EXPLORING ETHNOMATHEMATICS IN THE ACTIVITIES OF TRADERS AT THE NIKI-NIKI TRADITIONAL MARKET

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Abstract

Mathematics is a form of culture inherent in all aspects of society's life. In the cultural practices of certain communities, mathematical concepts are involved. There is an intersection between culture and mathematics. Therefore, this research is conducted to explore the mathematical concepts used by traders. This study was conducted at the Niki-Niki Traditional Market. The research subjects consist of 6 individuals, with 2 betel nut sellers, 2 chili pepper sellers, and 2 woven fabric sellers. The data in this study are primary data collected through observation, interviews, and documentation techniques. Data analysis employs the techniques of ethnographic research data analysis, including domain analysis, taxonomic analysis, componential analysis, and cultural theme analysis. The results of the research indicate that there are mathematical concepts of plane geometry and integers in the activities of traders. Concepts of plane geometry include points, rectangles, circles, rhombuses, straight lines, curved lines, and fractal geometry. Meanwhile, mathematical concepts related to integers include sets, counting, addition, subtraction, division, and multiplication.

Keywords: Activities and traders, Concept, Ethnomathematics, Exploration.

Abstrak

Matematika merupakan wujud budaya yang melekat dalam aspek kehidupan masyarakat secara utuh. Dalam praktek budaya masyarakat tertentu melibatkan konsep matematika. Antara budaya dan matematika ada irisannya. Karena itu, dilakukan penelitian ini untuk mengeksplorasi konsep matematika yang digunakan oleh pedagang. Penelitian ini dilakukan di Pasar Tradisional Niki-Niki. Subjek penelitian ini sebanyak 6 orang dengan perincian 2 orang penjual pinang, 2 orang penjual cabai dan 2 orang penjual kain tenun. Jenis data dalam penelitian ini adalah data primer yang dikumpulkan berdasarkan teknik observasi, wawancara, dan dokumentasi. Analisa datanya menggunakan teknik analisa data penelitian etnografi yaitu analisis domain, taksonomi, komponensial, dan tema kultural. Hasil penelitian menunjukkan bahwa terdapat konsep matematika bangun datar dan bilangan bulat pada aktivitas pedagang. Konsep bangun datar berupa titik, persegi panjang, lingkaran, belah ketupat, garis lurus, garis lengkung, dan geometri fraktal. Sedangkan konsep matematika terkait bilangan bulat adalah himpunan, membilang, penjumlahan, pengurangan, pembagian, dan perkalian.

Kata kunci: *Aktivitas dan pedagang, Eksplorasi, Etnomatematika, Konsep.*

INTRODUCTION

Mathematics is a deductive science because the truth must be proven through theorems, properties, and propositions (Maryati & Priatna, 2017). Mathematics is a science that

has an important role in various aspects of human life. There are many problems in everyday life that must be solved using mathematics such as counting, measuring and others. Therefore, mathematics is important for everyone to master, both in terms of its application and mindset.

Mathematics and culture are two things that have a very close relationship. The field of study that connects the world of mathematics and culture is ethnomathematics. The definition of ethnomathematics is as special methods used by certain groups of people in carrying out their activities such as grouping, sorting, counting, and measuring (Sarwoedi et al., 2018).

In everyday life, without realizing it, people often use the basic concepts of mathematics, which are examples of the application of mathematics, including counting activities. Counting can be done by anyone. For example, a housewife will calculate the income of money and arrange the expenditure of money used by her family. A bank employee who serves as a teller, will count every transaction or serve customers. Even small children can count the pocket money given by their mother. So, everyone will use mathematical concepts in their lives.

Puspadewi and Putra (2014) define ethnomathematics as special methods used by a certain cultural or community group in mathematical activity. Therefore, a study on ethnomathematics is necessary. Through the study of ethnomathematics, the intersection between cultural values and mathematical concepts will be understood. This is crucial to be known and explored for the benefit of students in schools as well as for society. In relation to mathematics learning in the classroom, the results of ethnomathematics studies need to be applied and introduced to students so that they understand the connection between learning materials and activities in community life. Similarly, for communities with such cultures. The study of ethnomathematics, especially in relation to cultural values, symbolic meanings, and philosophical meanings inherent in that culture, will add positive value for the community to preserve its culture and make it a learning resource for their children, both in relation to mathematics learning at school and social values in community life. Therefore, the study of ethnomathematics is very important for students and society. The most important thing is that through the study of ethnomathematics, it provides added value in terms of knowledge transfer and value transfer for society (Arisetyawan, 2019).

One of the mathematical practices in culture that is often performed is buying and selling activities (Rahim, 2023; Rakhmawati, 2016). Traditional markets are places where buying and selling transactions are frequently conducted. This also occurs at the Niki-Niki Traditional Market. In buying and selling transactions, there are usually various calculations involving addition, subtraction, multiplication, and division. These calculations are fundamental in solving mathematics problems, or in mathematical terms, known as arithmetic.

Traders at the Niki-Niki Traditional Market usually use various languages in conducting transactions, because residents at the traditional market come from various regions. The traders carry out counting activities every day starting from counting the number of items purchased by buyers, determining the amount of buyer returns, and calculating the selling price of each item. Most of the traders are not equipped with higher education, yet they are able to accurately calculate the number of transactions.

Many studies have been conducted on ethnomathematics, particularly on the culture in Timor Island. For example, exploration of geometry concepts in the traditional house of Tafatik Maromak Oan Malaka (Tahu et al., 2023), exploration of ethnomathematics in the traditional house of Sonaf Maubes-Insana (Tas'au et al., 2023), uncovering mathematical concepts and student characteristics in the marbles game of the Dawan tribe community (Son, 2017). However, these studies mainly focus on traditional houses and games. Ethnomathematics research on traditional markets has not been extensively explored. Therefore, this study aims to explore what mathematical concepts are utilized by traders in the Niki-Niki Traditional Market.

RESEARCH METHODS

The type of research used is qualitative research with an ethnographic approach. Qualitative research is a type of inquiry that yields findings that cannot be achieved using statistical procedures (Sujarweni, 2014). In this case, is essentially a research procedure that produces descriptive data in the form of written or spoken words from people and observable behaviors. Meanwhile, ethnographic research focuses on the culture occurring within a society. Ethnographic research is the science of humans, about origins, and customs. All of this is to seek human curiosity in totality in the past and present, with the aim of explaining and seeking truth about an issue (Rukin, 2021).

This ethnographic research, in its relation to the field of mathematics education, is categorized as ethnomathematics research. Ethnomathematics serves as a way to study mathematics by involving activities or cultures from the surrounding area, thus facilitating one's understanding of mathematics. Furthermore, ethnomathematics as a specific way used by a certain cultural group or society in activities containing mathematical knowledge (Lubis et al., 2018). Additionally, it is explicitly stated by Kehi et al. (2022) that ethnomathematics is the intersection between mathematics and culture.

This ethnomatematics research was conducted at Niki-Niki Market, South Central Timor (SCT) District, on January 2023. The subjects chosen by the author were 6 people with a standard of 2 areca nut sellers, 2 chili sellers and 2 woven cloth sellers. The type of data in this study is primary data. This data is in the form of oral obtained from the results of interviews between researchers and respondents (people studied) regarding the mathematical concepts used by traders in buying and selling transactions. The type of data in this study is primary data collected based on observation, interview, and documentation techniques. The data collected was then carried out with Domain, Taxonomy, Componential, and Cultural Theme analysis.

RESULTS AND DISCUSSION

Niki-Niki Market is located in Niki-Niki Village, Central Amanuban District, SCT Regency. The name Niki-Niki comes from the word Nik-Nik which is then perfected to become Niki-Niki which means "Always Glance or Greet Anyone who comes and passes by. The Niki-Niki market was formed in 1982, initially, it was known as the weekly market where there was only one market day a week. Then in 2008, the Niki-Niki market changed to the Inpres market (daily market) until now. Based on data collection techniques, researchers conducted data analysis in the form of domain analysis, taxonomic analysis, componential analysis, and cultural analysis which can be seen in Table 1.

The first stage in data analysis is domain analysis. The following are domain analysis results.

Table 1. Data analysis

Stages	Areca	Chili	Woven Cloth
Domain	General description of, understanding, benefits, and values contained	General description of, understanding, benefits, and values contained	General description of, understanding, benefits, and values contained
Taxonomy	Counting operation	Counting operation	The concept of geometry and calculating operations
Compensatory	Collection, division, subtraction, multiplication and counting	Collection, division, subtraction, and counting	Rhombus, point, straight line, rectangle, factual geometry, circle, subtraction, addition and multiplication
Cultural theme	Math concept	Math concept	Math concept

Domain analysis

Betel nut is an opener of communication, and cultural courtesy in the *Atoni Pah Meto* Tribe. The value contained in betel nut is as a symbol of communication in establishing social, cultural, economic, political and security contacts with. Selling betel nut is one of the business activities carried out by sellers at the Niki-Niki traditional market, because of their view that most SCT people like to eat betel nut (Figure 1).

| Betel nut | Chilli | Woven fabric |

Figure 1. Domain analysis

Chili is one of the important agricultural commodities and is widely cultivated in Indonesia. Chili has a specific aroma, taste and color, so it is widely used by the community as a spice and seasoning for cooking. As the population increases, the demand for chili in Indonesia is also increasing (Soelaiman & Ernawati, 2013). The reason people choose to sell chili at the traditional market is that chili has good economic value and can guarantee education costs. The chili seller's income level in the market in a day range from IDR 100,000 to IDR 250,000. IDR is Indonesian Rupiah.

SCT Regency has a culture that is quite unique and we can rarely find it in big

cities in Indonesia. These cultures include the culture of roasting mothers and babies after childbirth, greeting culture, betel-nut culture, dance culture at weddings, and weaving culture. The reason people choose the business of selling woven fabrics in the market is that woven fabrics have good economic value and can guarantee the economy in a family, especially in education. The income level of woven fabric sellers in the market ranges from IDR 400.000 to IDR 1.000.000.

The second stage in data analysis is taxonomic analysis. Based on the domain or activity specified in the first stage of data analysis, then the researcher performs a taxonomic analysis. The following is a taxonomic analysis based on the research results.

Taxonomic analysis

In this analysis, researchers can determine the concepts contained in the object under study. The mathematical concepts found in the buying and selling of areca and chili peppers at the Niki-Niki traditional market are arithmetic operations such as division, subtraction and multiplication. The pattern of heaps of areca and chili peppers contains the mathematical concepts of counting, namely sets and counting (Figure 2).

Betel nut   Chili
Figure 2. Areca and chili taxonomy analysis

The mathematical concepts found in the buying and selling of woven fabrics at the Niki-Niki traditional market include geometric concepts such as rhombuses, points, curved lines, rectangles, fractal geometries, straight lines, and circles. Calculations involve operations such as subtraction, addition, division, and multiplication (Figure 3).

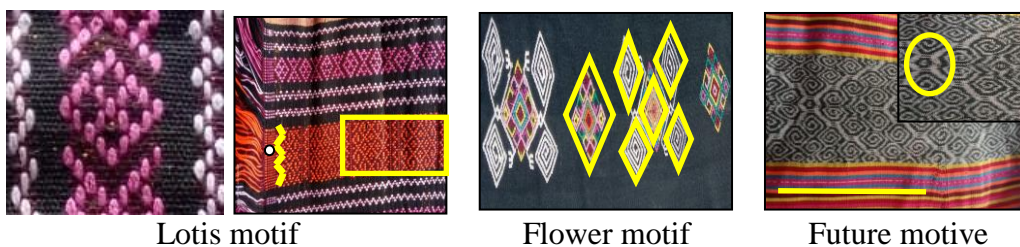Lotis motif   Flower motif   Future motive
Figure 3. Taxonomic analysis of woven fabrics

The mathematical concepts found in betel nuts, chili peppers, and woven fabrics can be detailed in Table 2.

Tabel 2. Math concept

Object Under Study	Math Concept
Betel nut	Division, multiplication, subtraction, set, and counting.
Chilli	Division, multiplication, subtraction, set, and counting.
Woven fabric	- Geometry concepts (rhombus, point, curved line, rectangle, fractal geometry, straight line and circle). - Counting operations (subtraction, addition, division and multiplication).

Componential analysis

The third stage in data analysis is componential analysis. Based on the taxonomic or activity analysis specified in the second stage of data analysis, the researcher then conducted a compensatory analysis. The following is a compensatory analysis based on the results of the study.

Betel nut and chili

The mathematical concepts found in the buying and selling of areca and chili peppersat the Niki-Niki traditional market are as follows.

Set: in one pile of betel nuts and chilies, there are several pieces containing mathematical concepts such as sets. For example, stack A is set A= {1, 2, 3, 4, …, 10} and set B= {11, 12, 13, 14, …, 20}. This is in accordance with opinion by Károlyi (2018) which states that a set is a collection of objects that are clearly defined, where these objects are stated as elements or members of the set.

Counting: the concept of counting can be expressed in the counting activity, namely when the trader counts the number of piles of areca nut produced at the selling place by ordering the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and so on according to the needs of the pile of areca nut. Counting is an activity of comparing. This comparison activity is carried out by corresponding or pairing equivalent objects, pairing patterns, pairing halves, pairing quantities, and matching objects with symbols (Adjie et al., 2020).

Division: division is repeated subtraction until it can no longer be divided. Division is also defined as repeated subtraction so that the final result is zero (Diyah et al., 2021;

Indah et al., 2020). The distribution is done. In one pile of areca nut and chili it is sold for IDR 5,000. Profits in one day of IDR 250,000. To find out how many piles are sold in one day, mathematical concepts such as the division as follows 250:5=50 piles can be used.

Subtraction and Multiplication: subtraction is the opposite of addition, usually the results obtained will be less than the number of objects that are reduced. Subtraction of integers can be likened to addition as opposed to subtraction numbers (Erikah, 2017). Meanwhile, multiplication is an operation on numbers known as repeated addition operations using numbers with the same value. This is in line with the opinion Hidayati (2015) that the multiplication operation on an integer is essentially a addition operation that is performed repeatedly. The concept of subtraction and multiplication through the process of determining refunds for sale and purchase transactions of areca and chili in mathematics learning is when calculating the amount of money received, for example in a sale and purchase transaction, someone buys 1 pile of betel nut and 1 pile chili at a price of 1 stack worth @ IDR 5,000. Then pay with money worth IDR 20,000 so that a reduction process occurs, namely 20,000 – (2×5,000)=10,000. Reduction is the opposite of addition, usually the results obtained will be less than the number of objects that are reduced. Subtraction of integers can be likened to addition as opposed to subtraction numbers (Erikah, 2017).

Woven fabric
Based on the results of the study, there are mathematical concepts in the form of woven fabric motifs, namely flat shapes, including the following.

Circle: in the process of weaving the special woven fabric with the futus motif, the white base thread is tied using a tusi (gewang rope) to form a circle. When the white base thread is dyed black, it will display black dots surrounded by white. This process illustrates a mathematical concept, namely a circle. A circle is a two-dimensional plane shape formed by the set of all points that are the same distance from a fixed point. A circle is also a closed curve that divides the plane into two regions: the interior and the exterior. The name of the circle usually corresponds to the name of its center point (As'ari et al., 2017).

Rhombus: the thread hooked in the weaving process of the lotis motif forms 4 sides of the same length and 2 pairs of non-right angles with opposite angles having the same

magnitude. A shape that has two dimensions, namely length and width but no height and thickness. Shapes that are viewed from the side can be classified into two types, namely wakes that have four sides and wakes that have three sides. A flat shape that has four sides is called a quadrilateral while a flat shape that has three sides is called a triangle (Sirait et al., 2023). Quadrilaterals consist of squares, rectangles, parallelograms, rhombuses, kites, and trapezoids, while triangles consist of isosceles, equilateral, right-angled and arbitrary triangles.

Fractal Geometry: From the picture on the woven cloth with the buna motif, it can be seen that the pattern on the woven cloth is made of an object that is projected repeatedly with the same size. The projection that is done in making the image motif on the woven fabric refers to two basic things, namely self-similarity and the same size. The two basic things used in making patterns on the woven fabric are very similar to the basic concepts of fractal geometry, namely self-similarity and dimension. According to Wahyuningsih and Hernadi (2020), Fractal geometry is a formal study of structures that are similar to itself and is the conceptual core of understanding natural complexity.

Rectangle: based on the results of the study, the rectangular shape is found in the woven cloth with the lotis motif in SCT Regency. The rectangular shape can be seen when the weavers link the threads with the aim of making a lotis motif, which produces a rectangular shape that has two pairs of parallel sides of the same length. A flat shape that has four sides is called a quadrilateral while a flat shape that has three sides is called a triangle (Sirait et al., 2023). Quadrilaterals consist of squares, rectangles, parallelograms, rhombuses, kites, and trapezoids, while triangles consist of isosceles, equilateral, right-angled and arbitrary triangles.

Point: the threads made by weavers with the aim of limiting the shape of one motif to another are seen to form dots. This point has the meaning of a geometric concept that does not have a certain size. A point is an object that has a position but does not have a size. A point is a dimensional mathematical object that can be specified in the *n*-dimensional using certain coordinates (Rongre, 2019). In this motif, there are colored thread patterns that are shaped like dots that are studied in mathematical concepts.

Curve: in the lotis motif, there are curved lines like curved lines in mathematical concepts. A curved line is a designation for a curved line that connects two points at different positions. According to Banase et al. (2022) that curved geometric motifs are a

form of geometric motif with the basic form of curved lines. In the woven fabric motif, there are curved lines like the curved lines in math material.

Straight line: The futus motif on the woven cloth is seen flanked by two edges with colorful threads. The threads of each color are seen separately forming a straight line that has no end and no beginning. This is in accordance with a straight line is a straight curve that has no end and no beginning (Udiyono & Yuwono, 2019). This means that it can be extended in both directions. In the other hand, line is an abstract concept whose shape is straight, elongated in both directions, unlimited and has no thickness (Bili et al., 2019; Mendoca et al., 2021).

Subtraction: the concept of reduction through the process of determining the initial capital for buying and selling woven fabrics in mathematics learning is when calculating the amount of money received. In a buying and selling transaction, the trader sells one woven cloth for IDR 1,000,000. He earned a profit of IDR 400,000 from the sale. How to determine the capital issued by the trader? to find out the initial capital issued, then there is a reduction process as follows IDR 1,000,000 – IDR 400,000 = IDR 600,000.

Addition and Multiplication: the concept of addition and multiplication found in the futus motif is to count the total rows of thread based on the color of the thread. If seen from the results of the documentation the futus motif is formed into three parts, namely the right side consisting of Maroon (2 rows), Yellow (7 rows), Red (7 rows), Pink (9 rows) Orange (6 rows), Blue (6 lines) and black and white (3 lines). The middle part is a futus motif which is a combination of white and black, while the left edge consists of Maroon (2 lines), Yellow (10 lines), Red (10 lines), Pink (14 lines) Orange (10 lines), Blue (10 lines) and black and white (5 lines). To count the number of rows of yarn on the right edge and the left edge, the operation counts as follows 2+7+7+9+6+6+3+2+10+10+10+10+14+5=101. Meanwhile, to count the total rows of yarn on the right edge and the left edge produced on one woven fabric, the futus motif can be multiplied by two. This can be seen from the futus motif woven fabric consisting of two sheets connected into one. The multiplication process is as follows 101×2=202 rows of yarn.

Cultural analysis
The last stage in data analysis is the analysis of cultural themes. The cultural theme or ethnomathematics findings contained in buying and selling activities at the Niki-Niki

traditional market are the geometric concepts of flat shapes and calculating operations. The geometric concepts of flat shapes are rectangles, circles, rhombuses, straight lines, points, curved lines and fractal geometry. Meanwhile, the counting operations are in the form of multiplication, division, addition and subtraction. It can be concluded that the cultural themes or ethnomathematics findings in this study are mathematical concepts.

CONCLUSION

Based on the research results, it can be concluded that the mathematical concepts found in buying and selling activities at the Niki-Niki Traditional Market are the mathematical concepts of flat shapes and numbers. The concept of flat shapes in the form of rectangles, circles, rhombuses, straight lines, points, curved lines and fractal geometry. While the mathematical concepts contained in integers are set, counting, division, multiplication, addition and subtraction.

The researcher recommends for further research that the application of ethnomathematics in this study emphasizes understanding of mathematical concepts and is limited to geometric material. So further research is needed on the material and other mathematical abilities so that the implications of the research results can be applied in learning.

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