

Research Article

Organology Analysis of Dol Musical Instruments as a Mathematics Learning Media Based on the Local Wisdom of Bengkulu in Elementary School

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Abstract.

The research was held back by the unique background of the Dol instrument as ritual music at the ceremony of the Tabut and the identity of the Bengkulu traditional music. The purpose of the study is to describe the organology of the Dol instrument and its method of production and describe the design of the implementation of musical instruments on mathematics learning materials in elementary schools in both physical and sociocultural detail. The theory used is ethnomusicology and mathematics learning media. The method used is case analysis, which requires a qualitative and quantitative descriptive approach to the organology of the Dol musical instrument and learning media. The data sources used are their sources and a validator with observation techniques interview techniques, and documentation techniques. The validity of data uses their types of triangulation (technique, source, and time). The result of this research was either a text box or a materials module. The result of the Dol instrument's organological analysis as a media learning mathematics based on local cultural wisdom at the elementary school is expected to assist every teacher in educating students in understanding the preservation of local culture and implanting the local area's cultural arts character. Besides, the results of this study will contribute to the literacy and media sources of common education and general education.

Keywords: bengkulu, dol musical instruments, elementary school, local wisdom, mathematics learning media, organology analysis.

1. INTRODUCTION

Habits and interactions of certain people with their environment give birth to culture. The condition of cultural complexity in certain communities is different from the culture in other areas. Indonesia as an archipelagic country has a unique cultural diversity in each region. Bengkulu as part of the west coast of Sumatera island has different cultural

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characteristics between each tribe that inhabits the area, such as the Malay tribe, Rejang tribe, Serawai tribe, Lembak tribe, Pekal tribe, Mukomuko tribe, Pasmah tribe [1]. One of them is the Malay tribe in Bengkulu City with a unique musical instrument called Dol music. Dol music is a traditional musical instrument typical of the Bengkulu region which is sacred and is used as a musical instrument to accompany events in the Tabut ritual. As a rite of passage, Dol music is used as a medium for conveying messages and ritual values in the Tabut ritual procession. Dol is a typical Bengkulu musical instrument in the classification of musical forms called ensembles and is included in the classification of membranophone musical instruments with dynamic choreopercussive characters.

Musicologically Dol is a form of percussion instrument that is not pitched [2]. The cultural values contained in the Dol musical instrument can be transferred through education and learning in the classroom. Learning will learn through culture can help students discuss and appreciate their own culture. In addition, it can increase creativity, and respect local cultural self-esteem. Dol is a typical Bengkulu musical instrument in the classification of musical forms called ensembles and is included in the classification of membranophone musical instruments with dynamic choreopercussive characters. Musicologically, Dol is a form of percussion instrument that is not pitched [2]. The cultural values contained in the Dol musical instrument can be transferred through education and learning in the classroom. Learning will learn through culture can help students discuss and appreciate their own culture. In addition, it can increase creativity, and respect local cultural self-esteem. Dol is a typical Bengkulu musical instrument in the classification of musical forms called ensembles and is included in the classification of membranophone musical instruments with dynamic choreopercussive characters. Musicologically, Dol is a form of percussion instrument that is not pitched [2]. The cultural values contained in the Dol musical instrument can be transferred through education and learning in the classroom. Learning will learn through culture can help students discuss and appreciate their own culture. In addition, it can increase creativity, and respect local cultural self-esteem. The cultural values contained in the Dol musical instrument can be transferred through education and learning in the classroom. Learning will learn through culture can help students discuss and appreciate their own culture. In addition, it can increase creativity, and respect local cultural self-esteem. The cultural values contained in the Dol musical instrument can be transferred through education and learning in the classroom. Learning will learn through culture can help students discuss and appreciate their own culture. In addition, it can increase creativity, and respect local cultural self-esteem.

Scientific collaboration between culture and mathematics, called Ethnomathematics is closely related to everyday life, therefore children will find it easier to discuss material if it departs from contextual and cultural problems [3]. Before being applied in education and learning in the classroom, it is necessary to study it to find out the ideas/understandings contained in the culture. This study is known as ethnomathematics. Special ethnomathematics has long been introduced by introducing leadership that connects mathematics to sociocultural life. Everything in humans contains mathematical ideas in it [4]. These activities include counting, finding, measuring, playing games, and designing. The purpose of ethnomathematics is to deny mathematical facts or concepts from various points of view and respect the rights and culture of each person [5]. Another goal is to involve links between mathematics and culture so that students' perceptions of mathematics become more precise and mathematics learning can be better adapted to the cultural context of students and society. Exploration to classify activities that contain mathematical concepts is very helpful in culturally-based mathematics learning.

This research is the mathematical geometry contained in the musical instrument Dol. These elements include the concepts of angles, planes (geometry), color series, and solids (geometry). The concept of geometry is found in the kelawang or Dol body with a conical cylinder shape and rattan rope ornaments that form Bengkulu typical carvings with a triangular shape that forms the handle of Dol. Fields (geometry) such as rectangles, triangles, and circles are found in the rattan rope pattern and the Dol color. Solid (geometry) such as the cylinder and conical frustum in the Dol body image. These findings can be used as material for learning geometry in elementary schools. During geometry, the material is difficult for students to understand because the teacher uses formal mathematics in their learning. Students' expectations in answering geometry are not in accordance with the expectations expected in geometry learning. Meanwhile, students who are able to understand mathematical concepts can be useful in their lives. Mathematics provides an opportunity to practice thinking skills and in the end, can develop intellectual abilities. Therefore, teachers are required to be able to design learning media that are able to provide student learning and concretize something abstract [6]. Meanwhile, students who are able to understand mathematical concepts can be useful for their lives. Mathematics provides an opportunity to practice thinking skills and in the end, can develop intellectual abilities. Therefore, teachers are required to be able to design learning media that are able to provide student learning and concretize something abstract. teachers are required to be able to design learning media that are able to provide student learning and concretize something abstract [6]. Meanwhile, students who are able to understand mathematical concepts can be

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There have been many previous studies discussing learning outcomes using learning media, such as how to calculate the arfak tribe in Indonesia using hatam [7]. Can be used as a learning medium for addition or integer aid. Likewise the concepts of numbers and symbols, graphs, logic, and probability that exist in Inuit, Navajo, and Iroquois cultures from North America and the theory of permutations and combinations in the books of Alam Al-Hussab and Raudah Al-Hussab in Malay Malay Islam [8]. Can be used as a learning medium to introduce statistics. The concepts of magnitude, area, volume, and pattern in the Yogyakarta palace [9] can be used as a medium for learning geometry. In the style of musical instruments, Marawis discovered the practice of mathematics, such as geometric shapes in the form of circles and mathematical concepts in the form of reflection, translation, folding symmetry, rotational symmetry, acute angles, and obtuse angles [10]. This study proves the existence of mathematical concepts contained in a culture, making it possible to be developed learning mathematics in elementary schools. Based on these results, the Dol musical instrument as the local wisdom of the Bengkulu people has mathematical material contained in it. From its shape, the Dol musical instrument contains the concept of geometry in it, the concept of an agreed field, a flat building, a space building. This concept is a concept that is discussed in elementary school. This study proves the existence of mathematical concepts contained in a culture, making it possible to be developed learning mathematics in elementary schools. Based on these results, the Dol musical instrument as the local wisdom of the Bengkulu people has mathematical material contained in it. From its shape, the Dol musical instrument contains the concept of geometry in it, the concept of an agreed field, a flat building, and a spacious building. This concept is a concept that is discussed in elementary school. This study proves the existence of mathematical concepts contained in a culture, making it possible to be developed in learning mathematics in elementary schools. Based on these results, the Dol musical instrument as the local wisdom of the

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2. RESEARCH METHOD

Researchers used a qualitative descriptive method [11]. A descriptive method was applied to describe the results of the Bengkulu Dol ethnomathematics exploration in the form of elementary school geometry concepts contained in musical instruments made from coconut tree heads. This study uses an ethnographic approach [12]. The observation technique with participant observation was chosen so that researchers could participate directly with the object taken. The subject used cluster random technique about Dol musical instrument. Researchers act as human instruments. The consequence is the position of the researcher that cannot be represented by others. Researchers make plans, choose correspondence as data sources, collect and collect data, make data interpretations, and d make raw conclusions on the findings. The interview guide was used to obtain findings about the desired objectives. The data obtained is then made to look for the geometric concepts contained in the Dol musical instrument. Next, look for the universal relationship between culture and mathematics (ethnomathematics). The researcher also explores further if there are sub-sections of the musical instrument and then it is presented in an image that presents the relationship between the concept and the musical instrument.

Research conducted by researchers is to do real research without engineering. Data collection tools are essentially methods that can be used by authors to collect data. The author as a key instrument also uses other data collection tools such as observation guides, interview guidelines, field notes, and cameras. The technique used by the author is a triangulation technique. Triangulation is defined as a data collection technique that combines various data collection techniques and existing data sources. If the author collects data by triangulation, the author actually tests the credibility of the data by using triangulation techniques. Thus the triangulation used by the author is source triangulation, technical triangulation, and time triangulation. Source triangulation is a

type of triangulation that is used to get Dol musical instrument data from different sources using different techniques, technical triangulation is used to test the credibility of the data which is done by checking the data to the same source with different techniques, time triangulation is This technique is done by checking with interviews, observations, or other techniques in different times or situations. The author conducts data analysis at the time of data collection, namely during observations, interviews, and documentation results. And after collecting data for a certain period, qualitative data analysis is carried out interactively and continues thoroughly so that it is already saturated [11]. Activities in data analysis are data reduction, display, and conclusion drawing/verification.

3. result and discussion

The people of Bengkulu city every year celebrate an annual folk party called the Tabut, in this ritual procession, there is a musical element, namely the Dol music. The transformation that occurs with Dol music in Bengkulu makes every important moment such as traditional ceremonies, inauguration, clan giving (initiation), and artist creativity, Dol's voice always accompanies these activities. This Dol musical instrument is made from the head of the Bongkol coconut tree (the lower part of the coconut tree). Organologically, Dol is cylindrical with one side of the membrane or single-headed. However, this shape is not exactly cylindrical in terms of the texture of the raw material. This large drum only has one side of the membrane as a sound source being hit to play it. The Dol instrument as part of the Dol musical ensemble, in a ritual procession, is played statically or sometimes carried by two people and one person acts as a beater/player alternately while walking. Coconut Trunk Bongkol was selected which has a diameter of 40-100 cm. The top is covered with leather made of bull skin. Before being used to cover, the skin is dried by drying. Dol size itself is adjusted to the height of the person wearing it.



Figure 1: Dol and Kelawang Dol.

This study found several geometric concepts on Dol musical instruments that can be used as teaching materials for elementary school mathematics based on local culture. Geometry is a branch of mathematics that does not prioritize the relationship between numbers even though there are numbers in it, but geometry studies the relationship between points, lines, angles, planes, flat shapes, and flat shapes. There are two types of geometry that are studied in elementary school, namely two-dimensional and three-dimensional geometry. Two-dimensional geometry is geometry that only consists of two dimensions (length and width), or only has area but no volume, while three-dimensional geometry is a three-dimensional geometric shape (length, width, and height) or has volume [13].

Mathematics subjects are given at the elementary school level in addition to getting mathematics itself, but also to develop students' logical, analytical, systematic, critical, creative thinking patterns and develop collaborative patterns of problem solving habits. This competency is needed by students in developing the ability to find, obtain, manage, and use information based on scientific logical thinking concepts to survive in an uncertain life [14]. Broadly speaking, the standard of mathematics competence in elementary schools related to the geometric concepts contained in musical instruments can be seen in Table 1 and Table 2.

TABLE 1: Elementary mathematics competency standards geometry concept [5].

Competence Base	Learning outcomes	Indicator	Subject Matter
Recognizing flat shapes and building shape	Grouping various simple shapes	Name objects that are geometrically shaped like balls, tubes, blocks or cubes Grouping objects according to shape, surface, or other characteristics	Build shape and flat shape
	Investigate various simple flat shapes	Name objects that are geometrically triangular, quadrangular in terms of many sides Trace or create various triangular shapes and rectangular Grouping various shapes triangle and square four according to shape, surface, or other features	

3.1. The Concept of Angles and Planes (Geometry)

Characteristics of Dol is to have the handle/hand in the middle. This is to make it easier for users to hit Dol. The size of the handle follows the size of the body / the center of the

TABLE 2: Geometry concepts in *Dol* musical instrument organology.

Organology On Musical Instrument Dol	Concept Geometry	Elementary School Mathematics Competency Standards
Top Body Hand Grip Strap Rattan rope carving and Knitting	Circle Cylinder Conical cylinder Triangle angle	Recognizing flat shapes and building spaces

Dol. The concept of angle can be seen from the right angle formed between the handle and the center of the *Dol*. Triangle concept tracing is found in rattan rope knitting and triangle carving on *Dol*. The carving with this color is a philosophical form of the typical Bengkulu Malay carving, namely Pucuk Rebung and to beautify the appearance of *Dol*. The characteristics of the four colors that must be present in the *Dol* carving, namely red, green, yellow and black, have their own meaning for the supporting community.

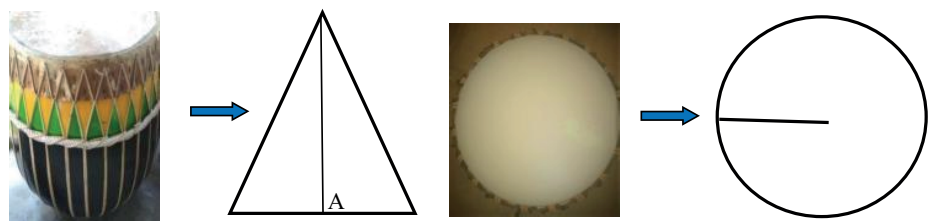


Figure 2: The concept of a flat image on a triangle and circle *Dol* musical instrument.

The style of carving on the triangle is a flat shape formed by three sides that are straight lines and have three angles. In addition to having 3 sides or edges and angles, the properties of a triangle have an angle of 180°. The candlestick forms an isosceles triangle. It is a triangle in which both sides are the same length and have two equal angles. If *a* is the base and *t* is the height, then the area and perimeter of an isosceles triangle can use the following formula.

$$\text{area } A = 2 \times \left(\frac{1}{2} \cdot at\right) \text{ (1)}$$

$$= axt$$

$$\text{circumference } A = \text{side} \times \text{side} \times \text{side} \text{ (2)}$$

At the top (membrane) *Dol* candlestick patterns contain the concept of a circle which is the set of all points on a plane within a certain distance called the radius of a point called the center. Some of the properties of a circle have infinite rotational symmetry, have folding symmetry having one side. If $\pi = 3.14$ or $\frac{22}{7}$, *r* is the radius and *d* is the diameter (2 *xr*), then the formula for the area and circumference of a circle is as follows.

$$\text{Area circle} = \pi \times r^2 \text{ (3)}$$

$$\text{circumference circle} = 2\pi \times d \text{ (4)}$$

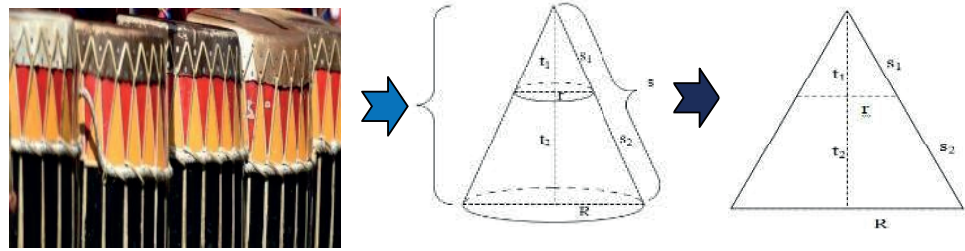


Figure 3: Cone concept on carving and rattan rope *Dol*, frustum of cone concept.

Figure 3 show the concept of congruence infrustum of the cone concept (triangle) is obtained:

$$\text{Surface Area} = \pi r (r+s) \quad (5)$$

$$\text{Area of Blanket} = \pi r s \quad (6)$$

$$\text{Volume} = 1/3 \pi r^2 t \quad (7)$$

Description:

r = radius of circle base

s = length of the line of the cone painter

t = height of the cone

Based on the results of the discussion of mathematical material that can be explored and obtained in culture. This is because mathematics is a cultural product so the development of mathematics cannot be separated from the development of the existing culture. In addition, the level of knowledge in mathematical concepts grows and has implications for the influence of cultural development to achieve a civilization [15]. Ethnomathematical-based Mathematics learning that applies local culture can change people's perceptions about the application of mathematical material in everyday life [16, 17]. With ethnomathematical-based learning, students can not only understand mathematical concepts well but also can recognize and preserve their local culture.

3.2. Dol Music Instrument as a Medium for Learning Mathematics

Geometry thinking and real thinking is very important in art, design, graphics, animation, and many other vocational fields. The introduction of geometry as a basic skill in mathematics has long been in the elementary school curriculum. The rationale is geometry which is closely related to our daily life. Both practical and aesthetic aspects can be found in the fields of art and architecture, space planning, house planning, building planning, design, and property. The topics and materials can interest students and can be used to develop geometry knowledge, student skills, and problem-solving

(PBL). In learning about responsive culture, mathematics teachers are expected to be able to realize mathematics as a science that is inherent in the culture, or in other words using a cultural approach. Therefore, Teachers also need to understand the social and cultural patterns of their students. Teachers need to have knowledge of the local culture related to mathematics, understand the mathematical knowledge that students get from daily activities, and have the skills to develop and develop culture-based mathematics learning [18].

It is not something new to include ethnomathematics into the curriculum, but by having a special way to solve the problems generated, especially in learning mathematics. Raising culture-based mathematics (ethnomathematics) does not mean subjecting society to primitives or returning to the past. But how can the culture that has become the original character of the local community survive from time to time [19]. The ethnomathematics of the Dol musical instrument based on local wisdom as a mathematics learning material can please and motivate students in learning. This can make them understand and love their local wisdom culture.

The main finding in this study is that the Dol musical instrument as part of local cultural wisdom contains material on the concept of geometry in it. This concept is one of the mathematics materials given in elementary school. The concept of angle can be learned by observing the carvings and rattan ropes on Dol's body. The concept of a plane (geometry) with its properties such as triangles, rectangles, and circles can be studied by observing the overall shape of the organology Dol. Similarly, the concept of a cylinder can be learned by observing Dol's body parts, while the concept of a conical frustum can be learned from the shape of Dol's rattan rope. Learning using the Dol musical instrument as a local culture-based learning medium will greatly assist students in learning mathematics. Students can further explore and exploit their knowledge by understanding and measuring every part of the Dol musical instrument. After that, they can determine the area and shape of Dol's organology thoroughly. Therefore, the integration of culture-based learning into learning can be a solution in helping students to understand and supporting mathematical concepts in school [20].

The results of this previous study prove that the concept of mathematics, especially geometry, is indeed contained in every culture of local wisdom of the community, making it possible to be integrated with mathematics learning in elementary schools. The results of this study focus on finding materials that can be developed into learning media for geometry in elementary schools, especially on angles, planes (geometry), and space (geometry). The implication of this research is the use of the Dol musical instrument in the field of education, one of which is through learning media to explain the concept

of geometry in elementary schools. Students can play Dol to express musical creativity and also develop mathematical concepts.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the geometric concept is found in the Dol parts explaining the concept of right angles, the body part explaining the cylinder concept, the head/membrane part explaining the circle, carvings and rattan rope on the Dol body explaining the cone and triangular frustum. In addition, overall Dol's organology can explain the material of flat shapes and spaces such as triangles, rectangles, and circles. The Dol musical instrument in the results of this study is expected to be a medium of learning in ethnomathematical-based elementary schools. Students will better understand mathematical concepts by using media that are close to everyday life and provide direct experience with their own culture.

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