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An ethnomathematics study at Palang fish auction site

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ABSTRACT

The fish auction site in Palang is an integral part of the daily lives of the fishermen community in Palang and reflects local wisdom. Mathematics is a part of human activity, and ethnomathematics can serve as a bridge connecting mathematics with local wisdom. This qualitative study aims to describe the ethnomathematics present at the Palang fish auction site. Observation and interview methods were used to collect data, which were then analyzed descriptively and qualitatively. The study's results show that in the counting aspect, arithmetic concepts were identified; in the locating aspect, geometric transformation concepts were found; in the measuring aspect, measurement concepts were obtained; and in the designing aspect, geometric concepts were discovered. This research has implications as an alternative resource for learning media, practice exercises, and assessment in elementary, middle, and high school education. Future research can further develop these findings to enhance students' motivation and understanding of mathematics.

Sebuah studi tentang etnomatematika di tempat pelelangan ikan Palang

Kata Kunci:

Matematika budaya
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ABSTRAK

Tempat pelelangan ikan di Palang merupakan bagian integral dari kehidupan sehari-hari masyarakat nelayan di Palang dan mencerminkan kearifan lokal. Matematika adalah bagian dari aktivitas manusia, dan etnomatematika dapat menjadi jembatan yang menghubungkan matematika dengan kearifan lokal. Penelitian kualitatif ini bertujuan untuk mendeskripsikan etnomatematika yang terdapat di tempat pelelangan ikan Palang. Metode observasi dan wawancara digunakan untuk mengumpulkan data yang kemudian dianalisis secara deskriptif dan kualitatif. Hasil studi menunjukkan bahwa pada aspek *counting* diperoleh konsep aritmatika, pada aspek *locating* ditemukan konsep transformasi geometri, pada aspek *measuring* diperoleh konsep pengukuran, dan pada aspek *designing* ditemukan konsep geometri. Penelitian ini memberikan implikasi sebagai alternatif bahan untuk media pembelajaran, latihan soal, maupun evaluasi pembelajaran di jenjang SD, SMP, dan SMA. Penelitian selanjutnya dapat mengembangkan hasil studi ini lebih lanjut untuk meningkatkan motivasi belajar serta pemahaman matematika peserta didik.

1. INTRODUCTION

Mathematics is the queen and the servant of science, serving as a language and an art form [1]. Mathematics is a part of human activity [2]. Human activity is related to local cultures [3]. This means that mathematics is a Culture [4]. According to Ngiza, mathematics is part of the culture, so it has a universal nature and is owned by all humans [5]. Culture and mathematics is a unity [6]. Mathematics is a science that studies structure, relationship, and regularity, which can be proven by reasoning [7]. Thus, it becomes logical and can be implemented in human life. Referring to the description above, human activities that come into contact with local wisdom can be used as a medium for mathematics learning. Ethnomathematics can be an intermediary between mathematics and local wisdom.

The rapid development in life requires educators and learners to improve their competence in all fields [8]. One of them is that students must be more active in learning mathematics. The positive impact can train students to process and analyze information and construct knowledge [9]. In reality, some students have no interest in learning mathematics and consider mathematics difficult [10]. According to Sriyanto, the cause of students' difficulty in understanding mathematics learning is due to the abstract characteristics of mathematics. Their point of view is that mathematics is difficult and the boredom that arises when learning mathematics [11]. In addition, students have not sufficiently understood the perception related to the implementation of mathematics learning in daily activities taught in schools [12]. This problem makes the low learning outcomes and learning interest of students in learning mathematics so that learning mathematics becomes less meaningful. Learning will become more meaningful if it is close to learners' daily lives [13].

Local wisdom is the identity of a community group or region [14]. It is a cultural asset that can be used to wisely manage social interactions [15]. Local wisdom, especially in Tuban Regency, becomes an aspect that can be related to mathematics learning to be more meaningful. Local wisdom can be related to mathematics through ethnomathematics.

Ethnomathematics can be a bridge between mathematics and local wisdom. Learning mathematics through ethnomathematics will be closer to the activities of students because the learning is related to local wisdom in each area [16]. D'ambrosio introduced Ethnomathematics as a mathematical science applied to different cultural groups, which are professional classes, working groups, Indigenous people, children, and groups of various ages [17]. Ethnomathematics can be interpreted as a way or science applied in a society, specifically in mathematical activity [18]. According to D'ambrosio, ethnomathematics is a culture, language, and ethnic group associated with the learning of mathematics [19]. From these various definitions, Ethnomathematics emerges, develops, is inherent, and is applied repeatedly in the form of local wisdom in a community group. According to Bishop, Mathematical aspects that can indicate ethnomathematics are counting, measuring, locating, designing, playing, and explaining [20].

Tuban is one of the coastal districts in the North Coast region of East Java, with a beach length of approximately 65 km [21]. Therefore, in Tuban Regency, there are several fish auction sites. A fish auction site is a place used as a market to sell fish by fishermen [22]. One of the main functions of the fish auction site is to carry out marketing activities or auctions of fishermen's catches [23]. The culture applied to buying and selling transactions at the fish auction site is one of the local wisdom [24].

Research related to ethnomathematics has been carried out by several researchers. The research conducted by Pramesti is explorative research that aims to explore, identify, and reveal the activities of coastal communities who work as fishermen in Wonokerto,

Pekalongan Regency [25]. In addition, The research conducted by Kou et al. in the Neomuti traditional market of North Central Timor Regency revealed a way to determine the selling price, namely the production price added to the desired profit [26].

In connection with the above problems, the researchers want to combine the local wisdom of Tuban Regency with mathematics through ethnomathematics. The absence of ethnomathematics research on fish auction sites in Tuban Regency can contribute to mathematical knowledge and cultural insights. Apart from researching buying and selling transactions, this research also researched the equipment used for transactions at the fish auction site in the Palang sub-district. Thus, the researchers conducted an "Ethnomathematics Study at the Palang fish auction site." This study aims to describe the ethnomathematics at the fish auction site of Palang to facilitate educators and learners, especially in Tuban Regency, to understand mathematics and make mathematics more interesting and meaningful.

Research related to ethnomathematics in education has been extensively conducted, including explorations of ethnomathematics in coastal community activities [25], traditional markets [26], the tradition of cutting dreadlocks [27], and geometry learning [28]. However, among these studies, research that specifically explores ethnomathematics at the fish auction site and connects it with various mathematical concepts is still rare.

This study aims to investigate ethnomathematics at the Palang fish auction site and integrate them with mathematical concepts to address this research gap. Unlike previous studies, this research uses a descriptive qualitative approach to explore and describe how activities at the Palang fish auction site reflect mathematical concepts, such as arithmetic, geometric transformations, measurement, and geometric design. This approach provides a deeper understanding of how local wisdom can be integrated into mathematics education. The findings of this study are expected to enrich the ethnomathematics literature and provide recommendations for the development of more contextual and effective learning media.

Contribution to the literature

This research contributes to:

- Expanding the understanding of how mathematical concepts are discovered and applied in daily activities.
- Providing new insights into the use of mathematical concepts within specific cultural contexts, which may have received less attention in previous literature.
- Laying the groundwork for further research that connects mathematics with local wisdom in various other cultural contexts enriches ethnomathematics.

2. METHOD

The ethnomathematics data analyzed are qualitative. The data analysis results are presented in detail in a descriptive form. Thus, this study is qualitative-descriptive research with an empirical and theoretical approach. The approach aims to obtain a description and in-depth analysis of data related to local wisdom. This approach is known as the ethnographic approach [29].

The research site is the Palang fish auction site located at the Palang village, Palang Sub-district, Tuban Regency, East Java. *Jeragan* or fishermen with boats and *bakul* or sellers became the subject of this study. The researchers conducted observations, interviews, and literature studies to collect the data. The researchers employed the

qualitative data analysis technique proposed by Miles and Huberman, which consists of data reduction, data presentation, and conclusion [30].

The researchers employed triangulation techniques to check the validity of the data. The presentation of data with a detailed description was carried out to meet the transferability criteria. Auditing techniques were performed to meet the dependability and confirmability.

3. RESULTS AND DISCUSSION

Palang fish auction site consists of a harbor. The northern part of the fish auction site is used to weigh and auction fish from *jeragan* to *bakul*. The southern part of the fish auction site is used to sell fish from *bakul* to buyers in retail. The researcher observed the buying and selling transactions and interviewed two resource persons at the Palang fish auction site, S01 and S02. S01 is a person who owns a ship called *Jeragan*, and S02 is a seller who is commonly called *Bakul*.

The ethnomathematics study at the Palang fish auction site is based on counting, locating, measuring, designing, playing, and explaining [27]. Based on observations and interviews, the researchers obtained four mathematical aspects out of six mathematical aspects in buying and selling transactions and buying and selling equipment at the Palang fish auction site, namely counting, locating, measuring, and designing.

3.1 Counting

Counting is related to numbers, counting operations, counting tools, and quantification used in society [31]. The counting activities are addition, subtraction, multiplication, division, and other numerical activities related to "how many" [28]. In the aspect of counting, the Palang fish auction site uses a semi-permanent sales system, as described in the following transcript of the interview with S01.

P01003 : *How is the selling system at the Palang fish auction site?*
S01003 : *The selling system is semi-permanent. The trader who dares to buy fish at a high price gets the fish, and therefore, the price of the fish changes.*
P01004 : *What is the difference between semi-permanent and permanent?*
S01004 : *If it is permanent, the price is fixed. If it is semi-permanent, the price can change.*
P01005 : *Does the fish auction site office give full payment from the bakul to the jeragan?*
S01005 : *No, it does not. The money from the bakul is calculated by the fish auction site office and deducted 10% of the total fish sold. The 10% is a contribution to the fish auction site office. The workflow is from jeragan to the fish auction site office and Bakul to the fish auction site office. The fish auction site gets a 10% cut of the total fish sold.*
P01006 : *How is the process of weighing the fish to be sold?*
S01006 : *The fish is weighed using large kilogram scales. The fish auction site owns three big scales. The scales can hold 500 kg. The big scales are used to weigh fish from Jeragan to big bakul. From the big bakul to the small bakul, the weighing uses a basket that has been weighed before. Small bakul sells their fish in kilogram units, called ngeber or retailing. Usually, the small bakul uses lead scales, and no one uses digital scales.*

The results of the interview with S01 aligned with the results of the interview with S02. The transcript of the interview is as follows:

P02001 : *What is the process or flow of fish sales at the Palang fish auction site?*
S02001 : *The fish is owned by the fisherman or jeragan who owns the boat and then bought by bakul. The auction system is used, giving the highest bidder the fish. After that, it is weighed and given a paper ticket for the jeragan and for the bakul. The bakul gives the money to the fish auction site office and then the jeragan asks for the money from selling the fish to the auction site office. The ticket is later deposited to the fish auction site office. The jeragan is given a white ticket, and the bakul is given a yellow/green ticket. The fish auction site office manages the money. The fish auction site office for Palang fish auction site management deducts 10%. So, everything goes through the Palang fish auction site office.*
P02013 : *How is the sale of fish of different sizes?*
S02013 : *In the Palang fish auction site, different types of fish have different prices. If they are the same type but different sizes, the price is the same.*
P02014 : *Do all bakul set the same price for each size?*
S02014 : *Because of the auction system, some bidders have the same price, and some have different prices, depending on the quality. Early in the morning, the price of fish can be considered cheap. In the afternoon, the price keeps getting up.*

Based on the results of interviews with S01 and S02, in the aspect of counting, the sales system used in the Palang fish auction site is semi-permanent and auction. Semi-permanent is where the prices are always changing or not fixed. Early in the morning, the price of fish sequentially starts from more expensive and gets cheaper in the afternoon. The sale is done by auction. The *bakul* that dares to pay more will get the fish.

In buying and selling transactions at the Palang fish auction site, basic counting activities are carried out between *jeragan* and *bakul* or *bakul* and *bakul*. This counting activity uses the mathematical concept of arithmetic. Arithmetic is a basic calculation activity in the form of addition, subtraction, multiplication, and division [28].

The buying and selling transactions at the Palang fish auction site employ mathematical concepts, such as comparison, fraction, decimal, percent, profit and loss calculation, and linear equation system. The total calculation the fish auction site office uses is the final result minus 10% of the total sales. 10% is the contribution that must be paid to the Palang fish auction site. The calculation is as follows:

$$\text{Total sales} = (\text{total weight of fish} \times \text{price of fish per kg}) - 10\% \quad (1)$$

The calculation can be applied to percent material and social arithmetic. Percent material can be presented in fractional or decimal form ($10\% = \frac{10}{100} = 0{,}1$).

In other studies, there are also some similarities and differences in research results. Research conducted by Pramesti on the sales system of the Wonokerto Pekalongan coastal fishing community found the application of mathematical concepts in the form of linear equations and social arithmetic [25]. At the end of the transaction, profit and loss calculation is also related to the mathematical concept [13]. In addition, research conducted by Nurjanah at the Palang fish auction site found the differences in fish selling prices that can be used to determine profits, revenues, and losses obtained [32].

The appraisal concept is also used in buying and selling transactions at the Palang fish auction site. The transaction between *jeragan* and *bakul* is done using big scales according to the concept of downward unit estimation. For example, if the total weight of the fish is 96,5 kg, then the assessment of the unit down is 96 kg. This finding is by the following transcript of the interview with S01.

P01018 : *Are there people who buy ¼ kg of fish here?*
S01018 : *The sales in the northern fish auction site use basket units, while in the southern fish auction site, they use kilograms. The smallest scale is 0.5 kg. If each basket is purchased, it will be rounded down. For example, 96,5 kg will be rounded down to 96 kg.*

The method used is the local Javanese language during buying and selling transactions. Javanese is a local language used to communicate and interact with each other within the scope of Javanese society [33]. This local language is used in counting activities for Javanese people, one of which is used to count fish obtained or in buying and selling transactions at the Palang fish auction site. Here is the transcript of the interview with S01.

P01012 : *Do you know the unit of "sejinah, seket"? How are the numbers mentioned in the buying and selling process at the Palang fish auction site?*
S01012 : *Sejinah is ten. It is like siji, loro, telu, papat, limo, enem, pitu, wolu, songo, sejinah. Seket is fifty. In terms of basket, it is usually said sak bakul, rong bakul. Three baskets means telung bakul, patang bakul, limang bakul, enem bakul, pitung bakul, wolung bakul, sangang bakul, sejinah bakul, seket, suwidak, and satus. Usually, the scales are telu las to pat belas bakul.*

Below are the results of interviews with S02.

P02011 : *What are the sizes of lead scales, ma'am?*
S02011 : *Sak kilo, sak tengah kilo, rong ounce, sak ounce, and sak tengah ounce. The least amount sold at the southern fish auction site is ½ kg. So, if you usually buy a sak kilo, setengah kilo, karo tengah kilo is one kilogram and a half. The purchase at the northern fish auction site is basket and kilogram. It will be rounded down if there is more than sak prapat kilo and sak tengah kilo. For example, 90½ kg will be rounded down to 90 kg.*
P02012 : *For sales using baskets, how do you say one basket or two baskets in buying and selling fish?*
S02012 : *Yes, one basket is sak bakul, two is rong bakul, three is telung bakul, patang bakul, limang bakul, enem bakul, pitung bakul, wolung bakul, and sangang bakul. Sejinah bakul is ten baskets, suwelas bakul, and rolas bakul.*

Here is how to count kilograms, *bakul* units, and *gendung* units using the local Javanese language in buying and selling transactions carried out at Palang fish auction site.

Table 1. Counting Numbers in Javanese

Numbers	How to Count
1	*Siji*
2	*Loro*
3	*Telu*
4	*Papat*

5	*Limo*
6	*Enem*
7	*Pitu*
8	*Wolu*
9	*Songo*
10	*Sejinah*
11	*Suwelas*
12	*Ro las*
13	*Telu las*
25	*Selawe*
50	*Seket*
60	*Suwidak*
100	*Satus*

Table 2. Counting *Bakul* Units in Javanese

Units	How to Count
One *bakul*	*Sak bakul*
Two *bakul*	*Rong bakul*
Three *bakul*	*Telung bakul*
Four *bakul*	*Patang bakul*
Five *bakul*	*Limang bakul*
Six *bakul*	*Nem bakul*
Seven *bakul*	*Pitung bakul*
Eight *bakul*	*Wolung bakul*
Nine *bakul*	*Sangang bakul*
Ten *bakul*	*Sejinah bakul*

Table 3. Counting *Gendung* Units in Javanese

Units	How to Count
One *gendung*	*Sak gendung*
Two *gendung*	*Rong gendung*
Three *gendung*	*Telung gendung*
Four *gendung*	*Patang gendung*
Five *gendung*	*Limang gendung*
Six *gendung*	*Nem gendung*
Seven *gendung*	*Pitung gendung*
Eight *gendung*	*Wolung gendung*
Nine *gendung*	*Sangang gendung*
Ten *gendung*	*Sejinah gendung*

Table 4. Counting Fractions in Javanese

Units	How to Count
1 kg	*Sak kilo*
$\frac{1}{2}$ kg	*Sak tengah kilo*
$\frac{1}{4}$ kg	*Sak prapat kilo*
$\frac{3}{4}$ kg	*Telung prapat kilo*
$1\frac{1}{2}$ kg	*Karo tengah kilo*

In other studies, there are also some similarities and differences in research results. The research conducted by Rohmadina used Javanese calculations in house construction activities in Kencong Village, Kencong District, Jember Regency [34]. The similarity is the usage of the Javanese in counting. However, the difference lies in counting the number ten, namely *sejinah* used in the Palang fish auction site and *sepuluh* in Kencong Village. In addition, research conducted by Ngiza has similarities in calculating fractions [5]. The

differences have different causal factors, one of which is the language or dialect used in a society depending on the habits in that society.

3.2 Locating

Locating is determining and regulating an object's position, direction, path, and relationship with other objects in a particular environment [31]. In the aspect of locating, the northern part of the fish auction site sells many fish, while the fish in the southern part are sold in retail. The arrangement of fish sold at the Palang fish auction site is divided into type, *bakul*, and *gendung*. Grouping activity is collecting goods based on their types [28].

Figure 1. The Arrangement of Fish in the Southern Fish Auction Site

Based on the observation in Figure 1, the fish in the southern part of the fish auction site are arranged at the bottom using *bandang* mats. The fish sold are classified according to type and size. With the classification, it will be easier for *bakul* to determine the selling price. This finding also aligns with S01's statement, which is as follows.

P01010 : *How is the arrangement of fish sold at the fish auction site?*
S01010 : *Fish in one basket should be of the same kind. Fish in a basket can only be stacked up to two piles of baskets so that the basket does not shift and the fish does not spill, with a maximum of three piles at least.*

S02 describes something similar. Below are the results of interviews with S02.

P02007 : *The bakul buy the fish from the jeragan, ma'am. Do they sell only to the smaller bakul? Or can they sell to retail buyers?*
S02007 : *The big bakul are at the northern fish auction site. Usually, the buyers are big bakul. There is no retail. The small bakul at the southern fish auction site sells in retail. So, buyers usually buy at the southern fish auction site.*
P02008 : *For the sales at the southern fish auction site, is it on the floor or with a table or what, ma'am?*
S02008 : *Bakul, who sells at the southern fish auction site, is retailing on the floor. They do not use tables but use mats. It is arranged per type of fish. On the right is tengiri fish, on the left is tuna fish, and so on. It is a basket in the northern part of the fish auction site. So, it is arranged in baskets and*

stacked. There cannot be many stacks, at most three stacks, but usually only two stacks.

The fish in the northern fish auction site are stacked with an average of two piles and a maximum of three piles of the same type. The fish are arranged on the basket pile using the following pattern.

Figure 2. The Arrangement of Stacked Baskets with Alternating Portrait and Landscape Patterns

The first basket in the stack is landscape, the second portrait, and the third landscape. If it can be further stacked, the next basket stack will be portrait, and so on. Below is the sketch of the stack pattern.

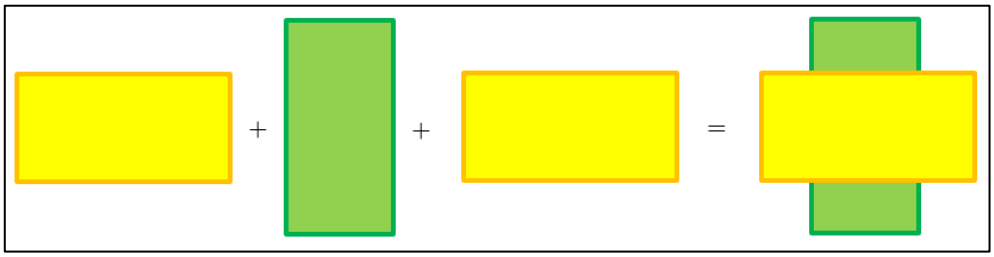

Figure 3. Stacked Baskets Sketch

In the research conducted by Kou, there is also a way of stacking vegetables that are classified according to type on tarpaulin mats [26]. In addition, the arrangement of fish sold is also classified according to the type of fish. In this study, basket stacks are arranged upward in a patterned manner. So, the stacks will form "landscape, portrait, landscape, portrait, ...” and so on.

The basket is arranged using the concept of geometric transformation, namely rotation by 90° to the same center point of rotation, for example, $O(0,0)$. Rotation is a transformation that moves a point to another by rotating the point about a certain center point as far as α. The notation for a rotation is $R(P,\alpha)$, where P is the center point of rotation and α is the rotation angle. Suppose a point A(x,y) is rotated by α about the center point $O(0,0)$; it will produce a shadow in the form of point $A'(x', y')$.' The formula can be written as follows [35]:

$$A(x,y) \xrightarrow{R_{[O(0,0),\alpha]}} A'(x',y') \qquad (2)$$

The rules used are as follows:

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \qquad (3)$$

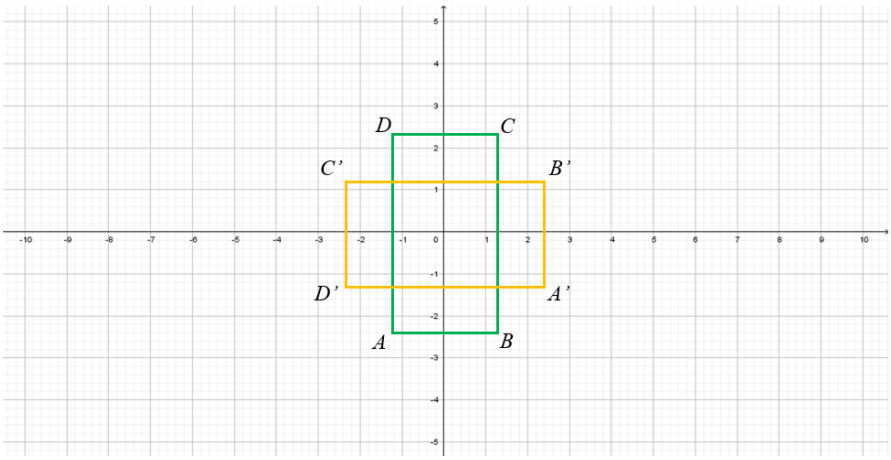

Figure 4. The Basket Arrangement is Rotated By 90° about the Center Point of Rotation O(0,0) in Cartesian Coordinates

3.3 Measuring

Measuring is the activity of measuring various measures by the local wisdom of a cultural group [27]. The size used in each region is certainly different and not standard. In measuring, the kilogram is used in buying and selling fish. However, Palang also uses the units *bakul* and *gendung* in the fish auction site. This finding is by the following transcript of the interview with S01.

P01009 : *What is the unit used in sales? Is it kg, or are there other units?*
S01009 : *We use kilogram here. However, usually at the time of weighing it is calculated using a bakul. One bakul usually weighs 32, 33, or 34 kg. For the calculation, it is added up all and later minus the weight of the bakul, which is 2 kg. There are also gendung, sak gendung is usually filled with squid. The price can be up to Rp5,000,000.00 each gendung.*
P01011 : *Does every jeragan have a bakul?*
S01011 : *The one who owns the bakul is the fish auction site. So, Jeragan rents the bakut from the fish auction site for Rp1,000.00. If you rent 150 bakul, that means Jeragan pays Rp. 150,000. If you rent 200, Jeragan pays Rp. 200,000.00.*
P01017 : *Is there any tool other than a calculator to calculate the total purchase price?*
S01017 : *We use a calculator here to make it faster.*

In line with S01, S02 also explained the same thing. The following is the transcript of the interview with S02.

P02003 : *Does that mean the units used are kilos, ma'am?*
S02003 : *Yes, kilo and bakul.*
P02004 : *What is a bakul? How many kilos is a bakul usually?*
S02004 : *Bakul is a container, a box like a basket with green and yellow color. A bakul usually contains 32-35 kg of fish. There is another container that you use, called gendung. Sak gendung is equal to approximately 90-98 kg.*

P02005 : *How much does the gendung itself weigh?*
S02005 : *The gendung is 2 kg, but when weighed, we usually use the basket, not the gendung. The gendung is used when the weighing is finished. Usually, the gendung is also used for squid containers. Later, when the bakul is weighed, it is reduced by 2 kg.*
P02009 : *Does the fish auction site privately own the bakul, ma'am?*
S02009 : *The bakul belongs to the fish auction site office, so those who want to weigh and sell their fish rent a bakul at the fish auction site for Rp1,000.00. So, if you rent 200 baskets, you pay Rp200,000.00 to the fish auction site office.*
P02015 : *How does the bakul calculate the total price of fish bought by buyers?*
S02015 : *They use calculators to make it faster.*

Basket unit is used in transactions between *jeragan* and *bakul*. To sell fish, a basket rental system is used. The rental price of one basket is IDR 1,000.00. In the aspect of counting, Palang fish auction site, *jeragan*, and *bakul* officers use a calculator to calculate the total price of fish sold and purchased.

Total weight of fish = result of scales – (2 kg × number of *baskets*) (4)

The *gendung* unit is used when the fish will be transported to the car and used for squid. One *gendung* is equal to 90-98 kg. It is not used in the weighing process.

In terms of measuring, the total weight of the fish is obtained by weighing it using large scales belonging to the Palang fish auction site that can withstand loads up to 500 kg. If measured with a basket, a large scale can fit 13-14 baskets. Based on observation, there are three large scales belonging to the Palang fish auction site, which are guarded by fish auction site officers to weigh fish.

Figure 5. The Large Scale Can Withstand Loads of Up to 500 kg

The results of these observations are in line with the transcript of the interview with S01.

P01006 : *What is the process of weighing the fish for sale?*
S01006 : *The fish is weighed using large kilogram scales. The fish auction site owns three big scales. The scales can hold 500 kg. The big scales are used to*

weigh fish from Jeragan to big bakul. From the big bakul to the small bakul, the weighing uses a basket that has been weighed before. Small bakul sells their fish in kilogram units, called ngeber or retailing. Usually, the small bakul uses lead scales, and no one uses digital scales.

The results of observations and interviews are by the interview with S02.

P02006 : *Who weighs it, ma'am?*
S02006 : *The fish auction site employee weighs the fish using three big scales. The scales can hold up to 500 kg of fish or around 13-14 baskets.*
P02010 : *Do retail bakul at the southern fish auction site use scales other than lead scales?*
S02010 : *The bakul use lead scales. However, the juragan uses the big fish auction site scale.*

Based on the above interviews and observations, *bakul* that sell fish in *ngeber* or retail uses lead scales. The size of the lead scales is 1 kg, $\frac{1}{2}$ kg, 2 ounces, 1 ounce, and $\frac{1}{2}$ ounces.

Figure 6. Lead Scales Used to Sell Fish Using Kilogram Units

In the aspect of measuring, there are *bakul* units and *gendung* units. *Sak bakul* equals 32-35 kg and *sak gendung* equals 90-98 kg. The weight measuring instruments used for weighing are large scales and lead scales. The material of this unit of weight is included in the material for measuring weight, calculating operations of algebraic forms, and social arithmetic.

The study conducted by Pramesti on the Wonokerto coastal fishing community of Pekalongan Regency can be related to mathematical concepts for junior high school [25]. In this study, one *bakul* is equal to 32-35 kg. The relevant mathematical material is the concept of social arithmetic and a system of linear equations of two variables. There are differences in the size of the *bakul* between the coastal fishing communities Wonokerto Pekalongan and the Palang fish auction site. The size, length, width, and height of the *bakul* are greater than that found in the Palang fish auction site. In addition, mathematics learning materials that are relevant to research results also have differences because the analysis results are different for each researcher.

3.4 Designing

Designing is creating a pattern for a particular cultural object [27]. The geometric shapes of an object are one example of the actualization aspects of designing. At the Palang fish auction site, there is a *bakul* in the form of a block and a *gendung* in the form of a tube. The *bakul* is used as a container for fish as well as a non-standard unit of measurement.

The *gendung* is used as a place to store fish and a non-standard unit of measurement. The shape of the *bakul* resembles a building block. *Bakul* unit has a length of 65cm, width of 43cm, and height of 31cm.

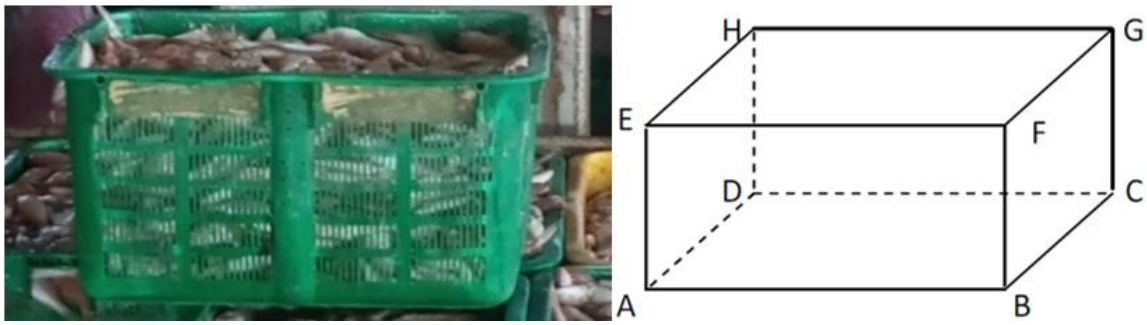

Figure 7. *Bakul* in the Shape of a Block

The mathematical concepts of *bakul* can be used to study the properties of blocks, the volume of blocks, and the surface area of blocks. Here are the formulas that can be used [36].

$$Block\ volume = V = p\ \times l \times t \quad (5)$$

$$Block\ surface\ area = L = 2(pl + pt + lt) \quad (6)$$

$$The\ surface\ area\ of\ the\ capless\ block = L = pl + 2(pt + lt) \quad (7)$$

Description:
V = Volume
L = Area
p = Length
l = Width
t = Height

In addition to the shape of the *bakul*, there is a *gendung* in the form of a tube. It has a diameter of 58 cm and a height of 93 cm. The mathematical concepts in the *gendung* can be used to learn the properties of tubes, tube volume, and tube surface area. Here are the formulas that can be used [37].

$$Tube\ volume = V = \pi\ \times r^2 \times t \quad (8)$$

$$Tube\ surface\ area = L = 2 \times \pi \times r(r + t) \quad (9)$$

$$The\ surface\ area\ of\ the\ capless\ tube = L = \pi \times r(r + 2 \times t) \quad (10)$$

With description:
V = Volume
L = Area
π = Pi
r = Line
t = Height

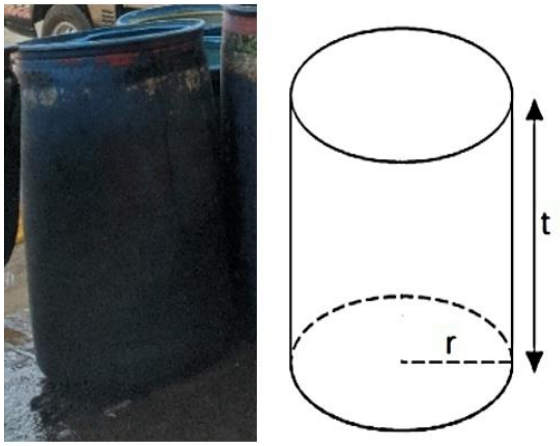

Figure 8. *Gendung* in the Shape of a Tube

Several studies discuss the geometric shapes, namely Wahyuni & Alifia, who examined ethnomathematics in the geometric shapes of the Probolinggo Museum [38], Krisma & Nurjanah who researched ethnomathematics at the Imogiri Kings Complex [39], and Salsabila & Soebagyo who examined ethnomathematics in the geometric shape of the Cut Meutia mosque [40]. The previous research is different from this study because the object of research is different but has similarities in the exploration of ethnomathematics on aspects of geometry. Future research can develop the results of this study so that it can increase student's motivation to learn and understand mathematics.

4. CONCLUSION

The results of this ethnomathematics study at the Palang fish auction site obtained four out of six mathematical aspects. First, the counting aspect contains the arithmetic concept in the buying and selling transaction system. Second, the locating aspect contains the concept of geometry transformation, which is found in the arrangement of fish. Third, in the measuring aspect, the concept of measurement is obtained on *bakul* and *gendung*. Fourth, In the designing aspect, the concept of geometry is obtained in the form of *bakul* and *gendung*. The results of this study have implications for alternative learning media, practice questions, and learning evaluations at the elementary, junior high, and high school levels.

AUTHOR CONTRIBUTION STATEMENT

KA was responsible for designing the research framework, drafting the initial manuscript, leading the research coordination, formulating the research questions, and analyzing and interpreting the data. W contributed to the research design and methodology, developed the qualitative analysis protocol, provided critical revisions to the manuscript, and supported the data collection process.

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