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Exploration of the Gondang Batak Form in relation to the Concept of Spatial Building

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Abstract

This study aims to explore the relationship between the physical form Batak gondangas, a traditional musical instrument, with the concept of geometric solids in mathematics learning in elementary schools. Through an ethnomathematics approach, this study shows that local cultural forms such as gondang can be used as a contextual learning tool that strengthens students' understanding of the concept of geometric shapes, particularly cylinders and cones. The research method used was descriptive qualitative with observation, documentation, and interview techniques. The results showed that introducing the Batak gondang shape in the learning context was able to increase students' interest and understanding of geometry and provide educational value rooted in local culture.

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1. INTRODUCTION

Mathematics is a core subject in the elementary education curriculum and plays a crucial role in developing students' logical, analytical, and systematic thinking skills. Despite this, mathematics is often viewed as a difficult and abstract subject by most students, especially in elementary school. This perception arises because the presentation of mathematical material tends to be dominated by symbols, numbers, and formulas that are not directly connected to students' concrete experiences.

One topic often considered difficult and poorly understood by students is the concept of geometric shapes. This topic encompasses various three-dimensional geometric shapes such as cubes, cuboids, cylinders, cones, pyramids, and spheres. Students often only learn about these shapes through two-dimensional drawings in textbooks or theoretical explanations from teachers, followed by memorization of volume and surface area formulas. In many cases, learning does not provide sufficient space for students to directly observe, touch, and understand the relationship between these geometric shapes and the real objects they encounter in everyday life. As a result, students' understanding of geometric shapes becomes shallow and mechanistic.

In the context of meaningful mathematics learning, it is important to introduce a contextual and culturally-based approach so that students can see the relevance of mathematical material to their world. One approach that has received attention in recent years is ethnomathematics, the study of the relationship between mathematics and culture. Through ethnomathematics, various elements of local culture, such as textile motifs, traditional buildings, traditional games, and even musical instruments, can be used as a medium for understanding mathematical concepts in a more realistic and grounded way.

Indonesia, as a country rich in cultural diversity, holds extraordinary potential for developing culture-based mathematics learning. One interesting cultural heritage to study from a

mathematical perspective is the Batak gondang, a traditional musical instrument of the Batak people from North Sumatra. The gondang has a unique physical shape—made of a hollow wooden log with leather coverings at both ends—that resembles a cylindrical geometric shape, and in some types of gondang, there is a cone-shaped section at the sound funnel. These geometric shapes have great potential to be used as a concrete medium for introducing geometric shapes to students.

Besides being a visual medium, the use of gondang also brings an emotional and cultural dimension to learning. Students learn not only mathematics but also recognize and appreciate their local culture. This is highly relevant to the Independent Curriculum, which emphasizes the importance of locally context-based learning, personalized learning, and strengthening the Pancasila Student Profile, particularly in recognizing cultures and becoming learners rooted in the values of global diversity.

This research aims to explore the potential of the Batak gondang's physical form in helping students understand spatial concepts in a more concrete and enjoyable way. By leveraging local cultural richness as a bridge to mathematics learning, it is hoped that students will develop a deeper conceptual understanding and build a strong cultural identity. This research also makes an important contribution to the development of mathematics learning models that are contextual, relevant, and inclusive of Indonesia's cultural diversity.

2. LITERATURE REVIEW

The literature review in this study covers four main pillars: the concept of ethnomathematics, the characteristics of the Batak gondang in a cultural context, the concept of spatial figures in the elementary school curriculum, and the contextual learning approach. These four aspects serve as the theoretical basis and framework for developing a mathematics learning approach based on local culture. Ethnomathematics and Contextual Mathematics Education Ethnomathematics, first introduced by Ubiratan D'Ambrosio (1985), is a branch of study in mathematics education that examines mathematical practices that grow and develop within a particular cultural community. D'Ambrosio defines ethnomathematics as "the mathematics practiced by different cultural groups, including how they calculate, measure, classify, and design geometric structures." In an educational context, this approach offers a new paradigm in mathematics learning, namely by linking abstract concepts with students' social and cultural practices.

Ethnomathematics allows teachers to use local culture as a learning context, allowing students to build mathematical understanding through intimate and meaningful experiences. Previous studies have shown that an ethnomathematics approach can increase students' learning interest, conceptual understanding, and pride in their cultural identity (Rosa & Orey, 2011). Gondang Batak from a Cultural and Geometry Perspective

The Batak gondang is a traditional musical instrument that plays an important role in the traditional life of the Toba Batak people, especially in religious ceremonies, weddings, and death rituals. In terms of shape, the gondang is usually made from a large, hollowed-out log covered with animal skin on both sides, forming a cylindrical structure resembling a cylindrical geometric shape. Some types of gondang also have a cone-shaped section that functions as a resonator or sound funnel. The unique physical form of the gondang makes it relevant as a concrete medium in geometry learning. Furthermore, the gondang functions not only as a musical instrument, but also as a cultural symbol that contains spiritual, historical, and social values. The integration of gondang in mathematics learning can strengthen students' ties with their local culture, while enriching the learning process with affective and aesthetic dimensions. The Concept of Spatial Structures in the Elementary School Curriculum

Learning about geometric shapes in elementary school plays a crucial role in developing students' spatial skills and logical thinking abilities. In the Independent Curriculum, geometric shapes are taught in stages from grades 4 to 6. The material covered includes an introduction to shapes (cubes, cuboids, cylinders, cones, pyramids, and spheres), as well as calculating their surface areas and volumes. However, in practice, learning about geometric shapes is often

theoretical and lacks connection to real objects. Students are often exposed to two-dimensional images in textbooks or mathematical formulas, potentially making it difficult for them to visualize the actual shapes of these shapes. Therefore, an approach that can provide students with real-world models that are familiar to them is needed to make the learning process more meaningful.

Contextual Learning Approach, Contextual Teaching and Learning (CTL) approach according to Johnson (2002) is a learning strategy that emphasizes the importance of linking subject matter to students' real-life contexts. CTL encourages teachers to create a learning environment that allows students to construct new knowledge through connections with their daily experiences, culture, and social environment. In mathematics learning, a contextual approach is crucial for bridging students' understanding of abstract concepts. When students are able to see the connection between what they learn and their own lives, their motivation and understanding of the material will increase significantly. Therefore, the use of Batak gondang as a spatial visual aid is not only culturally relevant, but also pedagogically effective within the contextual learning framework.

Based on the four theoretical foundations above, this research positions itself at the intersection of mathematics education, local culture, and contextual pedagogy. This literature review confirms that the exploration of the Batak gondang form in learning spatial geometry is not only innovative in terms of teaching media but also strengthens the direction of education rooted in students' cultural identity and lived experiences.

3. RESEARCH METHOD

This study uses a descriptive qualitative approach, which aims to describe and interpret how the Batak gondang form can be used to strengthen the learning of geometric shapes in elementary schools. Location and Subjects of the Study The study was conducted in two elementary schools in North Sumatra, namely SDN 1 Balige and SDN 3 Samosir. The research subjects consisted of: 2 sixth grade teachers, 40 sixth grade students, 1 Batak cultural figure as a resource person Data Collection Techniques. Direct observation of the physical form of the Batak gondang. Interviews with teachers and Batak traditional figures. Visual documentation of the gondang as a cultural artifact. Analysis of learning activities using the gondang model as an aid. Data Analysis Techniques. Data were analyzed through data reduction, data presentation, and drawing conclusions according to the Miles & Huberman (1994) model.

3. RESULTS

This study aims to explore the Batak gondang form as a contextual medium for learning spatial concepts in elementary schools. Results obtained from field observations, interviews with teachers and cultural figures, and classroom implementation revealed several significant findings.
Geometric Characteristics of Gondang Batak

Through direct observation of several types of Batak gondang, it was discovered that these musical instruments share remarkably consistent geometric characteristics. In general, the main body of the gondang is cylindrical, with varying lengths and diameters depending on the type of gondang and its function in traditional ceremonies. This cylindrical surface resembles the cylindrical shape of the cylindrical solid, as taught in elementary school mathematics curricula. Interestingly, some types of gondang—such as those that function as sound speakers or resonators—have conical or semi-conical ends, which are used to amplify the sound output. This modification of shape is what makes the gondang a cultural object rich in three-dimensional geometric representations. The proportions and shape of the gondang, which are easy to observe and measure, make it highly suitable for use as a concrete medium in mathematics learning, particularly in understanding the concepts of volume and surface area of solid shapes.
Teacher and Student Responses

Interviews with classroom teachers involved in implementing this approach indicate that teachers perceived an improvement in students' understanding of spatial geometry concepts, particularly in recognizing shapes, measuring dimensions, and calculating volume. Teachers

stated that this approach was livelier and more contextual, and made mathematics lessons feel more "meaningful" for students because it connected them to their own culture. From the students' perspective, feedback was very positive. Many students stated that they found it easier to understand the material because they could touch and directly observe the shape of the gondang used. They also felt more emotionally and culturally engaged, as the gondang is a familiar object in their daily lives and family ceremonies. Furthermore, local traditional leaders and community members welcomed the use of gondang in school learning activities. They viewed this as an important effort to preserve Batak culture while simultaneously improving the quality of local education, which remains unaffected by its cultural roots.

Implementation in Learning Activities

During the learning implementation process, students are invited to observe the gondang directly, measure its physical dimensions such as the diameter of the base and the height of the gondang body, and calculate its estimated volume using the cylinder volume formula:

$V=\pi \times r2 \times tV = \pi \times r^2 \times tV=\pi \times r2 \times t$

In practice, students used measuring tapes and simple measuring tools provided by the teacher to record the dimensions of the gondang and then calculate its volume in their notebooks. This process stimulated curiosity and active interaction in the class.

The results of the activity showed: 80% of students were able to calculate the volume of a cylinder correctly, demonstrating success in understanding and applying mathematical formulas. 85% of students showed high interest in learning activities, which was reflected in active participation, enthusiasm in asking questions, and cooperation in groups. 90% of students were able to associate the shape of the gondang with the geometric shapes studied, demonstrating strong conceptual understanding and good visual-mathematical integration.

4. DISCUSSION

The findings of this study provide evidence that integrating local culture, particularly the Batak gondang, into mathematics learning has a positive impact on students' cognitive, affective, and sociocultural aspects. Initially known only as a traditional musical instrument, the gondang holds significant potential as an educational medium for introducing mathematical concepts contextually.

Reimagining Culture as an Educational Medium

By introducing the gondang as a representation of a geometric shape, students not only learn mathematics but also see culture as a source of knowledge. They learn that traditional objects are not just a relic of the past but also a living and relevant source of learning. This approach also reinforces the values of the Pancasila Student Profile, particularly in strengthening cultural identity and the spirit of lifelong learning.

Constructivism in Ethnomathematics

Theoretically, this approach reflects constructivist theory (Piaget and Vygotsky), in which students construct knowledge through direct experience. Students' interactions with real objects such as drums, as well as the processes of measurement and calculation, create active learning situations that allow knowledge construction to occur naturally and meaningfully.

Furthermore, this ethnomathematics approach also strengthens conceptual understanding, not just memorizing formulas. When students see for themselves that a gondang is a cylinder and can calculate its volume, they understand that mathematics is part of the real world, not just symbols on a blackboard. Challenges and Practical Implications Although this approach has great potential, there are several challenges that need to be considered, including: Teachers' readiness to recognize and use cultural objects as learning media. Availability of local cultural resources around the school that can be accessed and used. Collaboration is needed between schools, indigenous communities, and local governments to develop culture-based learning resources sustainably. However, if these challenges can be overcome, this approach can be an innovative alternative to address the weaknesses of conventional approaches that are too focused on memorization and symbols.

5. CONCLUSION

Exploring the Batak gondang as a means of learning mathematics based on local culture has positively contributed to students' understanding of geometric shapes. The gondang, which physically resembles a cylinder and a cone, can be used as a concrete medium for teaching geometry contextually. This type of learning not only fosters mathematical thinking skills but also instills cultural values in students. The results of this study indicate that an ethnomathematics approach that emphasizes local wisdom is highly relevant for application in the context of Indonesian education, which is rich in cultural diversity. Therefore, it is recommended that teachers begin exploring other cultural objects as sources of innovative and down-to-earth mathematics learning.

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