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Ethnomathematics exploration of the rattan handicrafts that can be applied in mathematics learning in secondary schools

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Abstract. Research on cultural values in mathematics learning is not widely available by researchers. Mathematical elements contained in culture need to be discussed further so that they can facilitate contextual mathematics learning. To realize this learning, it is necessary to first identify by exploring local cultural relics that express their relationship with mathematical concepts. The researcher tries to find the mathematical elements contained in the rattan handicraft products of the Lhoknga community. The researcher then describes and analyzes the mathematical elements to be used in understanding the appropriate geometric concepts. The research employed an exploratory descriptive qualitative approach. The research subject was a rattan craftsman from the Lhoknga community, in Indonesia, obtained by purposive sampling. Research data were obtained through semi-structured interviews conducted by researchers. Data collection uses a video recorder, and then data is documented for analysis using the Spradley model. The results showed that the rattan handicraft products produced by the Lhoknga community were food serving cover, pumpkins (*boh labu*), onion basket, parcel basket, and fruit basket. Geometry concepts contained in all of these products are lines and angles, circles, transformations, and curved side geometry. This study could also be developed on other mathematical materials.

1. Introduction

Mathematics and culture are two components that cannot be separated from everyday life. Culture has been integrated into all aspects of community life and is applicable in society, while Mathematics is knowledge used by humans in solving everyday problems. Mathematics is a symbolic technology that develops based on cultural skills or environmental activities [1]. Therefore, culture and Mathematics are two important things that cannot be separated and need more attention.

Facts in the field show that mathematical ideas and concepts have been used and developed by ancestors from ancient times [2]. These mathematical ideas arose naturally through the knowledge and views of certain tribes or groups of people without formal education or training. These acquired skills were ultimately passed down over the generations. This is in line with the opinion that mathematical thinking is behind the actions and discourses of many people and even behind all kinds of human activity products [3].

However, Mathematics is sometimes difficult to understand because the learning process tends to be formal and rigid, and less fun [4]. Besides, understanding the values in Mathematics learning presented by the teacher has not reached all aspects, such as culture. This is in line with the opinion stating that mathematics taught in schools is always a culture-free lesson that involves learning that



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should be universally accepted in terms of facts, concepts, and content [5].

Mathematics learning should be innovated so that it can facilitate contextual Mathematics learning [6]. One of the aspects that can be developed for innovation in Mathematics learning is the local culture. Mathematical elements in culture need to be studied further to foster a sense of love for ancestral heritage. To realize this learning, it is necessary to first identify by exploring local cultural heritage that can be related to concepts in Mathematics. The process of this activity is what is defined by ethnomathematics [6].

Ethnomathematics presents mathematical concepts related to students' daily and cultural experiences, thus enhancing students' meaningful and relevant connection skills and deepening their understanding of Mathematics [5]. The presence of ethnomathematics in Mathematics learning provides a new situation. Mathematics learning is carried out in the classroom, but also the outside world in the form of surrounding culture can also be used as a concrete learning media for Mathematics. Culture-based learning in Mathematics learning is an innovation to eliminate the notion that Mathematics is rigid and, at the same time, introduces a culture that is not widely recognized by students [7]. When ethnomathematics is applied in the Mathematics curriculum in schools, it can maintain a student's identity while succeeding academically [5]. Thus, through ethnomathematics, Mathematics learning will be more enjoyable, bring students closer to their unique culture, and increase student interest and motivation in learning Mathematics.

2. Methods

This research employed an exploratory descriptive qualitative approach. The researcher tries to find the mathematical elements in the rattan handicraft products of the Lhoknga community. The researcher then describes and analyzes the mathematical elements to be used in understanding the appropriate geometric concepts. The choice of rattan handicraft as a medium is due to considering the ease of obtaining it. The mathematical elements resulted can be seen more clearly to understand the required geometric concepts.

This research was conducted at Kriya Rattan Kreasi Tanjong Indah as a unit of the Tanjong Adee Beu Makmu Village Owned Enterprise, located on Jalan Banda Aceh-Meulaboh Kilometer 10, Gampong Tanjong, Lhoknga District, Aceh Besar District. The research subject was a female rattan craftsman with the initial YS obtained based on a sample of consideration.

The research data is in the form of geometric concepts found in rattan handicrafts as a handicraft product of Ms. YS. Data collection is done through observation, interviews, and documentation of the subject during his work. To see the suitability of the geometry concepts produced by the subject with mathematics material taught in schools, the researchers analyzed the geometric concepts that students learn in junior high schools based on the applicable curriculum in Indonesia.

Two activities were carried out in data collection. First, the researcher made unstructured observations. The researcher made observations freely by recording the rattan handicraft business products as a result of the ethnomathematics of society and documenting them. Second, the researcher conducted interviews with subjects to explore ethnomathematics data on rattan handicraft products because there may be things that cannot be revealed through observation and documentation. This aims to clarify and complete the data. The interview used in this study was semi-structured. Although the researcher used a research instrument developed for interview guidelines, the interview guideline used were only an outline of the problem to be asked.

Documentation was carried out during the making process of rattan handicraft products, also recorded and photographed the finished products. The documentation results in this study were pictures in the form of photos of rattan handicraft products containing geometric concepts and their overall physical forms. Furthermore, the data analysis technique in this study used the Spradley model with data analysis steps, including activities of domain analysis, taxonomic analysis, compositional analysis, and analysis of cultural themes [8]. Then, the researcher attempted to check the validity of the data by using different data collection techniques from the same source, namely participatory observation, in-depth interviews, and documentation simultaneously.

3. Results and discussion

Based on the results of the data collection, there are five types of rattan handicraft products produced, namely food serving cover (*tudung saji*), pumpkins (*boh labu*), onion baskets, parcel baskets (*raga hadiah*), and fruit baskets (*raga*). The process of making each type of rattan handicraft does not use ready-made molds but use a “ribbon” or “hand span” or “measure the length of the sleeve” made by the craftsmen themselves. Craftsmen have used certain approximate values as a unit of measure for private property. However, this measure is used consistently to produce rattan handicraft products that are uniform in shape, and this is ethnomathematics.

There are several geometric concepts found in each of the rattan handicraft products of this research. The description of each product is described in terms of a learning domain and taxonomy. The domain is where the material is generally given based on the mathematics learning curriculum in Indonesia. Taxonomy is a detail of material that is a branch of the domain. To be clearer, a description of each product based on the researcher's analysis and needs in Indonesia learning curriculum is given in pictures and tables. The following is a description of each rattan product produced.

3.1. Food serving cover (*tudung saji*)



Figure 1. A food serving cover (*tudung saji*).

Craftsman produces the food serving cover (*tudung saji*) in a circle with a diameter of 35 cm at the base and top and a smaller circle at the top with a diameter of 30 cm. This form is very suitable for understanding students in determining the area of a circle that occurs and calculating the ratio of the area of a circle. In addition, the food serving cover (*tudung saji*) has several other geometric concepts such as parallel lines, the intersection of two lines, and the angle between two lines. The parallel lines can be observed at the edges of the food serving cover (*tudung saji*). This parallel can be used to motivate students to understand transformation, especially translation. The intersection of the lines can be seen at the top of the food serving cover (*tudung saji*), which produces a circle center angle.

Based on the geometric concept described, rattan handicrafts can be used as a medium for learning geometry for junior high schools. For example, the teacher presents these objects in the class, or the teacher gives them as project assignments for students in groups. The complete results of the analysis of the geometric concepts regarding the serving hoods used in junior high schools can be seen in Table 1.

Table 1. Domain and taxonomic analyses for food serving covers (*tudung saji*).

Class/Semester	Domain	Taxonomy
VII Semester II	Lines and Angles	Line Segments Intersecting Lines Coinciding Lines Parallel Lines Acute Angles
VIII Semester II	Circles	Circles
IX Semester I	Transformations	Dilations

3.2. Pumpkins (*boh labu*)



Figure 2. A pumpkin (*boh labu*).

A pumpkin craft, as shown in Figure 2, resembles a food serving cover. However, pumpkins are slightly smaller than food serving covers and have lids. At the same time, the edges are similar to the curvature of a pumpkin or the edge of a ball. Pumpkins (*boh labu*) use the concept of congruent circles. The bottom and top have a circle that is almost as wide. This is very suitable as a geometry learning medium that instills the concept of tubes. However, students will find it difficult to identify the shape of the tube because the edge of the pumpkins is curved. However, if observed as a whole, the shape of the pumpkin shape is almost similar to a truncated ball. The word pumpkins (*boh labu*) itself is taken from the Aceh language, which means in Indonesian "pumpkin fruit". The complete results of the mathematics curriculum analysis and learning needs can be seen in Table 2.

Table 2. Domain and taxonomic analyses for pumpkins (*boh labu*)

Class/Semester	Domain	Taxonomy
VII Semester II	Lines and Angles	Line Segments Intersecting Line Coinciding Lines Acute Angles
VIII Semester II	Circles	Circles
IX Semester I	Transformations	Dilatations
IX Semester II	Curved-Side Geometry	Spheres

3.3. Onion basket (*raga bawang*)



Figure 3. A onion basket (*raga bawang*)

The handicraft product in the form of an onion basket is similar to a food cover. However, the shape opens upwards, as shown in Figure 3. The onion basket (*raga bawang*) also uses the congruent circle concept. The bottom half has the same circle as the top circle. The two are positioned on the curved edge of the onion basket (*raga bawang*) in the shape of two congruent circles. The circle of the top onion basket (*raga bawang*) is about 16 cm in diameter, the bottom circle is similar. This is very suitable as a geometry learning medium that implements the concept of a tube volume without a lid. In general, students find it difficult to determine the volume of a tube-like object and the area of a blanket if it is given without a cover. The complete results of the curriculum analysis and learning needs can be seen in Table 3.

Table 3. Domain and taxonomic analyses for onion baskets (*keranjang bawang*)

Class/Semester	Domain	Taxonomy
VII Semester II	Lines and Angles	Line Segments
		Parallel Lines
		Intersecting Lines
		Coinciding Lines
		Acute angles
VIII Semester II	Circles	Right angles
		Circles
IX Semester I	Transformations	Dilatations
IX Semester II	Curved-Side Geometry	Cylinders

3.4. Parcel basket (*raga hadiah*)



Figure 4. A parcel basket (*raga hadiah*).

The shape of a parcel basket (*raga hadiah*) is similar to an onion basket. It's just that, at the top, there is a circle that is positioned slightly curved, as shown in Figure 4. The circle size of the bottom parcel basket (*raga hadiah*) is about 32 cm in diameter. This is very suitable as a geometry learning medium that instills the concept of tube volume. In general, students find it difficult to determine the volume of a tube-like object because of the incongruent shapes of the base and top planes. The complete results of the curriculum analysis and learning needs can be seen in Table 4.

Table 4. Domain and taxonomy analyses for parcel baskets (*raga hadiah*).

Class/Semester	Domain	Taxonomy
VII Semester II	Lines and Angles	Line Segments
		Intersecting Lines
		Coinciding Lines
		Acute Angles
		Right Angles
		Straight Angles
		Complementary Angles
VIII Semester II	Circles	Circles
IX Semester I	Transformations	Dilatations
IX Semester II	Curved-Side Geometry	Cylinders

3.5. Fruit basket (*raga*)



Figure 5. A fruit basket (*raga*)

The shape of a fruit basket (*raga*) is similar to an onion basket (*raga bawang*) and a parcel basket (*raga hadiah*). It's just that the dominance of its shape rests on a base in the form of a circular area, while the upper part is woven in the form of curves resembling a semicircle arranged continuously, as shown in Figure 5. The fruit basket (*raga*) slightly resembles a beheaded cone. The lower part is a circular area arranged using a circle center angle with a diameter of about 24 cm. This is very suitable

as a geometry learning medium that instills the concept of cones. In general, students find it difficult to determine the volume of a truncated cone. The complete results of the curriculum analysis and learning needs can be seen in Table 5.

Table 5. Domain and taxonomic analyses for fruit baskets (*raga*)

Class/Semester	Domain	Taxonomy
VII Semester II	Lines and Angles	Line Segments
		Intersecting Lines
		Coinciding Lines
		Acute Angles
		Obtuse Angles
		Right Angles
		Straight Angles
		Opposite Angles
VIII Semester II	Circles	Circles
IX Semester I	Transformations	Dilatations

When you look at the five handicraft productions above, the Lhoknga community has implemented some geometric concepts in designing handicrafts from rattan. This knowledge was received from generation to generation from their ancestors. It's just that the novelty that appears is the motif depicted and the size. Some of the existing geometric concepts are the application of the concepts of lines, angles, circles, and transformations. These concepts really need to be instilled in students from an early age through the results of these crafts. So far, the teacher has introduced the two concepts through direct pictures. This method will give a different impression if it is given directly with the props.

Through handicrafts from natural resources, teachers should be able to take advantage of these results to help teachers bring students to a better understanding of geometric concepts. The teacher can use this media by showing or introducing the manufacturing process directly so that students have a better understanding and learning does not look monotonous. Students have direct experience with seeing or observing concrete objects they learn as something close to their world. So far, understanding geometric concepts has often been neglected because the teacher immediately provides an understanding of lines, angles, circles, and transformations through pictures. Thus, it can make students love the biodiversity in their environment more and preserve handicrafts from rattan in the Lhoknga community [9].

All forms of culture related to Mathematics can be used as learning materials, particularly in the rattan handicrafts of the Lhoknga community, which have many geometric elements. Ethnomathematics is not only at the implicit level or just a composition of ideas, but also it was explicitly practiced in reality, presented and still being presented by different cultural groups [10]. It shows that ethnomathematics is not only at the level of implicit or only composition of ideas, but is also explicitly practiced in reality, presented, and still demonstrated by different cultural groups.

Mathematics lessons that are still a specter and local culture that is almost lost make ethnomathematics a solution. Ethnomathematics not only math but also explore the cultural values that existed inside [11]. This indicates that ethnomathematics does not only comprehend Mathematics but also explores the cultural values in it.

The use of ethnomathematics through the Lhoknga community rattan crafts is believed to be effectively used as a learning resource for students and also very helpful for teachers. With this media, the teacher will explain more closely the instilling of the geometric concepts learned. This is supported by one of the results of the study conducted by Hartoyo, which stated that Mathematics applied a local environmental approach by looking at what students find to be considered Mathematics containing

local content. Students will find it easier to understand Mathematics if it is related to everyday life [12].

The mathematical context that has been explored in the historical heritage in the form of rattan handicrafts of the Lhoknga community indicates that the activities and creations of the former community are familiar with and related to Mathematics. As stated by Kadir, ethnomathematics is a relationship between Mathematics and the cultural activities of a former community, in which the results of its activities can still be seen today [13]. This is also conveyed by Adam, who stated that cultural aspects contribute to recognizing Mathematics as part of everyday life, increasing the ability to make meaningful connections, and deepening mathematical understanding [14].

4. Conclusions

This research has collected the rattan handicraft products produced by the Lhoknga community. Some of the handicrafts are food serving covers (*tudung saji*), pumpkins (*boh labu*), onion baskets (*raga bawang*), parcel baskets (*raga hadiah*), and fruit basket (*raga*). Teachers should be able to use the results of these crafts to instill some geometric concepts in mathematics learning. Some geometric concepts that can be helped by learning through the five handicrafts include lines and angles (line segments, intersecting lines, coinciding lines, parallel lines, acute angles, obtuse angles, right angles, straight angles, complementary angles, opposite angles), circles, transformations (dilatation), and curved side geometry (spheres and cylinders). It can be considered that there is a need for a more in-depth abundant disclosure of the ethnomathematics of the rattan handicrafts of the Lhoknga community. This study could also be developed on other mathematical materials.

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