are community members who have been involved in *bubo* fishing activities; (3) informants have good understanding of the nature of the bamboo fish trap as a fishing method; (4) informants have the willingness to become informants and have sufficient time to provide information whenever needed; and (5) informants can convey complete information either in their dialect (Kinaray-a) or language (Filipino and English).

2.4 Research Instrument

The research instruments used in this study involved the observation guide and the interview guide questions. To establish the validity of the research instruments, the observation guide and interview guide questions were validated using content validity. To ensure that the study's objectives were met, educational and ethnographic research experts evaluated the relevance of each question or item in the instrument. To judge the relevance of each question, the experts critiqued each item as follows: (1) accept, (2) revise, (3) reject. They were explicitly requested to provide recommendations for each item that they had marked "revised" or "rejected." At the end of the validation, the researcher analyzed the responses from the experts.

2.5 Data Gathering Procedure

Before gathering the data needed for the study, the researcher had to secure a permit from the barangay captain and local officials. After securing the permit, the researcher identified and selected fisherfolk based on the set criteria as key informants for the study. The researcher adapted Spradley's 12 steps in the developmental research sequence. The data collection technique used in this study involved participant observation and ethnographic interviews. Observation data were collected using recording sheets, field notes, photographs, audio recordings, and video recordings. The ethnographic interview was conducted using an interview guide approach. The results from the ethnographic interview were then transcribed and translated by the researcher with the help of an expert. Data collection in this study was considered complete when the researcher had gathered sufficient information to meet the research objectives. The data in this study were then analyzed using Spradley's ethnographic analysis, which consisted of (1) domain analysis, (2) taxonomic analysis, (3) componential analysis, and (4) thematic analysis. Data triangulation, member checking, and audit trail were also used to establish the validity of the data gathered in this study.

2.6 Ethical Considerations

To maintain ethical considerations in the study, the researcher made great efforts to avoid gathering information without the knowledge of the informants and their proper consent. Hence, the researcher informed the informants that their participation was voluntary and that they were free to withdraw from the study at any time. During the study, the researcher ensured that informed consent was obtained from all participants. The researcher took steps to ensure the research data remains confidential as much as possible. The researcher also strived to avoid plagiarism and research misconduct wherever possible. Moreover, the researcher took steps to avoid careless errors and negligence, maintained accurate records of the research activities, and treated colleagues with respect and fairness. The researcher, being open to criticism, maintained and improved personal and professional

competence and expertise through lifelong education and learning.

3.0 Results and Discussion

3.1 Bubo Fishing in Barbaza, Antique

Fish traps are widely used and culturally practiced around the world, and it appears that they have been invented multiple times (Zayas, 2022). Barbaza, Antique, is known for its extensive coastal plains. Given its geographical location on the seacoast, fishing has been one of the most important economic sources of livelihood for most inhabitants. The Barbazeños have sustained their livelihood through deep-sea fishing. Despite the many advances of today, most local fisherfolk still prefer to use traditional and unsophisticated approaches to catch fish. *Bubo* fishing is one of the fishing activities in Barbaza, Antique, that is rich in many ethnomathematical aspects. It is very effective in catching high-quality fish and various types of seafood with high market prices. It is a sustainable and eco-friendly fishing method.

The *bubo* fish traps are organically made using bamboo or *kawayan* as the primary material. One of the key informants, Koykoy, has described “Bamboo is an essential material used in making the *bubo* fish trap. Due to its abundance and availability, it is considered the practical choice for a material to use in making the fish trap.” He added, “It does not cause harm to the environment. It may be because the majority of the materials used are bamboo. This makes the trap sustainable and separates it from other fishing paraphernalia used today.”

After several months of use, the bamboo fish traps may have weathered and would need to be replaced with new ones. This traditional crafting is called *pagrara* or bamboo weaving. Bamboo weaving utilizes bamboo as a raw material, weaving it into patterns using a variety of weaving methods (Zheng & Zhu, 2021). Despite lacking formal training in mathematics, local fisherfolk were able to generate various geometrical designs and patterns (Eclarin et al., 2022). Different mathematical concepts and ideas, such as counting, measuring, determining the location of objects, using implication logic, and various geometry concepts, emerged in the weaving practices of the Adonara society (Wara & Dominikus, 2017); weaving craftsmen of the Osing community (Yudianto et al., 2020); and woven bamboo in Pecalongan Village (Sumining et al., 2023). Figure 1 below shows the *bubo* fish traps made by the local fisherfolk.



Figure 1. The Bubo or Bamboo Fish Trap in Its Front View (Left) And Rear View (Right)

After a good haul at sea, fisherfolks would sell or trade their catch to buyers. These are weighed on the scale before being sold. The weight of their catch is typically expressed in kilograms (kg). There is a wide variety of fish that can be caught using the *bubo* fish traps, and all of them are considered delicacies by the locals. These fisherfolks would often deliver fish products to different houses, asking their neighbors if they were interested in buying fresh, newly caught fish. Sometimes, they would also fetch and deliver them to the local markets. Additionally, bamboo fish traps may also be sold to interested buyers, some of whom are also fisherfolk. One of the key informants, Ontoy, mentioned that crafting bamboo fish traps and using them for fishing is a tradition in the town, and it is very profitable. The bamboo fish traps could be sold for a range of 500 pesos to 1,000 pesos, depending on the size and materials used.

Bubo fishing practices of the Barbazeños may have been inherited from their ancestors, which is also comparable to most fishing practices. Moreover, personal experiences may have also played a significant role in the livelihood of the fisherfolk. Their knowledge and skills regarding the use of *bubo* fish traps were obtained by observing and learning from older fisherfolk. An informant, Jocel, explained, “*Bubo* is our traditional fishing method. We have learned *bubo* fishing from our parents, grandfathers, and ancestors. It seems to have been passed down from generation to generation. Thus, *bubo* fishing is a skill inherited from our elders.” Similarly, younger children learn fishing with their fathers or uncles, then observe their line of work and do it repeatedly until they have perfected it (Siar, 2003). Access to *bubo* fishing resources depends on the individual practices, skills, and knowledge of the fisherfolk.

3.2 The Ethnomathematical Practices, Skills, and Knowledge of Local Fisherfolk in *Bubo* Fishing

After a series of careful analyses, the researcher was able to determine the processes and techniques in *bubo* fishing. These processes and techniques were identified as the cultural themes of the study. These recurring themes were distinguished as ethnomathematical practices in *bubo* fishing. The ethnomathematical practices refer to the various *bubo* fishing activities performed and demonstrated by fisherfolk in general. As seen in Figure 2, the ethnomathematical practices found in *bubo* fishing include: (1) preparation of materials in making the *bubo*, (2) creation of the *bubo*, (3) measurement and estimation, and (4) placement and retrieval of the *bubo* fish trap.

Conversely, the ethnomathematical skills and knowledge were derived and rooted in the processes and techniques demonstrated by the fisherfolk. The ethnomathematical skills derived from this study are the fisherfolk’s abilities and methods used while carefully applying and putting into practice the mathematical knowledge and concepts they have acquired. These involve (1) making bamboo strips, (2) making *sukdap* or thin sheets of bamboo strips, (3) *pagrara* or bamboo weaving, (4) assembling the parts of the *bubo* fish trap, (5) measuring and estimating using non-standard units of measurements, (6) *pamalngat* or marking the location, and (7) using the *pataw* or buoy (See Figure 2).

Alternatively, ethnomathematical knowledge refers to the fisherfolk’s familiarity and understanding of various mathematical concepts and ideas. In Figure 2, the ethnomathematical knowledge present in *bubo* fishing include (1) basic counting, (2) basic operations, (3) plane figures and solids, (4) area of a rectangle, (5) volume of a rectangular prism, (6) tessellation of squares, rectangles, and hexagons, (7) angles, (8) approximating measures of quantities, (9) converting non-standard units of measurements to standard units of measurements, (10) point, line, and plane, and (11) the Cartesian coordinate plane.

Preparation of Materials for Making the *Bubo* Fish Trap

In making the *bubo* fish trap, the local fisherfolks would need to consider and prepare the following materials: bamboo (for making bamboo strips and *sukdap*), bamboo strips (used for bamboo weaving), *sukdap* (used for tying and binding woven bamboo strips), *bolo* or machete (used for cutting the bamboo), nylon (for tying and binding woven bamboo strips; an alternative for *sukdap*), nylon ropes, stones, Styrofoam, a piece of cloth, and sticks that may be available from the surroundings.

The fisherfolks would first need to choose big and mature bamboos. These bamboos are cut to size, with lengths varying depending on the desired size of the fish trap they plan to make. Although bamboo is robust and complex in its natural form, it can be very flexible when converted into a thin sliver owing to its strong fiber properties. Using the *bolo*, they separate the skin of the bamboo from its flesh and cut it into smaller pieces known as bamboo strips. The estimated length of the bamboo strips must be one *dupa* or approximately 1.5 meters, and this serves as a standard guide for constructing the bamboo fish trap. When the number of bamboo strips is sufficient, the fisherfolk may continue with the bamboo weaving procedure.

The fisherfolks would need to use *sukdap* or thin sheets of bamboo strips, which are estimated to be one *dangaw* in measure, or the length between the tips of the stretched thumb and the small finger. *Sukdap* is used for binding the woven bamboo strips. An informant, Koykoy, stated, “Traditionally, we are using *sukdap* to bind the bamboos. *Sukdap* is a thin skin part of the bamboo. However, since the times are changing and everything is improving, we also have to improve our binding materials.” Hence, to strengthen and further enhance the connection of the woven bamboo strips, they could use nylon to complete the construction of the bamboo fish trap.

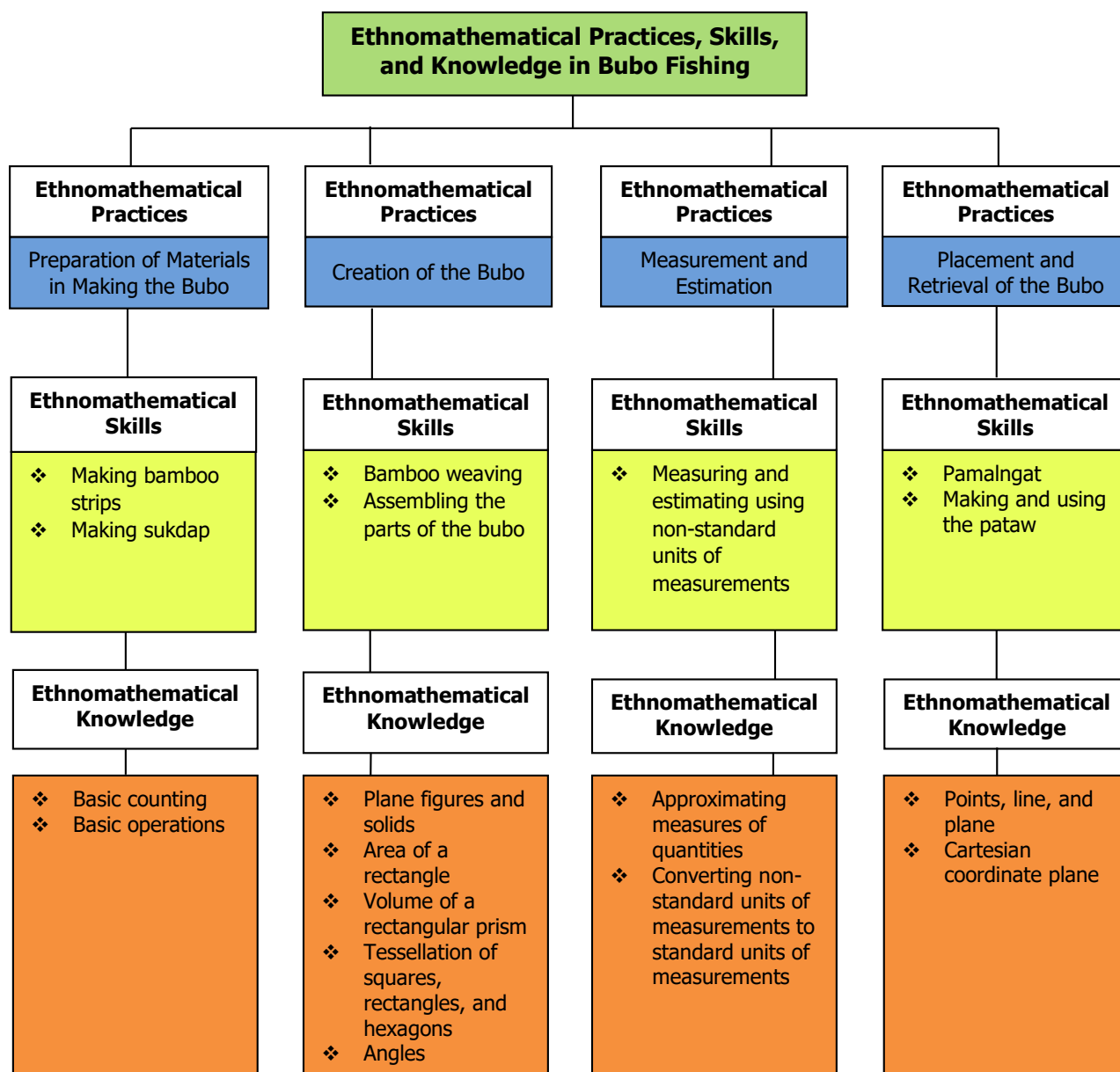


Figure 2. Thematic Map of the Ethnomathematical Practices, Skills, And Knowledge of Fisherfolks in Bubo Fishing

Basic counting is an early mathematical knowledge that involves one's ability to count in ascending order. For basic counting, the fisherfolks would count the number of bamboo strips by touching or transferring each strip in a set, one by one. Often, they also use skip counting or counting by twos. Here, the fisherfolks would count every other number, and each count is two more than the previous count. For basic operations, the fisherfolks use addition and subtraction when selecting a desired number of bamboo strips or *sukdap* to use. Addition is done by simply combining distinct sets of bamboo strips and *sukdap*. For subtraction, instead of combining the two sets, the fisherfolk will remove one quantity from another. Figure 3 illustrates how an informant, Pano, prepares materials, such as bamboo strips, prior to the weaving procedure.



Figure 3. An Informant Counting and Preparing the Bamboo Strips

The fisherfolks would also have to prepare the stone sinkers, also known as *pamato*. These stones would be needed after all the woven parts of the bamboo fish trap have been finished and combined. The *pamato* will be used when the *bubo* fish trap is finally ready for the waters. The other materials that they must also prepare include the Styrofoam, a piece of cloth, wooden sticks, and nylon ropes for the construction of the *pataw* or buoy. The *pataw* is not a significant part of the bamboo fish trap, but it is essential in *bubo* fishing for most of the locals.

Creation of the Bubo Fish Trap

Bamboo is the most widely used material for making fish traps. Bamboo weaving is a traditional craft in the town, where various materials are crafted into different designs and patterns using diverse weaving methods (Zheng & Zhu, 2021). The bamboo fish trap has three main parts: (a) the *salog* or the stomach, (b) the *lawas* or the body, and (c) the *garaw* or the mouth of the *bubo*. Traditionally, the fisherfolks begin by making the stomach or the bottom area of the bamboo fish trap. Removal of fish caught is through an opening located at the sides or the lower portion of the trap. Hence, the stomach serves as the opening part to catch the food when it is completed. The weaving process itself has a definite beginning and end. The fisherfolks first measure the bamboo strips and decide on the size of the *bolo* they want to make. Then, they start to lay down the bamboo strips on the ground for the first weave, which they call *pagbalay*. Here, the bamboo strips are interlaced perpendicularly through the previously laid strips. And so, a strip after another. They will need to use the *sukdap* or nylon to connect the bamboo strips. The interweaving eventually results in a mesh-like rectangular sheet. According to one of the key informants, Odong, "Counting the right number of bamboo strips is very important and the weaving process must be accurate." This implies that bamboo weaving requires utmost skill and care. Figure 4 below shows an informant weaving the stomach of the *bubo* (left) and the finished product (right). The stomach forms a rectangular shape, and the design constitutes patterns and tessellation of squares and rectangles.



Figure 4. Weaving the Stomach of the Bamboo Fish Trap

The body is the central part of the bamboo fish trap, as this is where the fish caught are usually contained. The weaving process is mostly the same as that of the *bubo*'s stomach. Unlike the stomach, the interweaving of the body of the bamboo fish trap results in a figure resembling the letter H (see Figure 5). One of the informants, Koykoy, has stated, “The *bubo* fish trap is woven to have its body form like a letter H. Its bottom part is a rectangular shape. The size of its body must be the same as its bottom part, and you must also weave them together and combine them. So that is it, then you decide if you need to bind them using nylon and add braces.” When the weaving process is complete, both parts (the stomach and the body) will be ready for installation. After consolidation, these parts are assembled to form a rectangular prism or a cuboid structure. The fisherfolks would then need pieces of bamboo, approximately 2 inches in width, that would serve as a flange or backbone. They must attach these pieces of bamboo to the top and the bottom of the *bamboo* fish trap using *sukdap* or nylon materials. Figure 6 shows the bamboo fish trap after installing the body and the stomach of the *bubo* (left) and the fish trap after attaching small pieces of bamboo that serve as a backbone for formability (right).



Figure 5. Weaving the Body of the Bamboo Fish Trap



Figure 6. Installing and Combining the Stomach and the Body of the Bamboo Fish Trap

The *garaw* is the mouth or the opening part of the bamboo fish trap. In making the mouth of the *bubo* fish trap, a bamboo strip is initially measured and compared with the cuboid structure. The fisherfolks need to carve a bamboo strip and estimate the desired size of the *garaw*. After doing so, they would interlace the bamboo strips, one strip after another, forming hexagonal-shaped holes. The interweaving eventually results in a semi-conical or cylindrical structure (see Figure 7). The locals need to have some thorns made from bamboo strips, approximately twelve inches long, with a sharp point, and attach them to the *garaw*. The purpose of this is to make it difficult for any fish that enters the trap to get out. According to one of the informants, Ontoy, “The *garaw* is where the fish

will enter, and it can no longer escape. We use a bamboo pole with a hook to catch the fish. Any fish will get caught as long as it can enter its mouth.”

Figure 8 illustrates the attachment of the mouth to the *bubo* fish trap. The *garaw* is positioned in the enclosure lengthways from the edge to the mid-part of the trap. The exterior opening is wider, yet the hole progressively narrows towards the end, where a second opening is located. Once the bamboo fish trap is complete, it must be left out in the sun to dry for about three days. According to one of the key informants, Jocel, “Drying the bamboo makes the bamboo fish trap durable and long-lasting.”



Figure 7. Weaving the Mouth of the Bamboo Fish Trap



Figure 8. Placing the Mouth of the Bamboo Fish Trap

After the drying process, the *bubo* fish trap will now need some stone sinkers or *pebbles* before it is placed in the water. This will help increase the sinking time of the fish trap, making it less likely to be washed away by strong tidal currents. Eventually, the locals will have to reduce the number of stone sinkers when the *boulder* is already immersed in the water for quite some time. The fisherfolks will also need to place a sharpened bamboo stick called a *palpal* that is attached behind the *bubo* fish trap. This will serve as an anchor for the bamboo fish trap, preventing the *bubo* from being washed away during strong currents.

The design and structure of the *bubo* fish traps are very intricate and require a high amount of skill and knowledge from the worker. Essentially, all the parts of the bamboo fish trap serve different functions, and the worker must ensure that each part is well-made and well-executed.

Measurement and Estimation

The fisherfolk use a variety of measurements. Measuring is one of the most recognizable mathematical activities of the fisherfolks (Herrera & Palomo, 2022). Measurements exist to numerically represent the degrees of attributes of objects or events, allowing for comparison with others (Hagan, 2014). Fishermen commonly use their body parts and other objects for convenient measures of length. They use these convenient measures of length to make their fishing boats, paddles, nets, and other fishing gear. The use of body measures is culturally universal among fisherfolk (Herrera & Palomo, 2022). Some of the standard non-standard units of measurement they use for length are reflected in Table 1.

Table 1. Units of Measurement for Length, Their Definitions, and Their Equivalent Standard Unit of Measurement

Units of Measurement for Length		
Convenient Measures of Length Using Body Parts	Definitions	Equivalent Standard Unit of Measurements
Dangaw	The length between the tips of the stretched thumb and the small finger	1 dangaw = 8 inches
Kahig	The length of the foot	1 kahig = 12 inches or 1 foot
Butkon	The length of the arm	1 butkon = 16 inches
Tuhod	The length from the base of the foot to the top of the knee	1 tuhod = ½ meter
Dupa	The length of the outstretched arms	1 dupa = 1.5 meters or 68 inches

Body-based measurements refer to the use of subjective body parts or proportions as units of measure. On this basis, it is likely that other cultures independently use units of measure that are very similar to each other. Using body parts for measuring activities is a common practice in cultures around the world (Kaaronen et al., 2022). Body-based measurements of various ritual artifacts are evident in the Malay's "mother dibble" (Winstedt, 1961); Navajo masks (Kluckhohn et al., 1971); and Semai ceremonial rice stalks (Karim, 1981). Body-based units of measure are also used in the design of ceremonial buildings, as seen in the work of the Minangkabau (Fitriza et al., 2019) and the Marquesan people (Handy, 1923).

The fisherfolks also often use distinct dry measures to measure the amount or volume of fish products they catch. Dry measure is a system of units for measuring the volume or capacity of unpackaged goods, distinct from liquid measures (Herrera & Palomo, 2022). Some of these dry measures are reflected in Table 2 below.

Table 2. Conversion Factors in Dry Measures

Non-Standard Unit of Measurements	Standard Unit of Measurements
1 leche	250 grams of rice
1 salmon	375 grams of rice
1 gantang	2.25 kilograms of rice
1 kaha	25 kilograms
1 banyera	35 kilograms
1 kaing	70 kilograms

Over time, fisherfolks have developed non-standard methods of measurement for making fishing gear and tools, as well as for measuring the size and quantity of fish caught. Non-standard units of measurement are not typically used but are highly operational in fisherfolk's daily lives. These measurements have been used by the fisherfolks for generations, even before conventional units for length and weight were developed.

Placement and Retrieval of the Bubo Fish Trap

Finding the specific location and placement of the *bubo* fish trap seems like an arduous task, considering the vast ocean, without relying on any relatively high-tech devices. However, they have techniques for locating specific areas of the bamboo fish traps, namely: (a) *pamalngat* or marking the location and (2) the use of *pataw* or buoy. *Pamalngat* is one of the widely used ethnomathematical practices among fisherfolk in navigation. It is a method that utilizes the fisherfolk's line of sight, angles, geographical landmarks, houses, constellations, or any other stationary objects visible to them as references to identify a specific location or placement in the sea. This method

is similar to the tri-square technique or the use of an imaginary letter L. This process is similar to locating a point (spot) using coordinates (objects or landmarks) from two perpendicular directions.

An informant, Koykoy, explained, “You have to remember and mark the spot where you have dropped the *bubo* fish trap. You must remember the alignments. You must angle it to exactly 90° . You must look at the shorelines. You must mark your south or your north. We call it *pamalngat*. You must remember the mountains and their curves, remember the alignment. Then you look at the cell site in the town of Tibiao, and you must also remember its alignment. You have to remember that spot where there are many fish, that is where you are going to drop your fish trap again.” Marking the location of the bamboo fish traps is very important. It allows fisherfolk to locate the fish trap when it is submerged underwater easily. Sometimes, fisherfolks use the same approach to determine the right place to fish (Into, 2019). Figure 9 shows an informant retrieving the *bubo* fish trap at sea by carefully pulling them in by hand to collect the catch.

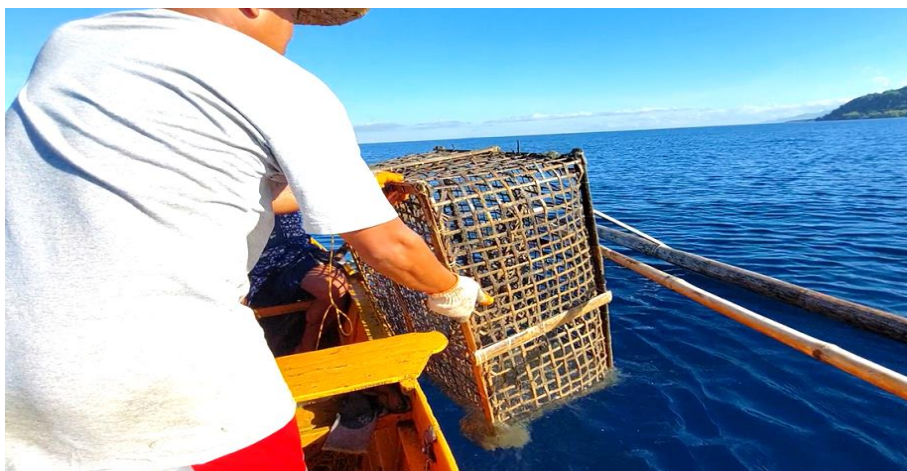


Figure 9. Retrieving the Bubo Fish Traps

Locating the *bubo* fish traps is like geometry at work. Figure 10 below illustrates how fisherfolks mark their location. The lines represent the line of sight of the fisherfolk. The mountain and the coconut tree form a right angle. The lines intersect at a specific point, representing the unique location of the submerged *bubo* fish trap.



Figure10. Graphical Representation of the Pamalngat

Alternatively, fisherfolks may sometimes need a *pataw* or buoy that serves as a marker at sea. *Pataw* is a term commonly used by Barbazeno fisherfolks that refers to a structure used as a marker for the *bubo* fish trap. It is made of small bamboo or sticks that are approximately 5 meters long, with Styrofoam attached to them and a flag (made of a piece of cloth) that will help make it more visible from a distance. At the bottom of the *pataw*, fisherfolks tie a rope that serves as the binder or main connector of the *pataw* to the bamboo fish trap. Once the *bubo* fish trap reaches the ocean floor, the fisherfolks will need to add an extra five *dupa* of nylon rope binder. They call this additional length of the binder '*kulami*'. According to Sulatra (2023), *kulami* enables the *bubo* fish trap to withstand the strong currents on the sea floor and the large waves.

In setting up the *bubo* fish trap, the fisherfolks begin by estimating the depth of the sea and the length of the tie they are going to use. Once they reach the intended lengths, one end of the tie is attached to the buoy, and the other end is attached to the fish trap. The fisherfolks must ensure that the length of the nylon ropes they are using is sufficient to reach the bottom of the sea after they drop the *bubo* fish trap. To retrieve it, they will use a long rope, about 30 to 50 meters long, that is attached to the buoy and the bamboo fish trap. They must pull it up patiently and bring the *bubo* fish trap to the surface. They take an extra few minutes to clean the *bubo* fish trap, scan the damage and its condition, and then drop it back into the water. Figure 11 shows how the bamboo fish trap and the buoy are submerged and placed into the sea.

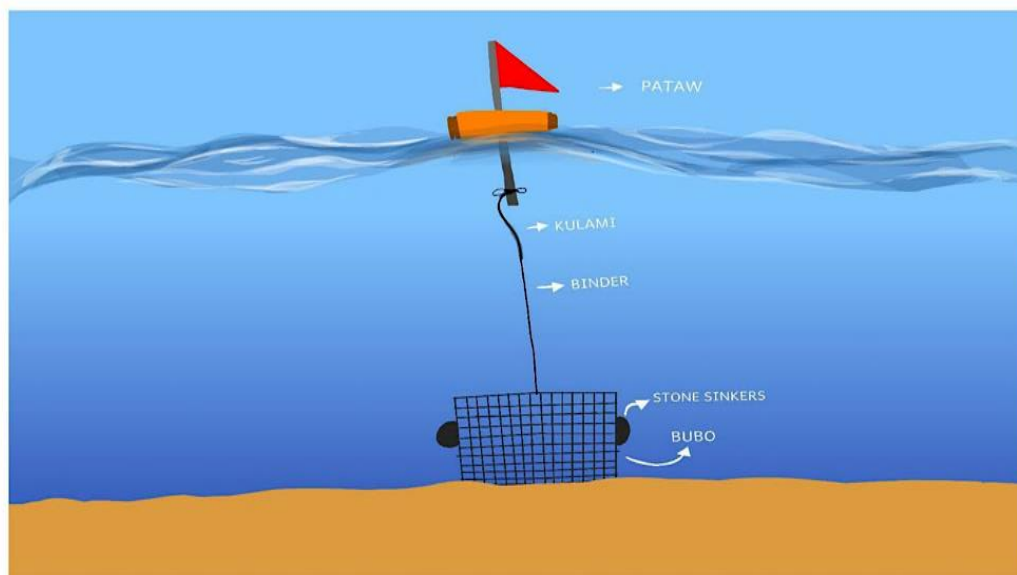


Figure 11. Graphical Representation of the Set-up of the *Pataw* and the *Bubo* Fish Trap

Armed with only a pair of spherical organs of sight, the fisherfolks can know the exact location of the *bubo* fish traps they have lowered into the sea (Into, 2019). They constantly pay attention to specific points of orientation at sea and watch a pair of familiar landmarks, observing how these landmarks appear from their boats to mark their current position (Igarashi, 1974). Bishop (1988) has identified locating as one of the universal mathematical activities, as it involves spatial reasoning, estimation, and potentially geometry, utilizing landmarks, angles, models, diagrams, and distances to navigate and find optimal fishing spots.

4.0 Conclusion

In this study, the local fisherfolk, although most have no formal schooling, possess a firm grasp of mathematical principles essential for their profession. The ethnomathematical practices, skills, and knowledge of the fisherfolks, as derived from this study, can be elaborated into concepts that may be utilized and integrated into mathematics lessons. Educators may employ varied strategies to address the diverse needs of learners. Activities situated outside of the classroom may help the learners explore mathematics within their immediate environment. Moreover, the findings of this study may challenge mathematics teachers and educators in general to develop and design instruction that is comparative and applicable to the learners' cultural backgrounds and experiences. The integration of local culture into mathematics learning will provide additional meaning to the learning process.

The findings of this study demonstrate that the fishing community offers rich and valuable mathematical information that can inspire and guide educators in developing and designing context-based curriculum content and teaching-learning materials. Therefore, teachers must be able to learn about the communities and the socio-cultural backgrounds of the learners. When mathematics problems and examples draw on the learners' experiences, traditions, and environments, they are more likely to see the value and relevance of what they are learning.

Linking mathematics and the community can enrich the learning experiences of the learners, help them develop their self-confidence, provide a strong sense of self-identity, and foster pride and appreciation for diverse perspectives. Bridging the gap between mathematics and the real world can inspire learners to develop a deeper appreciation for the subject of mathematics, its value, and significance. By making mathematics more relatable and demonstrating its practical value, educators can inspire a generation of learners who appreciate the power of mathematical concepts and their relevance in the real world.

The result of this study may inspire future researchers to contribute to the growing field of ethnomathematics and to make a positive impact on mathematics education and community development. Essentially, future studies could explore and make contextualized and localized learning not just a temporary trend, but part of ongoing efforts to provide relevant and meaningful education.

Ethnomathematics offers a robust framework for making mathematics education more relevant, inclusive, and meaningful for all learners. By carefully addressing the challenges and considerations associated with its implementation, educators and policymakers can harness the potential of ethnomathematics to transform mathematics learning and foster a more equitable and culturally responsive educational system.

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The author is the sole contributor to this study.

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7.0 Conflict of Interests

The author declares that upon the completion of this paper, there is no conflicting party or interest.

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