Ethnomathematics Study on the Activities of Tenun Sipirok Making and Its Implementation in Learning Mathematics

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Abstract

This study aims to examine the philosophy of the motifs Tenun Belumbah and the motif of Pelangka, as well as explore and analyze the ethnomathematics contained in the Tenun Sipirok, South Tapanuli Regency. The research method used in this research is a qualitative method with an ethnographic approach. Data was obtained by using interviews and documentation. Based on data analysis, it was found that the philosophy of the Tenun Belumbah cloth motif symbolizes security, and the Pelangka motif symbolizes prosperity, ethnomathematics activities identified in the Tenun Sipirok Cloth in, South Tapanuli Regency, explain, calculate, measure, and design. At the same time, the mathematical concepts contained in woven fabrics are flat shapes, geometric transformations, simple graphics, and especially regular graphics.

Keywords: *Ethnomathematics; Mathematics; Tenun Belumbah; Pelangka Motif.*

Abstrak

Penelitian ini bertujuan untuk mengkaji filosofi motif kain Tenun Belumbah dan motif Pelangka, serta mengeksplorasi dan menganalisis etnomatematika yang terkandung di dalamnya Kain tenun di Sipirok Kabupaten Tapanuli Selatan. Metode penelitian yang digunakan dalam hal ini Penelitian ini merupakan metode kualitatif dengan pendekatan etnografi. Data diperoleh dengan menggunakan metode wawancara dan dokumentasi. Berdasarkan analisis data, ditemukan bahwa filosofi dari motif kain tenun Belumbah melambangkan keamanan dan motif Pelangka melambangkan kemakmuran, kegiatan etnomatematika diidentifikasi dalam Kain Tenun di Sipirok Kabupaten Tapanuli Selatan menjelaskan, menghitung, mengukur, dan merancang. Sedangkan konsep matematika yang terkandung dalam Kain tenun adalah bentuk datar, geometri transformasi, grafik sederhana, dan khusus grafik reguler.

Kata Kunci: Etnomatematika; Matematika; Kain Tenun Belumbah; Motif Pelangka.

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INTRODUCTION

One of the needs of society that must be met is education. Education is important to increase knowledge and be ready to face current technological advances. The attitude must be taken to deal with technological advances by pouring creative ideas and thoughts to solve a problem critically. Education is identic with the school, which aims to build good individual character so that it becomes an example of dignified student behavior. Schools are places for people who wish to pursue formal education by providing adequate facilities and infrastructure and professional educators and education staff. Education at school is a means of receiving new knowledge and developing abilities by participating in activities at school. The progress of human civilization is inseparable from the important role of mathematics. The important part of mathematics can be seen in people's daily lives, so the first thing to do is learn the language, followed by learning to count, which is identical to learning mathematics.

Mathematics is a science that is used in other fields of science and various technological developments, so mathematics is a subject that must be studied in schools. Mathematics is synonymous with numbers and number arithmetic operations. The material taught in mathematics is very broad but can also be related to scientific matters. Mathematics is also referred to as an abstract subject, because the discussion presented uses variables, making it difficult for students to understand. Many students complain about the difficulty of understanding and learning mathematics. One of the factors is caused by memorizing formulas, constructing formulas, and needing to be more careful with numbers.

The current mathematics learning process also tends to be too dry, theoretical, less contextual, and artificial. Learning is also less varied, thus affecting students' interest in studying mathematics further. Teaching mathematics at school is too formal, so the mathematics children encounter in everyday life is very different from what they find at school. Mathematics is recognized as developing along with developing human civilization, while human society always produces culture. One of the cultural products is the weaving craft. Learning mathematics really needs to provide content/bridge between

mathematics in the everyday world based on local culture and school mathematics.

Interest in local culture, especially the culture of South Tapanuli, must be maintained and even enhanced, in addition to increasingly sophisticated technology and the influx of foreign cultures that make people forget their own culture. For example, most people are more interested in the culture of other countries. The introduction of Ethnomathematics to students by inserting the culture of South Tapanuli is expected to be able to make learning mathematics meaningful and to be a means of increasing students' love for local culture.

The term ethnomathematics was first used in the 1930s to reflect changes in the conception of humanity in anthropology and other disciplines (Swapna Mukhopadhyay & Brian Greer). The ethnomathematics movement began with the formation of the International Study Group on Ethnomathematics in 1985 at the National Council of Teachers of Mathematics (NCTM) meeting in San Antonio, Texas, under the leadership of its founder, a mathematician and philosopher, Dr. Ubiratan 529 D'Ambroiso. D'Ambroiso uses the term ethnomathematics in many of his writings and speeches to explain the relationship between cultural practices about the development and use of mathematical ideas or concepts (Eduardo Jesus Arismendi-Pardi, 2001). According to Gates & Vistro in Thomas Varghese & Daniel P. (2006), the notion of ethnomathematics was developed to combine a broader view of mathematics related to the real world. John in Mohammed W. Z. & Ibrahim S. (2010) states that ethnomathematics studies mathematical techniques to identify cultural groups to understand, explain, and manage problems that arise from themselves. Based on the description above, it can be concluded that ethnomathematics is an artistic study to identify the mathematical elements contained in that culture that can be used in mathematics education or learning.

Ethnomathematics refers to a form of cultural knowledge or characteristics of social or cultural activities that can be recognized by other groups (Louis in Mohammed W. Z. & Ibrahim S., 2010). In this case, the culture of every community in a certain place is different from other people's culture but still

recognized. The things that are included in culture are local languages, people's ways of thinking, literary works, customs, relics or artifacts, and traditional games.

Based on my background, I intend to study Ethnomathematics in the Activity of Making Tenun Sipirok and Their Implementation in Learning Mathematics.

RESEARCH METHODS

This research is a qualitative descriptive study. The research was conducted to dig up information about ethnomathematics in the South Tapanuli culture, namely on woven fabrics, including mathematical concepts. Analysis was carried out on developments and several other research journals. The data obtained is in the form of qualitative data. In contrast, the data sources are obtained from observation, documentation, interviews, and literature related to Tenun Sipirok. The instrument in this research is the researcher himself. The data validity technique was carried out using method triangulation by checking data sources and method triangulation; the data were analyzed descriptively and qualitatively. The object of this research is the elements of mathematical culture that exist in the Tenun Sipirok related to the production process of the motifs and the philosophical meanings contained.

RESULTS AND DISCUSSION

These results obtain information about the philosophy of woven fabrics. The motifs contained in woven fabrics are very diverse; in one cloth, there is usually more than one motif. Many motifs on one piece of material depend on the buyer's order and the size of the motifs. Data were collected at locations where woven fabrics were produced and woven fabric galleries. The selected woven fabric motifs are those that are always made and produced by themselves. According to the motifs studied are the Tiang Belumbah and the Pelangka motifs, geometric shapes, and ethnomathematics activities by Bishop. Philosophical analysis is based on interviews with weavers and existing documents. The

geometrical analysis is based on the properties of the woven fabric motifs according to the characteristics of flat shapes and graphs. According to Bishop, the mathematical activity analysis is based on activities, namely counting, measuring, and designing, where each of these activities can be seen in the weaving activities carried out by the weavers.

1. Philosophy on Woven Fabric Motifs

North Sumatra is a province that produces woven fabrics. One of the well-known weavings and has its own philosophy, namely woven cloth. The Batak people of Sipirok village make the woven fabric, especially for women and men. They have learned to recognize the materials and tools for making weaving from a young age. So, when they are teenagers, they can weave for their own needs. As the name implies, woven fabric is made using a tying technique. The process of tying motifs is commonly called debt, which is the process of making motifs by tying the threads that have been arranged with a rope. The lines are connected to form the desired motif. The part that is linked will become the motif after the dyeing process. In ancient times, people used tree roots; because of the development of the era, the community used rope rapidly. The dominant color of the woven fabric is red. Dyeing is the process of giving color to threads bound with natural or chemical dyes.

Natural dyes are taken from the natural surroundings, such as leaves, roots, stems, skins, fruit, tubers, seeds, and animal fat, such as snakes and turtledoves. According to the surrounding Dayak community, coloring has no special meaning. Sintang tie woven fabric has various motifs. There are only two motives studied in this study.

The motif of the Tiang Belumbah or Tiang Rumah Betang. This motif symbolizes security, conveying the message that the house is a shelter that must be sturdy so that life is calm and safe.

Figure 1. Motif of the Tiang Belumbah

Next for the Pelangka Motif. Pelangka or can be called a place to release rice grains. The shape of the motif resembling a tool for removing rice grains symbolizes prosperity. Every family needs to use Pelangka because it can facilitate hard work and determine the level of well-being. The motifs found on woven fabrics are as follows:

Figure 2. Pelangka Motifs

2. Mathematical Concepts in Kain Tenun Motifs Seen from Geometry and Graphs

There are various mathematical concepts in Kain Tenun Ikat Sintang. In one cloth, several mathematical concepts are found. This mathematical concept is located in the Tiang Belumbah and Pelangka motifs. The following are some of the mathematical concepts found in Tenun Ikat Sintang which are associated with mathematical concepts:

a. Plane

Planes are very diverse. According to Amalia (in Wulandari, 2020), a Plane is a flat or flat object or plane with only two sizes (two dimensions). There are Planes of flat wakes seen from the shapes and motifs, which are identified by the characteristics of flat shapes.

If you look closely at the pattern, the woven fabric has four equal sides with four equal angles by the characteristics of a flat rhombus in which the four sides are congruent, the opposite angles are congruent, the diagonals intersect in the middle, and the diagonals divide the corners into congruent parts. These characteristics identify the woven fabric motif to form a flat, rhombus.

Figure 3. Kain Tenun Motifs Seen in Geometry

If you look closely at the Pelangka motif, you can see six sides of the same length, six angles of the same size, and six axes of symmetry. To these characteristics, the Pelangka motif is identified as forming a flat shape in the form of a hexagonal flat shape.

Figure 4. Kain Tenun Motifs Seen in Geometry

Based on Figures 3 and 4, several examples of the plane can be identified. These planes include rhombus and hexagonal. This research is also similar to the research conducted by Putra, Peradhayana, & Wardika (2022, p.100), which is an ethnomathematics analysis of Bali woven fabrics. This study stated that mathematical concepts were found in materials in the form of a plane, such as circles, squares, triangles, and rhombuses.

b. Geometry Transformation

One of the branches of geometry is transformation geometry which can be found in mathematics lessons in high school. In general, the transformation geometry is divided into several, namely translation (shift), reflection (reflection), rotation (by rotating), and dilatation (enlarged or reduced).

1) Translation

The mathematical element in the Woven Fabric motif above is translation. The translation is defined as a shift in a shape/object towards a certain direction with the same distance at all points. In the research by Sutarto, Hastuti, & Supiyanti (2021) found translations (shifts) contained in sasak weaving in the Subahnale weaving motif and the Bintang Empat motif; this translation occurs when one motif is formed from a change of another motif. As in the picture below, the motive has shifted downwards.

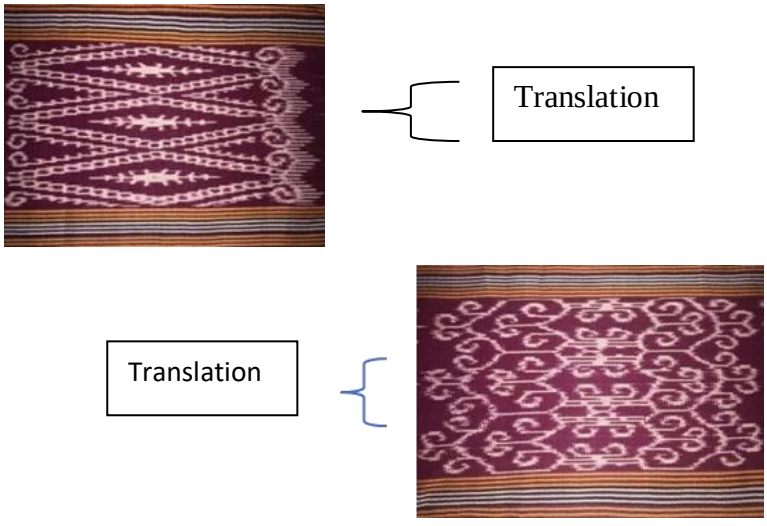

Figure 5. Woven Fabric Translation

2) Reflection

The mathematical element contained in the Woven Cloth motif is reflection. Reflection is defined as moving or shifting an object or shape towards a line/mirror with the same distance at all points. In the picture above, you can see the image of the Tiang Belumbah experiencing reflection or reflection of the x line. Sutarto et al. (2021) also found the concept of reflection in Kain Tenun Sasak in the Subahnale woven motifs, the Kain Tenun Wayang motifs, the Kain Tenun Keker motifs, and the Alang/Lumbung motifs.

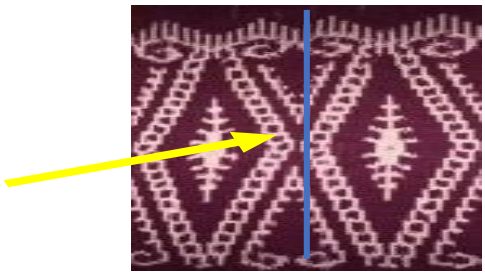

Figure 6. Reflection on Kain Tenun Motifs

3) Rotation

The mathematical element contained in the Pelangka motif is rotation. Rotation is defined as shifting or moving all points. The above Pelangka motif has a rotation at all points of 1800. In line with research that was previously conducted by Purnama, Utami, and Prihatinigtyas (2020), found that in Tenun Sasak, there is a mathematical element, namely the concept of rotation in the Pucuk Rebung motif, where a Kain Tenun Lunggi motif is formed from the rotation of other motives.

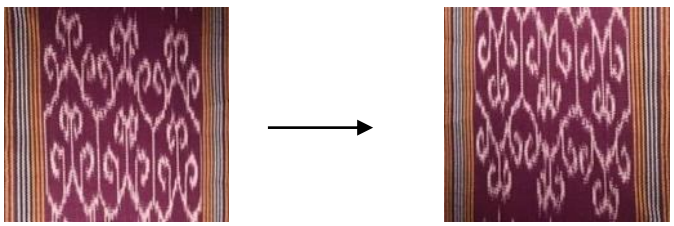

Figure 7. Rotation on Kain Tenun Motifs

4) Dilatation

The mathematical element contained in the Tiang Belumbah motif is dilatation. Dilation can be in the form of enlargement or reduction of plane wake objects. The picture on the Tiang Belumbah is a flat rhombus Plane. There is a reduction in the shape of a rhombus.

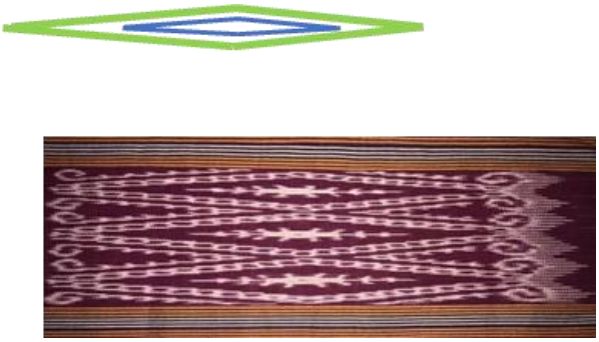

Figure 8. Dilatation on Kain Tenun Motifs

c. Graph

In the Tiang Belumbah motif and Pelangka motif, several types of graphs are identified, as follows.

If you look closely at the Pelangka motif, it has characteristics and shapes that resemble those of a loop. Loops or sides are sides that have the same endpoints. There is a circle shape in the Pelangka motif when the sides are pressed together to form a loop. Based on these characteristics, the Pelangka motif is identified as forming a loop.

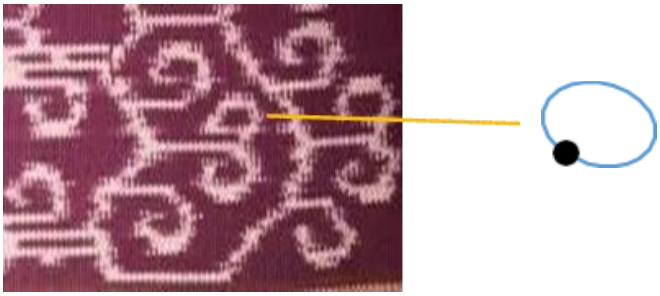

Figure 9. Simple Graph Kain Tenun

The motif of Tiang Belumbah seen from its shape, can also be grouped into special graphs in the form of regular graphs and complete graphs. A typical graph is one in which all vertices have the same degree. The motif of Tiang Belumbah, for example, graph.

Figure 10. Simple Regular Graph Kain Tenun

As seen from Figure 9, all points on G have degrees 2, for example, d(A) = 2. Meanwhile, for the Pelangka motif, for example, Graph H. As seen from Figure 10, all points on H have degrees 2, for example, d(B)=2. It can be said that the Tiang Belumbah and Pelangka motifs are identified in a special graph, namely a simple graph (regular graph). Apart from being identified as regular graphs, motifs are also recognized as complete graphs, where motifs are in the form of simple graphs with all vertices connected by edges.

3. Ethnomathematics Activities

Counting activities are related to the question "how many." To describe numbers, record and count using fingers, body parts, stones, sticks, ropes, etc. Counting activities in the community was originally to assist the community in presenting the object it has with another thing that has the same value.

This activity occurs when estimating the completion time of one piece of cloth. Based on the results of the interviews with the three informants, it can be seen that the weaving process takes time, which varies depending on the busyness of each weaver. The average weaver can finish in 1.5 months for one large piece of cloth and 1.5 months for scarves. One woven cloth can produce six scarves, while only one part of a large cloth. If someone wants to order

woven fabric with a certain motif, one can predict when the order will be completed. For example, if someone wants to order five large pieces of cloth, it will take at least 7.5 months. Indirectly there is a mathematical activity when estimating the length of manufacture and the amount of material produced. Researchers estimate this using the concept of comparison of worth.

In addition, the counting activity also occurs when calculating the selling price of woven fabrics. Based on the results of interviews with the three informants, it can be seen that woven fabrics are sold at varying prices but are similar depending on the size, and some are sold depending on the dyes used. For scarves, the three informants sold for Rp. 50,000.00, while shawls and large cloth were sold at various prices. Large fabrics average IDR 500,000.00. If we want to buy material, we can estimate the price paid or the cost of the cloth. From the interview results, indirectly, there is a mathematical activity in calculating the price paid or the price of the material. Researchers estimate this is a social arithmetic concept.

The community originally carried out the activity of measuring to compare an object with other objects. Counting activities carried out generally use body parts to measure length, while for measuring time, the tools and things used are different for each cultural group. Measuring activity relates to pattern width or distance measurement and measuring the cloth width used. The size of each pattern varies. On average, one motif pattern is made measuring more than 30 cm with a count of 30 folds, 40 folds, 50 folds, etc., depending on the type of motif. In 1 scarf, weavers can make more than one pattern shape. Looking at the information regarding the size of the motifs, the size of the area can be found, and it can be estimated that there are many motifs in one cloth.

As an example of the weaving that researchers are studying, there are two motifs in one weaving, namely the Tiang Belumbah and Pelangka. Weavers make two patterns in the form of the Tiang Belumbah motif with a count of 40 folds so that the size obtained when measured is 55 cm x 6 cm and 1 in the form of the Pelangka pattern with a count of 30 folds so that the size

obtained when measured is 35 cm x 6 cm on the scarf. Meanwhile, in the shawl, there are three patterns of motifs, the first row has 3 in the form of a Tiang Belumbah, the second row has 3 Pelangka shapes, and the third row has 3 Tiang Belumbah with the same size as the count of the scarf. Looking at the information about the size of the motifs, the size of the area can be found, and it can be estimated that there are many motifs in one cloth. Thus, indirectly there is measuring activity in the weaving activity, namely the size of the fabric with various motif sizes can be found for the width so that it can estimate the number of motifs. In the weaving process.

The design activity initially arose because people made works that could be enjoyed or used in everyday life. For example, artifacts made for religious events, home decorations, weapons of war, and in trade. Design activities are found in weaving activities, from making patterns that will be used as woven fabrics. Pattern making includes the designing stage, where this pattern will be constructed into woven ikat. Most weavers see existing practices and then develop them through their own imagination. Using the tie technique in designing the way, the calculation for the Tiang Belumbah motif is 30 folds, while for Pelangka, it is 40 folds. The motifs of the folds form a graph.

CONCLUSION

Based on data analysis and discussion, it can be concluded that: Kain Tenun motifs symbolize prosperity. This motif conveys the message that Kain Tenun is very important for every family to live their lives because it can facilitate hard work but determines the level of well-being.

The ethnomathematics activities found in the manufacture of woven woven fabrics are in the form of counting activities; the concept of value comparison and social arithmetic is found; the measuring activity is in the form of broad concepts, while the designing activities are located in the process of making woven using the ikat technique, which is formed using the tie technique to create a graph.

Suggestions that can be conveyed based on the research conclusions are as follows: educators can utilize the results of woven fabrics to be applied in learning. They can be tested in class so that they can become new research that is useful in the world of education. As for the next researcher, they can study further about the Kain Tenun of South Tapanuli Regency, apart from what was reviewed by the researcher.

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