06 (2) (2023) 213-226

OF SCIENCE AND MATHEMATICS EDUCATION

DOI: 10.24042/ijsme.v6i2.17182

July 2023

Ethnomathematics exploration of fish trader activities in the traditional market of Punggulan Village, Asahan Regency

Rini Angraini^{1*}, Fibri Rakhmawati²

^{1.2}Department of Mathematics Education, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Sumatera Utara, Indonesian

*Corresponding author: riniangraini267@gmail.com

ABSTRACT

Article history:	Ethnomathematics connects mathematical concepts with cultural		
Submitted: January 10, 2023 Accepted: June 15, 2023 Published: July 23, 2023	practices, providing insights into real-life applications. However, its integration into formal education remains limited. This study aims to explore the mathematical aspects of fish traders' activities in traditional markets and highlight their connection to cultural practices. A qualitative ethnographic approach was employed,		
Keywords:	utilizing library research, observations, and interviews for data		
ethnomathematics, fish trader activities, traditional market	collection. Data analysis followed the Miles and Huberman model, which involved data reduction, presentation, and conclusion. The findings reveal that fish trading activities encompass three main processes: measurement, packaging, and transactions. These activities incorporate mathematical concepts such as measurement, set theory, algebraic equations, weight comparison, social arithmetic, relations and functions, geometry, and probability. This study concludes that ethnomathematics serves as a bridge between mathematical theories and real-world applications. The implications of this research emphasize the importance of integrating ethnomathematics into formal education to provide students with contextual and meaningful learning experiences.		
Elandlan and she and at an	a still a so a da alticitara so a da caso cillaro di so a a so		

Eksplorasi etnomatematika pada aktivitas pedagang ikan di pasar tradisional Desa Punggulan, Kabupaten Asahan

Kata Kunci:	Etnomatematika menghubungkan konsep matematika dengan	
etnomatematika, aktivitas pedagang ikan, pasar tradisional	praktik budaya, menunjukkan penerapannya dalam kehidupan sehari-hari. Namun, integrasinya dalam pendidikan formal masih terbatas. Penelitian ini mengeksplorasi aspek matematis dalam aktivitas pedagang ikan di pasar tradisional dan kaitannya dengan budaya. Pendekatan kualitatif etnografi digunakan dengan teknik pengumpulan data melalui studi pustaka, observasi, dan wawancara. Analisis data mengikuti model Miles dan Huberman: reduksi data, penyajian, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa aktivitas perdagangan ikan mencakup tiga proses utama: pengukuran, pengemasan, dan transaksi, yang melibatkan konsep matematika seperti pengukuran, himpunan, persamaan linear, perbandingan berat, aritmetika sosial, relasi dan fungsi, geometri, serta peluang. Penelitian ini menyimpulkan bahwa etnomatematika menjembatani teori matematika dengan kehidupan nyata. Implikasi penelitian ini menekankan pentingnya integrasi etnomatematika dalam pendidikan formal untuk memberikan pengalaman belajar yang	
	kontekstual dan bermakna bagi siswa.	
© 2023 Unit Ris	set dan Publikasi Ilmiah FTK UIN Raden Intan Lampung	

E-ISSN: 2615-8639

Contribution to the Literature

This research contributes to:

- Focusing on fish trading activities in traditional markets is a context rarely explored in ethnomathematics literature, particularly in Punggulan Village, Asahan Regency.
- Highlighting the application of mathematical concepts such as measurement, set theory, linear equations, and social arithmetic in measuring, packaging, and fish trading transactions.
- This study provides a foundation for developing culturally-based mathematics education by connecting mathematical theory taught in schools with real-life applications in the local cultural context.

1. INTRODUCTION

Mathematics is a fundamental tool that supports various disciplines in solving complex problems and meeting practical needs [1], [2]. Its role in developing quality human resources also drives advancements in other fields of knowledge, preparing individuals to face emerging challenges [3]. Mastery of mathematical concepts from an early age is crucial to support this development, while diverse cultural backgrounds have uniquely shaped mathematics across different regions [4]. This adaptation reflects societal innovation in response to specific challenges they encounter. Mathematics can be considered a cultural product that functions as an effective tool for problem-solving as it originates from human thought and activities [5].

The relationship between mathematics and culture is known as ethnomathematics [6], [7]. Ethnomathematics refers to the specific methods used by certain community groups in performing activities such as classifying, organizing, counting, and measuring [8]. Ethnomathematics emerges from culture [9], indicating that mathematical concepts have become part of people's real-life experiences [10], even though they may not consciously recognize the mathematics applied in their daily activities. Ethnomathematics is essential as a learning medium for teachers and students because mathematical concepts found in community activities can broaden students' perspectives, demonstrating that mathematics is always connected to life through various everyday activities [11].

In schools, the mathematics curriculum should be connected with cultural contexts to enhance students' understanding by incorporating familiar cultural practices from an early age [12]. The Merdeka curriculum supports this by focusing on essential content that strengthens literacy and numeracy through diverse project-based learning, aiming to shape the Pancasila student profile [13]. This curriculum encourages flexibility for students, teachers, and schools to innovate and adapt learning to individual developmental needs and characteristics. However, mathematics instruction often remains too formal and disconnected from students' daily experiences due to conventional, textbook-centered teaching methods, limiting opportunities for discussion and personal expression [14]. As a result, students tend to perceive mathematics as a complex and irrelevant subject, diminishing their interest and making them view it as difficult and unhelpful.

Previous research has shown that community activities often contain elements of ethnomathematics. For example, rice farmers in Karawang apply mathematical concepts in land measurement and seed requirement calculation [15]. Similarly, farmers in Indramayu use grouping, measurement, and comparison concepts in their activities [16]. Additionally, research on ethnomathematics in bead weaving among the Dayak Kapuas Hulu community reveals the application of set theory, patterns, and social arithmetic in this craft [17]. Studies have also explored mathematical ideas in palm oil cultivation [18],

examining the concepts within "Pananrang," an agricultural system reference used by the Bugis community [19], and analyzed agriculture and cultural heritage in the daily life of the Melanau Tellian in Mukah, Sarawak [20]. Other research has investigated the application of ethnomathematics in Tidung tribal wedding traditions [21].

Based on the above discussion, mathematics education needs to be connected with surrounding culture so that students can broaden their horizons and learn arithmetic more effectively, as it directly relates to the culture they experience daily [22]. One approach is to explore mathematical activities within the community [23]. This aligns with the view that exploring mathematics in cultural activities provides broad and valuable insights for deep mathematics learning, supporting students' ability to understand mathematical concepts as they occur in society.

Previous research on ethnomathematics in community economic activities, particularly in the context of fisheries, has been widely studied [24]. For instance, studies have explored ethnomathematics in Panaeaba or oyster farming by fourteen Manugtaeaba (oyster farmers) [25], examined ethnomathematics in fishing activities of the Rembang community [26], investigated ethnomathematics in seed counting techniques for Osphronemus gouramy in Sundanese culture [27], studied ethnomathematics in fishing on the Musi River [28], and analyzed the use of traditional fish traps in Kijang, Bintan Regency [29]. However, to date, no research has specifically explored fish trading activities as part of the economic activities in the traditional Punggulan Village, Asahan Regency market. Therefore, this study aims to explore the ethnomathematics of fish traders' activities in the traditional market of Punggulan Village, Asahan Regency.

This study focuses on fish trading activities in traditional markets, which involve various mathematical concepts in measurement, packaging, and buying and selling—integral parts of the local economy. These fish trading activities reveal the application of unique mathematical concepts in the traders' daily practices, including weight measurement, price comparison, and set theory. Thus, this research provides a new perspective on how mathematics is applied in fish traders' cultural and economic contexts in traditional markets. This topic is rarely highlighted in ethnomathematics studies.

2. METHOD

The research employed a qualitative approach with an ethnographic perspective. Qualitative research is a systematic study of components and phenomena, along with their interrelationships, aiming to understand and explore a symptom or event (concept or issue) by examining these phenomena. In parallel, the ethnographic approach is an empirical and theoretical method that seeks to describe and analyze culture deeply through intensive fieldwork [30]. This approach allows researchers to capture the perspectives and lived experiences of participants in their natural settings. Consequently, the findings provide a comprehensive understanding of the cultural context influencing the studied phenomena.

The researcher used library research, observation, interviews, documentation, and field notes as data collection methods. Library data was gathered from various theoretical sources [31], including books, journals, and studies related to community activities. Observation involved directly observing the activities of fish traders or reviewing relevant literature. Additionally, interviews were conducted with four fish traders and four buyers, all with more than 15 years of experience in the field. This study was conducted at the Punggulan Village Traditional Market, located at Jl. Syech Silau Laut, Punggulan Village, Asahan Regency. The selection of this market was based on its long-standing role as a center for fish trading in the region. The collected data was analyzed qualitatively to identify patterns and insights relevant to the study objectives.

As Miles and Huberman outlined, data analysis techniques include data reduction, data presentation, and conclusion drawing [32]. Data reduction is achieved by summarizing, selecting key points, focusing on what is important, identifying themes and patterns, and eliminating unnecessary information from field notes [33]. The stages of the research are depicted in Figure 1 [34].



Figure 1. Research Flow

3. **RESULTS AND DISCUSSION**

The activities of fish traders in traditional markets are deeply rooted in the experiences passed down from previous generations. These activities follow a set of processes or stages. Based on data from library research, observations, interviews, documentation, and field notes, the exploration of fish trading activities in traditional markets is categorized into several stages: measurement, packaging, and buying and selling.

3.1 Measurement Process

Measurement is the first step fish traders take before beginning their business. It involves determining items' magnitude, dimensions, or capacity against a standard [35]. Traditionally, the people of Punggulan village use non-standard tools such as hands, fathoms, inches, or wooden pieces to measure length and volume. Units like fathoms, cubits, and inches are commonly used. Traders measure fish boxes and ice blocks to determine the appropriate amounts needed for storage. These practices reflect the application of ethnomathematics in everyday community activities [36].

1. The concept of linear equations with one variable: Some individuals calculate the length of objects using measuring instruments in inches. From the data gathered from S1, the box size is 3 inches long, the S2 box size is 3.5 inches, the S3 box size is 4 inches, and the S4 box is 3 inches. When measured with a tape measure, the length of the fish box is 68.5 cm. Using a one-variable linear equation, we can determine the length of one inch of a fish trader's hand in centimeters. This mathematical concept is covered in the seventh-grade learning materials.

Table 1. The Concept of a One-Variable Entern Equation				
Inch size S1	Inch Size S2	Inch Size S4	Inch Size 41	
3x = 68,5	3x = 68,5	4x = 68,5	3x = 68,5	
<i>x</i> = 22,8	<i>x</i> = 19,6	x = 17,125	<i>x</i> = 22,8	

Table 1. The Concept of a One-Variable Linear Equation

2. The concept of comparison is demonstrated through the sizes of two boxes: one with dimensions of 68.5 cm in length, 41.5 cm in width, and 45 cm in height, with a capacity of 120 kg, and a smaller box measuring 69 cm in length, 36 cm in width, and 27 cm in height, with a capacity of 50 kg of fish. Therefore, the weight ratio of the larger fish box

to the smaller one is 120:50. These mathematical concepts are part of the seventh-grade learning materials.

3. The three-dimensional shapes, specifically fish boxes and block-shaped ice chunks, can be calculated for both area and volume. The sizes of these boxes and ice chunks vary based on the needs of the fish traders. According to data gathered by the author, fish traders in the traditional market of Punggulan Village use boxes with dimensions of 68.5 cm in length, 41.5 cm in width, and 45 cm in height, as well as smaller boxes measuring 69 cm in length, 36 cm in width, and 27 cm in height. The ice chunks used have a length of 1 cm, a width of 3 cm, and a height of 7 cm. These mathematical concepts are included in the eight-grade learning materials.



Figure 2. Fish Box

Box Surface Area = 2(pl + pt + lt) $= 2(68,5 \times 41,5 + 68,5 \times 45 + 41,5 \times 45)$ = 2(2.842,75 + 3.082,5 + 1.867,5)= 2(7.792,75) $= 15.585,5 cm^{2}$ Volume Box = $p \times l \times t$

Volume Box = $p \times l \times t$ = 68,5 × 41,5 × 45 = 127.923,75 cm^3





Figure 3. Fish Box Size

Surface Area of Fish Box = 2(pl + pt + lt)= $2(69 \times 36 + 69 \times 27 + 36 \times 27)$ = 2(2.484 + 1.863 + 972)= 2(5.319)= $10.638 \ cm^2$ Fish Box Volume = $p \times l \times t$ = $69 \times 36 \times 27$ = $67.068 \ cm^3$





Figure 4. Ice Chunks

Ice Surface Area

$$= 2(pl + pt + lt)$$

$$= 2(1 \times 3 + 1 \times 7 + 3 \times 7)$$

$$= 2(3 + 7 + 21)$$

$$= 2(31)$$

$$= 62 cm^{2}$$
Ice volume

$$= p \times l \times t$$

$$= 1 \times 3 \times 7$$

$$= 21 cm^{3}$$

3.2 Packaging Process

Packaging goods is a process in which traders prepare their merchandise for buying and selling transactions [37]. The packaging of fish involves grouping different fish species.



Figure 5. School of Fish

Based on the results of interviews and observations with the subjects, it was found that the method of packing fish before starting to sell is dependent on the type of fish. Fish of the same type are grouped to simplify traders' and buyers' buying and selling process. The variety of fish traded is quite extensive. The ethnomathematics involved in the packaging process are outlined below.

1. In the grouping concept, fish are arranged in small trays (tampah). For example, if swordfish is being traded, there will be five large fish in one stack. If cencaru fish are traded, the stack contains 15 medium-sized or seven large-sized fish. When manyung fish are traded, the stack contains three large-sized fish; when stingrays are traded, the

Ethnomathematics exploration of fish

stack contains either 5 or 6 large fish. These mathematical concepts are relevant to the seventh-grade learning materials.

2. Social arithmetic is also applied to the net weight of the fish. The net weight for one large swordfish is 1 kg, for one medium-sized cencaru fish is 2.5 ounces, for one large manyung fish is 7 ounces, and for one stingray is 3 ounces. These concepts are also covered in the seventh-grade learning material. Below is an overview of the fish grouping activity.

3.3 Trading Process

Various numerical and counting activities are involved in buying and selling. These activities typically include addition, subtraction, multiplication, and division. Such calculations form the basis of arithmetic, a fundamental branch of mathematics [38]. Mastering these basic operations enables individuals to make informed financial decisions in everyday transactions. Additionally, arithmetic skills are essential for developing higher-level mathematical thinking and problem-solving abilities.

In Punggulan village, Javanese is the primary regional language spoken, as most of the population is Javanese. This regional language has influenced the numerical activities of the local people. The ethnomathematical practices related to numbers in Javanese society in Punggulan village are as follows:

1. Regarding place value, the people of Punggulan village tend to disregard the number 0 in positions such as the thousands, ten-thousands, or hundred-thousands. For example, they tend to pronounce numbers like 0, 1, 2, 3, ..., 9 as representing thousands, numbers 10, 11, 12, 13, ..., 99 as tens of thousands, and numbers 100, 101, 102, 103, ..., 999 as hundreds of thousands. This practice provides an interesting insight into their approach to place value, an important mathematical concept also covered in seventh-grade mathematics lessons.

Table 2. Activity Numerating Place Values of Numbers				
True Value	Javanese Pronunciation	Place Value Number		
1.000	1	Thousands		
10.000	10	Tens of Thousands		
100.000	100	Hundred Thousand		

2. The concept of social arithmetic related to weight measurements in Javanese is as follows: To indicate 1 kg, the word "*se*" is added to "kilo." For 2, 3, 4, 5, 7, 8, and 9 kg, the Javanese numbers for these values are combined with "ng" and "kilo." To express 6 kg and 9 kg, the words "*enem*" and "*sanga*" are used, followed by the word "kilo." For expressing tens of kilograms, Javanese numbers 1 through 9 are combined with the word "*las*." These mathematical concepts are taught in the seventh-grade learning materials.

Table 3. Activity Numerating Weight units		
Local Language Unit Weight	Weight Unit Conversion in Mathematics	
Sekilo	1 Kg	
Rong kilo	2 Kg	
Telung kilo	3 Kg	
Patang kilo	4 Kg	
Limang kilo	5 Kg	
Enem kilo	6 Kg	
Pitung kilo	7 Kg	
Wolung kilo	8 Kg	
Sangang kilo	9 Kg	

Sepuluh kilo	10 Kg
Sebelas kilo	11 Kg
Ronglas kilo	12 Kg

In terms of counting activities, several mathematical concepts were identified:

1. The concept of social arithmetic is about profit. A trader buys fish from fishermen, totaling 100 kg. The types of fish purchased include 20 kg of cencaru fish at Rp. 24,000 per kg, 20 kg of mackerel at Rp. 32,000 per kg, 10 kg of rays at Rp. 40,000 per kg, 15 kg of ogak fish (klotok) at Rp. 23,000 per kg, grapu fish at Rp. 38,000 per kg, 20 kg of swordfish at Rp. 34,000 per kg, and 7 kg of squid at Rp. 41,000 per kg. The trader then resells the fish at the following prices: cencaru fish at Rp. 28,000 per kg, grapu fish at Rp. 36,000 per kg, rays at Rp. 44,000 per kg, ogak fish at Rp. 26,000 per kg, grapu fish at Rp. 45,000 per kg, and squid at Rp. 48,000 per kg. The price for mackerel appears twice, so please clarify whether it refers to different fish or if it was a repetition. Using this information, we can calculate the initial capital and profit earned by the fish merchant. These mathematical concepts are typically covered in the seventh-grade learning materials. To calculate the initial capital of the fish trader, we can proceed as follows:

Initial Capital = $(20 \times 24.000) + (20 \times 32.000) + (10 \times 40.000) + (15 \times 23.000) + (10 \times 40.000) + (10 \times 40.0$

$$(8 \times 38.000) + (20 \times 34.000) + (7 \times 41.000)$$

= 480.000 + 640.000 + 400.000 + 345.000 + 304.000 + 680.000 + 287.000

$$= Rp. 3.136.000$$

Sales Price = $(20 \times 28.000) + (20 \times 36.000) + (10 \times 44.000) +$

- $(15 \times 26.000) + (8 \times 45.000) + (20 \times 38.000) + (7 \times 48.000)$
 - = 560.000 + 720.000 + 440.000 + 390.0000 + 360.000 + 760.000 + 336.000

$$= Rp. 3.566.000$$

Profit Gains = Sales price – initial capital

- = Rp. 3.566.000 Rp. 3.136.000
 - = Rp. 430.000



Figure 6. The Fish in the Market

2. The concept of relations and functions: Based on interview data and direct observation, the most preferred type of fish is mackerel. Additionally, there are fish with the same price, specifically mackerel, which is priced at Rp 32.000 per kilogram. These mathematical concepts can be found in the eighth-grade curriculum and can be described using arrow diagrams in terms of relations and functions.

Ethnomathematics exploration of fish

The most preferred fish:

Fish Price:







Figure 8. Relationships and Functions

3. A system of two-variable linear equations occurs when a consumer named Ros buys a certain number of mackerel (in kilograms) and 23 kg of Ogak fish (Klotok) for a total price of Rp 133,000. Meanwhile, Santi purchases 2.5 kg of mackerel and 2 kg of Ogak fish (Klotok) for Rp 26,000. Using a two-variable linear equation system, we can determine the price of 1 kg of mackerel and 1 kg of Ogak fish (Klotok). These mathematical concepts are typically covered in seventh-grade learning materials.

Suppose:

The price of 1 kg of mackerel = x, and the Price of 1 kg of Ogak fish = y The mathematical model for the problem is: 2x + 3y = 133.000 (1) 2,5x + 2y = 126.000 (2) The elimination of equations (1) and (2) is: $2x + 3y = 133.000 |\times 2|$ 4x + 6y = 266.000 $2,5x + 2y = 126.000 |\times 3|$ 7,5x + 6y = 378.000 -3,5x = -112.000x = 32.000 Then substitute the equation (1):

2x + 3y = 133.000 2(32.000) + 3y = 133.000 64.0000 + 3y = 133.000 3y = 133.000 - 64.000 3y = 69.000y = 23.000

Therefore, the price of 1 kg of mackerel is Rp32.000, and 1 kg of Ogak fish (Klotok) is Rp 23.000

4. The Concept of Opportunity: Fish traders can sell marine fish at a rate of 120 kg daily. Therefore, the opportunity for fish traders to successfully sell fish is 120/120 = 1. However, if fish traders encounter challenges, such as a decrease in the prices of chicken and carp, their ability to successfully sell fish is affected. In this case, the maximum sales potential is 100 kg per day, and the minimum is 60 kg per day. These mathematical concepts are covered in the material for seventh-graders.

From the explanation above, it is evident that fish traders in the Punggulan Village Traditional Market engage in several activities: measurement, grouping, numerical tasks, and counting. Grouping involves sorting goods based on their type while counting, and a frequent activity in various mathematical concepts like translation, subtraction, multiplication, and division is also observed. Numerical activities typically involve answering questions like "How much?" The tools used for these numerical tasks can include sticks, leaves, stones, or other natural materials. These activities can be linked to mathematical learning at the junior high school level. Various mathematical concepts are evident in the practices of Punggulan Village fish traders, such as set theory, linear equations with one variable, weight comparisons, social arithmetic, relations and functions, linear equations with two variables, geometry of flat and solid shapes, and probability. This aligns with the ethnomathematics research conducted by Mairing *et al.* (2023) on geometry material [39].

Incorporating ethnomathematics into the activities of traditional market fish traders in Punggulan Village can help create more creative and effective mathematics teaching methods. Ethnomathematics involves extracting mathematical knowledge through observation of real-life activities. This research highlights how ethnomathematics connects observations of the surrounding environment with classroom learning, promoting outsidethe-classroom methods. These methods allow students to explore new concepts and engage actively in learning, which can deepen their understanding and enthusiasm. Such learning environments allow students to directly interact with learning objects, increasing their enjoyment and comprehension.

In a study by Malalina *et al.*, fishermen use basic calculations and local knowledge to improve their catches. While their research focuses on fishing, our study emphasizes trade and commercialization, incorporating concepts like social arithmetic and sets in buying and selling activities [28]. Exploring ethnomathematics in the activities of traditional market fish traders contributes significantly to responsible and effective mathematics learning. Out-of-classroom experiences foster a broader understanding of mathematics, allowing students to grasp its true nature.

Ethnomathematics can help teachers create enjoyable, effective learning experiences and foster a greater appreciation for students' cultural heritage [40]. This field of study bridges culture and mathematics, offering a cognitive, affective, and psychomotor approach. Students understand mathematical concepts in real-world contexts by incorporating cultural elements into mathematics education. As a result, ethnomathematics research supports better classroom learning, making it easier for teachers to explain the material and encouraging new methods and ideas for quality instruction. Future research should focus on assessing the effectiveness of ethnomathematics-based learning and explore broader applications across various cultural contexts to strengthen its place in the educational curriculum.

4. CONCLUSION

This research has successfully demonstrated that the activities of fish traders in the traditional market of Punggulan Village, Asahan Regency, encompass various mathematical concepts, as anticipated. The activities of measuring, packaging, and conducting buying and selling transactions reveal the application of mathematical principles such as measurement, sets, one-variable linear equations, weight comparison, social arithmetic, relations and functions, two-variable linear equations, flat-side geometry, and probability. This finding confirms the relevance of mathematical concepts taught in schools to the daily economic activities of the local community, emphasizing the importance of understanding mathematics within a cultural context. Moreover, this study paves the way for more effective ethnomathematics-based teaching strategies. The concepts identified can enrich teaching materials, providing students with more contextually relevant and engaging ways to understand mathematics daily.

AUTHOR CONTRIBUTION STATEMENT

RA contributed to conceptualizing the research, study design, and data collection through observations and interviews with fish traders. Additional contributions included drafting the Introduction and Methodology sections and participating in manuscript revisions. FR contributed to data analysis, interpretation of results, and drafting of the Discussion and Conclusion sections, further ensuring clarity and coherence in manuscript revisions.

REFERENCES

- [1] M. Elías, J. Pérez, M. D. R. Cassot, E. A. Carrasco, M. Tomljenovic, and E. A. Zúñiga, "Development of digital and science, technology, engineering, and mathematics skills in chemistry teacher training," *Front. Educ.*, vol. 7, no, 1, pp. 1-17, 2022, doi: 10.3389/feduc.2022.932609.
- [2] A. Dominguez, J. De La Garza, M. Quezada-Espinoza, and G. Zavala, "Integration of physics and mathematics in STEM education: Use of modeling," *Educ. Sci.*, vol. 14, no. 1, pp. 1-16, 2023, doi: 10.3390/educsci14010020.
- [3] C. T. Doabler, N. J. Nelson, and B. Clarke, "Adapting evidence-based practices to meet the needs of english learners with mathematics difficulties," *Teach. Except. Child.*, vol. 48, no. 6, pp. 301–310, 2016, doi: 10.1177/0040059916650638.
- [4] M. Garcia-Olp, C. Nelson, and L. Saiz, "Decolonizing mathematics curriculum and pedagogy: indigenous knowledge has always been mathematics education," *Educ. Stud.*, vol. 58, no. 1, pp. 1–16, 2022, doi: 10.1080/00131946.2021.2010079.
- [5] S. Sorge, "Supporting mathematics and science teachers in implementing intercultural learning," *ZDM Math. Educ.*, vol. 55, no. 5, pp. 981–993, 2023, doi: 10.1007/s11858-023-01478-3.
- [6] D. A. M. Lidinillah, R. Rahman, W. Wahyudin, and S. Aryanto, "Integrating sundanese ethnomathematics into mathematics curriculum and teaching: A

systematic review from 2013 to 2020," *Infin. J.*, vol. 11, no. 1, pp. 33–54, 2022, doi: 10.22460/infinity.v11i1.p33-54.

- [7] M. Ascher and R. Ascher, "Ethnomathematics," *Hist. Sci.*, vol. 24, no. 2, pp. 36-43, 1986, doi: doi.org/10.1177/00732753860240020.
- [8] Y. L. Sukestiyarno, K. U. Z. Nugroho, S. Sugiman, and B. Waluya, "Learning trajectory of non-Euclidean geometry through ethnomathematics learning approaches to improve spatial ability," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 19, no. 6, pp. 1-17, 2023, doi: 10.29333/ejmste/13269.
- [9] P. Owusu and A. Obuo Addo, "Alikoto: Mathematics instruction and cultural games in Ghana," *Cogent Educ.*, vol. 10, no. 1, pp. 1-27, 2023, doi: 10.1080/2331186X.2023.2207045.
- [10] S. Hartinah, "Probing-prompting based on ethnomathematics learning model: The effect on mathematical communication skill," *J. Educ. Gift. Young Sci.*, vol. 7, no. 4, pp. 799–814, 2019, doi: 10.17478/jegys.574275.
- [11] N. Sari, S. Salafudin, M. S. Sholehuddin, and A. Sholikhah, "Development mathematics realistic education worksheet based on ethnomathematics in elementary school," *Phenom. J. Pendidik. MIPA*, vol. 12, no. 1, pp. 77-89, 2022, doi : 10.21580/phen.2022.12.1.10853
- [12] M. D. Boston and A. G. Wilhelm, "Middle school mathematics instruction in instructionally focused urban districts," *Urban Educ.*, vol. 52, no. 7, pp. 829–861, 2017, doi: 10.1177/0042085915574528.
- [13] D. Rahmadayanti and A. Hartoyo, "Potret kurikulum merdeka, wujud merdeka belajar di Sekolah Dasar," J. Basicedu, vol. 6, no. 4, pp. 7174-7187, 2022, doi: 10.31004/basicedu.v6i4.3431.
- [14] S. Sudirman, R. P. Yaniawati, M. Melawaty, and R. Indrawan, "Integrating ethnomathematics into augmented reality technology: Exploration, design, and implementation in geometry learning," in International Conference on Mathematics and Science Education J. Phys. Conf. Ser., 2019, pp. 1-9, 2020, doi: 10.1088/1742-6596/1521/3/032006.
- [15] I. N. Aini, "Etnomatematika : Matematika dalam kehidupan petani di Kabupaten Karawang," Jurnal Teori dan Riset Matematika, vol. 2, no. 2, pp. 1-6, 2018, doi : 10.25157/teorema.v2i2.1072.
- [16] Atika, F. L. Dawati, and A. Iswandi, "Eksplorasi etnomatematika pada masyarakat Desa Jambe Kecamatan Kertasmaya," *in Pros. Semin. Nas. Mat. Dan Sains*, Indramayu, Indonesia, 2019, pp. 306–309.
- [17] A. Haran, A. Hartoyo, and S. Sayu, "Etnomatematika dalam merangkai manik masyarakat Dayak kayaan Kapuas Hulu," J. Pendidik. Dan Pembelajaran Khatulistiwa, vol. 8, no. 2, pp. 1–8, 2019.
- [18] A. S. Marleny, Somakim, N. Aisyah, Darmawijoyo, and J. Araiku, "Ethnomathematics-based learning using oil palm cultivation context," in National Conference on Mathematics Education J. Phys. Conf. Ser., 2020, pp. 1–8, doi: 10.1088/1742-6596/1480/1/012011.
- [19] H. Pathuddin, Kamariah, and A. Mariani, "Ethnomathematics of Pananrang: A guidance of traditional farming system of the Buginese community," *J. Math. Educ.*, vol. 14, no. 2, pp. 205–224, 2023, doi: 10.22342/jme.v14i2.pp205-224.
- [20] S. Long and Y. Chik, "Fundamental Applications of Mathematics in Agriculture and Cultural Heritage in Daily Life of Melanau Tellian, Mukah, Sarawak: An Ethnomathematics Review," *Malays. J. Soc. Sci. Humanit. MJSSH*, vol. 5, no. 11, pp. 217–227, 2020, doi: 10.47405/mjssh.v5i11.551.

Ethnomathematics exploration of fish

- [21] A. Azriah, J. Jailani, H. Herison, and E. Julianingsih, "Konsep matematika pada tradisi pernikahan Suku Tidung," AKSIOMA J. Program Studi Pendidik. Mat., vol. 11, no. 3, pp. 2044-2058, 2022, doi: 10.24127/ajpm.v11i3.5590.
- [22] L. Shumate, G. D. Campbell-Whatley, and Y. Lo, "Infusing culturally responsive instruction to improve mathematics performance of latino students with specific learning disabilities," *Exceptionality*, vol. 20, no. 1, pp. 39–57, 2012, doi: 10.1080/09362835.2012.640905.
- [23] K. Owens, "The role of mathematics teacher education in overcoming narrow neocolonial views of mathematics," *Educ. Sci.*, vol. 13, no. 9, pp. 1-24, 2023, doi: 10.3390/educsci13090868.
- [24] D. A. M. Lidinillah, R. Rahman, W. Wahyudin, and S. Aryanto, "Integrating sundanese ethnomathematics into mathematics curriculum and teaching: A systematic review from 2013 to 2020," *Infin. J.*, vol. 11, no. 1, pp. 33-54, 2022, doi: 10.22460/infinity.v11i1.p33-54.
- [25] J. O. Borbon, "Unraveling ethnomathematics in oyster farming for K-12 mathematics," J. Sci. Math. Educ. Southeast Asia, vol. 45, no, 1, pp. 77–115, 2023.
- [26] F. Muna, M. H. Fuadi, and A. Nurhuda, "Ethnomathematics exploration of fisherman activities in the Rembang community," *Nusant. J. Behav. Soc. Sci.*, vol. 2, no. 2, pp. 41-44, 2023, doi: 10.47679/202327.
- [27] I. Muzdalipah and E. Yulianto, "Ethnomathematics study: The technique of counting fish seeds (*Osphronemus Gouramy*) of Sundanese style," *J. Medives J. Math. Educ. IKIP Veteran Semarang*, vol. 2, no. 1, Art. no. 1, Jan. 2018, doi: 10.31331/medives.v2i1.555.
- [28] M. Malalina, R. I. I. Putri, Z. Zulkardi, and Y. Hartono, "Ethnomathematics of fish catching exploration in Musi River," J. Phys. Conf. Ser., vol. 1663, no. 1, pp. 1-7, 2020, doi: 10.1088/1742-6596/1663/1/012007.
- [29] F. Febrian, P. Astuti, and S. Susanti, "Ethnomathematical study on indigenous fish trap: Example from Kijang, Bintan Regency," J. Pendidik. Mat., vol. 17, no. 1, pp. 21–36, 2022, doi: 10.22342/jpm.17.1.18787.21-36.
- [30] E. Zuliana, S. I. A. Dwiningrum, A. Wijaya, and Y. W. Purnomo, "The geometrical patterns and philosophical value of Javanese traditional mosque architecture for mathematics learning in primary school: An ethnomathematic study" *J. Educ. Cult. Soc.*, vol. 14, no. 2, pp. 512–532, 2023, doi: 10.15503/jecs2023.2.512.532.
- [31] U. Umbara, W. Wahyudin, and S. Prabawanto, "Exploring ethnomathematics with ethnomodeling methodological approach: How does Cigugur indigenous people using calculations to determine good day to build houses," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 17, no. 2, pp. 1–19, 2021, doi: 10.29333/ejmste/9673.
- [32] J. Bailey, "First steps in qualitative data analysis: Transcribing," Fam. Pract., vol. 25, no. 2, pp. 127–131, 2008, doi: 10.1093/fampra/cmn003.
- [33] E. Fossey, C. Harvey, F. Mcdermott, and L. Davidson, "Understanding and evaluating qualitative research," Aust. N. Z. J. Psychiatry, vol. 36, no. 6, pp. 717– 732, 2002, doi: 10.1046/j.1440-1614.2002.01100.x.
- [34] R. M. Hariastuti, M. T. Budiarto, and Manuharawati, "Combining Ethnomathematics, thematics, and connectedness in a mathematics learning model for Elementary School," *Spec. Ugdym.*, vol. 1, no. 43, pp. 9462-9486, 2022.
- [35] R. Rakhmawati, "Aktivitas matematika berbasis budaya pada masyarakat Lampung," *Al-Jabar J. Pendidik. Mat.*, vol. 7, no. 2, pp. 221–230, 2016, doi: 10.24042/ajpm.v7i2.37.

- [36] A. P. Putra and D. Prasetyo, "Peran etnomatematika dalam konsep dasar pembelajaran matematika," *Intersections*, vol. 7, no. 2, pp. 1–9, 2022, doi : 10.47200/intersections.v7i2.1312.
- [37] H. Pathuddin, K. Kamariah, and M. I. Nawawi, "Buginese ethnomathematics: Barongko cake explorations as mathematics learning resources," *J. Math. Educ.*, vol. 12, no. 2, pp. 295–312, 2021, doi: 10.22342/jme.12.2.12695.295-312.
- [38] M. Turmuzi, I. G. P. Suharta, and I. N. Suparta, "Ethnomathematical research in mathematics education journals in Indonesia: A case study of data design and analysis," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 19, no. 2, pp. 1–13, 2023, doi: 10.29333/ejmste/12836.
- [39] J. P. Mairing, "Ethnomathematics Learning Model Based on Motifs of Dayak Ngaju Central Kalimantan," *Mathematics Teaching Research Journal.*, vol. 15, no. 5, pp. 31-48, 2023.
- [40] W. Wiryanto, M. G. Primaniarta, and J. R. L. de Mattos, "Javanese ethnomathematics: Exploration of the tedhak siten tradition for class learning practices," *J. Math. Educ.*, vol. 13, no. 4, pp. 661–680, 2022, doi: 10.22342/jme.v13i4.pp661-680.