Ethnomathematics: Mathematical concepts in Tapis Lampung

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Ethnomathematics: Mathematical concepts in Tapis Lampung

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Abstract. The existence of ethnomatematics has existed since long ago. This is seen from various mathematical concepts that have become part of the life and traditions of society. One of them is contained in tapis Lampung. Tapis Lampung has motifs and patterns that describe the philosophy of Lampung people. Each motif has meaning and symbol in the pattern of cultural life. The process of developing Tapis Lampung has had a major impact on the economy of the community and significantly increased the potential of cultural tourism in exploring the wealth of the Indonesian art heritage. This process of introducing culture in a mathematical perspective better known as ethnomatematics. This concept has become the basis of society in using mathematics in life. This study aims to examine the philosophy contained in motifs of tapis and analyze the mathematical concept to find an ethnomatematics approach in mathematics learning. in various types of tapis Lampung including: Tapis Cucuk Pinggir, Tapis Jung Sarat, Tapis Limar Sekebar. Mathematics concept include One-Dimentional Geometry and Two-Dimentional Geometry, Geometry Transformation includes: concepts of reflection, dilation and rotation.

1. Introduction

Lampung is one of the provinces in Indonesia. Has a distinctive diversity that comes from two main tribes namely "Pepadun" and "Saibatin". The most striking characteristic comes from his handicraft namely tapis Lampung [1]. Tapis have different types, patterns and motifs according to the characteristics of each tribe. Tapis itself is a Lampung tribal women's clothing in the form of a "sarong" and made of woven cotton yarn with motifs made from decorative materials, gold thread and cotton yarn with a embroidery system[2].

Motifs are designs made from parts of shapes, various lines or elements, which are sometimes so strongly influenced by forms of stylation of nature, objects, with their own style and characteristics [3]. The creation of this ornament is based on human knowledge about the environment which can stimulate to create various kinds of ornamentation. The motif in Tapis is also often referred to as decoration [2]. The use of decorative items besides intended to beautify the fabric, also illustrates the background of the values of society [4]. The various motives contained in tapis have meanings that describe the philosophy of people's lives. The making of his motives is very caring and has a deep philosophy [5]

Raswan, a researcher and craftsman, explained that the process of making the motif applies mathematical concepts to both the process of calculating the double layer of gold thread, the distance between motifs and the embedding of gold thread to form motifs. Although not taking special measurements of various motives it forms a pattern of numbers and sizes that are consistent with the concept of symmetry in mathematics. Motifs formed in the form of perpendicular lines, intersecting lines and parallel lines. The ideas developed produced regular geometric rules so that they could later become part of mathematical studies through culture in Indonesia which could be used in the process of learning mathematics. There are decorative motifs on tapis that form geometric patterns that can be used as a source of learning in mathematics learning. According to Gunawardena, the learning resources that can be used for the learning process are very diverse both in type and form [6]. Ethnomathematics are important to use in teaching methodology and especially education programs [7]. Learning to use ethnomathematics, students are actively involved in discovering local culture in the Batang area related to Geometry [8]. Mathematics is universal knowledge, and underlies the development of science and technology. Mathematics is knowledge that is inherent in life activities, where each activity cannot be separated from mathematical activities [9]. On the market, in fields, and in various places of human activity. Mathematical phenomena are always present, even many human activities unwittingly become part of mathematics [10].

In a historical perspective, mathematics grows and develops from cultural habits or is accepted and agreed in general. See, how was the birth of geometry in the days of Babylon and ancient Egyptian civilization around 5000 BC or 4000 BC to 500 BC [11]. The use of geometry can be seen from the construction of ancient civilizations, such as irrigation, flood control, swamp drainage and large buildings. In ancient Egypt, geometry was used to build land boundaries on the banks of the Nil due to flooding. Floods continue to hit the Nil banks and have removed land boundaries owned by local communities.

In certain ethnicities, the culture inherent in society is unique and can be different from other ethnic groups. As an example of research on ethnomatematic exploration in Lampung script, one of the many cultures that exist in Lampung society is an ancient manuscript system. Aksara Lampung has an important position in Lampung's cultural life because it is used in communication, and according to its function, Lampung script is used in making or writing scripts, such as medicine, forecasting, spells, poetry, love, poetry, legal and scientific rules [5]. Of the twenty (20) Lampung characters, each letter has its own philosophical meaning with the division of each three letters that contain the same philosophy, namely the nature of animals as the assumption of Lampung society. Starting from the first letter to the 15th, use multiples of three. The last five letters in Lampung script have the same meaning. The ethnomatic activities contained in Lampung characters are as follows: Measuring Activities, Calculating Activities, Angles and Geometry Transformations [12]. The study seeks to reveal the extent to which the concepts underlying Lampung script are how to understand mathematical concepts and provide more space in cultural-based mathematics learning. This research is in accordance with the idea of D'Ambrosio who said that teaching mathematics for everyone must be adapted to culture [13].

Ethnomatematics also aims to study how students understand, articulate, process, and finally use mathematical ideas, concepts, and practices and are expected to be able to solve problems related to their daily activities [14]. The mathematical concept emerged self-taught through the making of geometric motifs, non geometric and naturalist. This process is not through formal education but through natural skills which are then handed down to the next generation.

Ethnomatematics is defined as a special method used by cultural groups in explaining mathematical concepts and activities. Ethnomatematics forms in this study is the main idea to analyzing ethnomatematics studies of tapis Lampung. Mathematics is the construction of human culture [10]. The term "ethnomatematics" was first used by Ubiratan D'Ambrosio, a Brazilian mathematician [15]. In 1960, D'Ambrosio described the relationship between the application of mathematics and differences in cultural groups as national-tribal societies, groups of workers,

children in certain age groups, or professional classes. Ethnomatematics is a discipline that tries to renew mathematics education [15].

Referring to how mathematics was found, the fact of history shows that the birth of mathematics cannot be separated from culture from one era to the next. The fact, therefore, is very appropriate if mathematics is seen as a cultural product. Because mathematics is a product of culture, the development of mathematics will not be separated from the development of existing culture. In contrast, the level of mathematical knowledge grows and has implications for how mathematics influences cultural development to reach civilization [16].

Ethnomathematics is mathematics that is applied by certain cultural groups, groups of workers / farmers, children from certain community classes, professional classes, etc. [17]. Culture in this context has a broad and unique perspective and is inherent in people's customs, for example: gardening, playing, making, and solving problems, how to dress, and so on.

Urbiratan D'Ambrosio is a mathematical education expert who rejects that mathematics is not something free of culture and value. Mathematics has been united, practiced and has become a tradition in all aspects of cultural life. The term Ethnomathematics was created by D'Ambrosio to describe mathematical practices in cultural groups that can be identified and considered as studies of mathematical ideas found in every culture. D'Ambrosio defines ethnomathatics as follows: *"The prefix ethno is today accepted as a very broad term that refers to the socialcultural context and therefore includes language, jargon, and codes of behavior, myths, and symbols. The derivation of mathema is difficult, but tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modeling. The suffix tics is derived from techné, and has the same root as technique "*[13].

Ethnomatematics is a mathematical concept in a culture developed by certain groups of people or tribes. The ethno concept is used to include all culturally identifiable groups including symbols, myths, codes, jargon, and even specific ways of thinking and conclusions [18]. Ethnomatematics is a science used to understand how mathematics is adapted from a culture [19]. Mathematical ideas arise naturally through the knowledge held by tribes or ethnic cultures in Lampung society. The formulation of the problem in this study is: To find out the meaning of the philosophy of tapis Lampung motif and the concept of mathematic that is applied to the motif of tapis Lampung in relation to the philosophical meaning itself.

2. Method

The research is classified into ethnographic research, namely empirical and theoretical approaches which aim to get a description and in-depth analysis of culture based on intensive fieldwork [20]. Ethnographic research is an attempt to find out how people organize the culture that is in their minds and use it in life. Researchers dig information through literature, observation and the interview process with several figures or residents of Lampung community who know information about the object to be excavated. Sources of data and information in this study were obtained through informants or research subjects, consisting of: 1) Gallery Kadiangan, he informant in the kadiangan gallery is Mr. Raswan. Mr. Raswan is a cultural man who pioneered the development of Tapis from the pepadun tribe, 2) Dra. Eko Wahyuningsih is a cultural guard in the Lampung State Museum "Ruwa Jurai", the reason for choosing the Lampung state museum as a place of research is that there are historical documents as well as several classic Tapis collections that the author needs to complete the research data, 3) Banon Eko Susetyo is a cultural researcher, one of the books written by Mr. Banon is "Knowing the Tapis Lampung embroidery", 4) Drs. Hi Azhari Kadir is a cultural and senior filter craftsman in Lampung. Mr. Azhari had served as an administrator of the Lampung national handicraft council in 1999.

This study aims to describe the results of the exploration of the Lampung ethnomatematics form of mathematical concepts on the motifs of Tapis Lampung. The procedure of the research carried out in this study is in accordance with the procedure of ethnographic approach research by Spradley which includes: determining informants to interview informants, make ethnographic

records, ask descriptive questions, conduct ethnographic interview analysis, make domain analysis, ask structural questions, carry out taxonomic analysis and write ethnography [20].

3. Results

Ethnomatematics with physical cultural elements can be found from traditional Lampung crafts, namely tapis. Tapis is not just a traditional craft, tapis is a symbol of the harmony of life Lampung peoples in social life and relationships with God. Tapis apparently depicts symbols, concepts, principles, and mathematical skills that are applied accidentally by craftsmen. This study explores specifically the concept of mathematic which is the material in cultural-based mathematics learning. The five types of tapis that will be analyze include: Tapis Cucuk Pinggir, Tapis Jung Sarat, Tapis Limar Sekebar, Tapis Bintang Perak, Tapis Raja Medal.
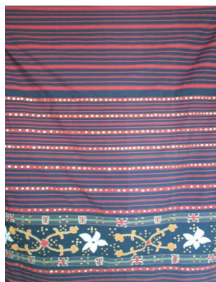
Figure 1. Tapis Cucuk Pinggir   **Figure 2**. Tapis Jung Sarat   **Figure 3.** Tapis Limar Sekebar

3.1 Tapis Cucuk Pinggir

Have motifs namely hias pucuk rebung, luak, manuk, and sasap bertajuk. Used by a group of wives in attending the ceremony or party. Also used by bridesmaids at traditional wedding ceremonies or parties. Came from Belambangan, Lampung Utara.

Geometry concept in tapis cucuk pinggir:

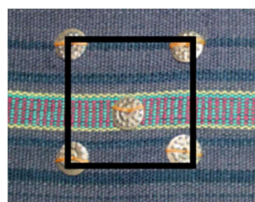### 3.1.1   Two- dimentional Geometri

Figure 4. Square Geometric motifs

The picture is a square geometric motif, this motif emerged in the Islamic era and became a grip in the making of Tapis Lampung motifs until now. This geometric motif means that an institution will be perfect and organized if it is supported by many parties who have a variety of expertise in accordance with their work.

Geometry transformation concept in this Tapis are:

3.1.2   Geometry transformation

3.1.2.1 Rotation

Pilin berganda motif have rotation concept. Rotation is to rotate each point on a field using a center point that has a distance equal to each rotated point (radius).

Rotation does not change the size of objects at all. Motif pilin berganda itself has the meaning of establishing family relations to be comprehensive to all family experts. It is not permissible to break family relationships. This can be seen from the following picture with a clockwise rotation of 180^0 obtained:
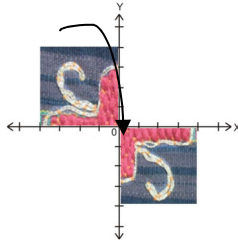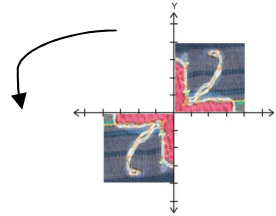

Figure 5. Clockwise rotation 180^0

Figure 6. Rotation with counter clockwise -180^0

3.1.2.2. Reflection

The concept of reflection is in the motif bunga sulur. Vines have the meaning of every science, deed, hich is good and useful should be shared so that it is maintained.
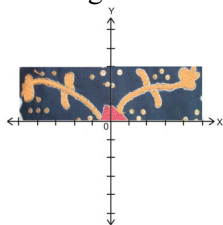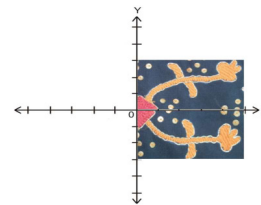

Figure 7. Y-axis reflection

Figure 8. X-axis reflection

3.2 Tapis Jung Sarat

Have motifs namely "tajuk besarung (pucuk rebung)" with motif "iluk keris" and "Sasab" with motif "mato kibau". Used by the bride during a traditional wedding ceremony. Can also be used by a group of wives of older relatives who attend the ceremony for taking titles, pengan, and muli cangget (dancer girl) at the traditional ceremony. From Belambangan, lampung Utara.

The concept of geometri in these motifs includes:

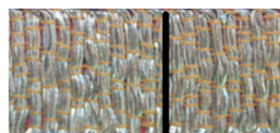*3.2.1   One- Dimentional Geometry*
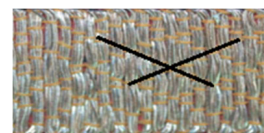

Figure 9. Sasab vertical motif

Figure 10. Intersects lines

Sasab motif has a meaning of useful knowledge, both physically and mentally in accordance with customary and religious norms. The density of the sasab motif also symbolizes a harmonious relationship between the nuclear family and the family in-law.

In the sasab motif a perpendicular line is formed through the vertical and horizontal lines of gold thread that in tapis filter basic.

The line that intersects the embroidered gold thread is interpreted as a fence that serves to protect the house from outside interference. The fence is also interpreted as a separator of a wholeness and a separation between true and wrong.

3.2.2   Two- Dimentional Geometry

Two-dimensional geometry is a flat shape that has a length and width. The concept of two-dimensional geometry contained in the Tapis include: triangle, square and rhombus. All three are symbols of form of pucuk rebung motif, tajuk berayun dan tajuk dipergaya while square and rhombus are patterns originating from geometric motifs of tapis.

3.2.2.1 Triangle

The triangle on the tapis motif is a transformation from   Tajuk berayun motif combained with motif sasab.
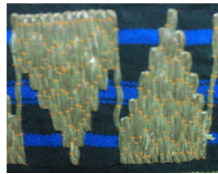

Figure 11. Tajuk Berayun motif

Tajuk berayun motif combained with motif sasab, the form like motif pucuk rebung. Motif tajuk berayun contains a firm philosophy at the agreed upon position so that it is not affected by negative things so that they are always in tune with the current era.
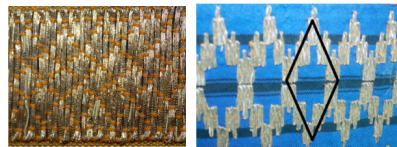
3.2.2.2 Rhombus

Figure 12. Rhombus motifs

The picture below shows that there is a rhombic concept. The rhombus motif is formed from a combination of gold sasab threads and the movement of slicing threads that is the thread that connects the gold thread with the fabric base, the rhombus motif itself has a philosophical meaning that maintaining good behavior and deeds for the common good in order to establish a good and always friendly relationship. share sustenance with others.

3.2.3   Geometry Transformation

3.2.3.1 Rotation

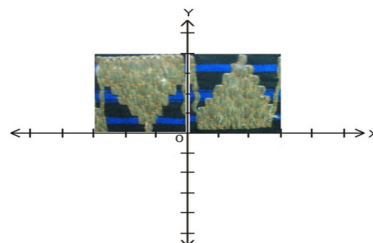This picture is tajuk berayun motif in rotation in point O(0,0) with rotation 180° .

Figure 13. Rotation 180^0

3.3 Tapis Limar Sekebar

Having motif hias pucuk rebung, bunga, limar dan sasap betajuk. Worn by a group of wives attending a ceremony or party. It can also be used by bridesmaids at traditional marriages or receptions. Come from and belambangan, Lampung Utara.

The concept of geometric transformation in these motifs includes:

3.3.1   Dilatation

In the concept of transformation geometry can be in the form of enlargement or reduction called dilation. Factors that cause enlargement or reduction in a wake are called the dilation factor. Belah ketupat motif made from golden tread with combination sasab and the movement of cutting threads that are threads that connect gold thread to the base of cloth, the belah ketupat motif itself has a philosophical meaning that maintains good behavior and actions for the common good in order to establish good friendship and always share sustenance with others.
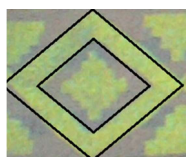

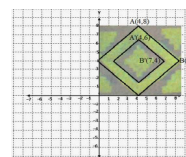**Figure 14.** Dilatation concept in Belah Ketupat motifs

Figure 15. Use of a cartesian diagram in dilatation of Belah Ketupat motifs

The Belah Ketupat Motifs above coordinates at A (4.8) and B (8.4) after a dilatation occurs in the form of a reduction in the pattern then the above Belah Ketupat Motifs coordinates become A '(4.6) and B' (7.4).

4. Discussion

Data collection and discussion of mathematical concepts are still carried out by the researchers themselves and have not been applied in learning in schools, this research is only done to find mathematical concepts in general without regard to mathematical material according to the level of schooling. Lampung can classify some material in accordance with the level of the school and discuss it in more depth, to improve learning activities that emphasize ethnomatematics aspects need to be made learning modules every level of school so that they can be applied to teaching and learning activities. This is done to introduce Indonesian culture to students in educational institutions, especially mathematics learning.

5. Conclusion

These various motifs turned out to have profound philosophical meanings related to the lives of Lampung people. Geometri concept include One-Dimentional Geometry and Two-Dimentional Geometry, Geometry Transformation includes: concepts of translation, reflection, dilation and rotation in various types of tapis Lampung including:Tapis cucuk pinggir, tapis jung sarat, tapis limar sekebar, tapis bintang perak.

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