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Exploration of the Keteng-Keteng Musical Instrument in Learning the Surface Area of Cylinders at SMPS Deli Murni Bandar Baru

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Abstrak

This research aims to explore the potential of traditional musical instruments.Keteng-Ketengas a contextual media in learning the concept of surface area of cylinders at the junior high school level. This musical instrument is known in the Batak Karo culture and has a distinctive cylindrical shape, making it relevant for use in understanding spatial figures. The research was conducted at SMPS Deli Murni Bandar Baru with an ethnomathematics approach. The method used was descriptive qualitative with observation, interview, and documentation techniques. The results showed that the use of Keteng-Keteng in learning was able to improve students' understanding of the surface area of cylinders and create a contextual, meaningful learning atmosphere rooted in local culture.

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1. INTRODUCTION

Mathematics is a fundamental subject that plays a crucial role in developing students' logical, analytical, and systematic thinking skills. At the junior high school (SMP) level, mathematics is an integral part of the national curriculum, yet ironically, many students still struggle to understand the material. This difficulty stems not only from the complexity of the material but also from the often abstract and non-contextual learning approach, far removed from the realities of students' daily lives.

One topic often considered difficult by students is spatial geometry, particularly the surface area of cylinders. In classroom practice, teachers tend to convey this material through formulas and two-dimensional drawings on the board or in textbooks, without providing concrete media that students can touch and observe. As a result, students have difficulty visualizing three-dimensional shapes and understanding the relationship between the cylinder's elements (base, surface area, and height) and their calculations. The learning process becomes disconnected from students' real-life experiences, ultimately weakening their absorption and interest in learning mathematics. This situation indicates an urgent need for a more contextual and meaningful learning approach, one that connects abstract mathematical concepts with real objects familiar to students' environments. One relevant and potential approach is ethnomathematics, an approach that explores and utilizes elements of local culture as a medium or context for mathematics learning. This approach not only links mathematics to students' cultures but also enlivens the learning process through concrete experiences rooted in students' own identities and environments.

In the context of the Karo community in North Sumatra, various cultural elements can be integrated into mathematics learning, one of which is the traditional musical instrument, the Keteng-Keteng. The Keteng-Keteng is a cylindrical percussion instrument, generally made of bamboo or wood, and is used in various traditional ceremonies and Karo artistic performances. Its physical shape, resembling a cylinder, makes it highly relevant as a concrete medium for learning about the surface area of cylinders. The use of the Keteng-Keteng in mathematics learning not only provides a concrete illustration of the geometric shapes being studied but also encourages students to appreciate their local culture. This aligns with the principles of the Independent Curriculum, which emphasizes the importance of contextual, enjoyable learning, and the development of students' character and identity.

This research was conducted at SMPS Deli Murni Bandar Baru, a school located in an area with a fairly dominant Karo population. Therefore, the existence and knowledge of the Keteng-Keteng musical instrument has become part of the daily lives of most students. By utilizing this local potential, this study aims to explore the effect of the use of the Keteng-Keteng musical instrument in learning the surface area of a cylinder, both in terms of conceptual understanding, student engagement in learning, and strengthening cultural values. Through this approach, it is hoped that mathematics learning will no longer be a burden of memorization and formulas alone, but rather become a fun, down-to-earth, and meaningful learning experience for students. In addition, the integration of local culture in education is also a strategic step in preserving cultural heritage and fostering a sense of pride in regional identity, in line with the goals of holistic national education.

2. LITERATURE REVIEW

Ethnomathematics is an approach in mathematics education that connects mathematical knowledge with local culture. D'Ambrosio (1985) refers to it as mathematics practiced by a particular cultural group. Rosa and Orey (2016) emphasize that ethnomathematics allows students to learn mathematical concepts through their own cultural experiences. Keteng-Keteng and Representation of Solid Geometry. Keteng-Keteng is a traditional musical instrument of the Karo people, cylindrical in shape made of wood or bamboo. Geometrically, its shape is similar to a cylindrical solid geometry, which has two circles as the base and lid, and a curved plane as the cylinder's cover. The Concept of Surface Area of a Cylinder in the Junior High School Curriculum In the Independent Curriculum for junior high school level, the surface area of a cylinder is studied through an understanding of the elements of solid geometry and their relationship to concrete objects. The formula used is:$L=2\pi r(t+r)L = 2\pi r(t + r)L=2πr(t+r)$ *with* rrr as the radius and ttt as the height of the cylinder. A real-world, object-based approach like Keteng-Keteng can facilitate this understanding. Contextual Learning Johnson (2002) states that contextual learning helps students understand subject matter through their real-world experiences. When mathematics is presented by relating it to local culture, students more easily construct meaning from the concepts they learn.

3. RESEARCH METHOD

This research uses a **descriptive qualitative** approach with an ethnomathematics framework. The aim is to describe how Keteng-Keteng is used in the learning of the surface area of cylinders at SMPS Deli Murni Bandar Baru as **Research Location and Subjects.** The research was conducted in **Deli Murni Junior High School, Bandar Baru**, Sibolangit District, Deli Serdang Regency. The subjects consisted of: 1 mathematics teacher, 25 eighth grade students, and 1 Karo cultural figure as a local informant. **Data Collection Techniques, Direct Observation** to the shape of Keteng-Keteng. **Interview** with teachers and cultural figures. **Documentation** during the learning process, data were analyzed using

the Miles and Huberman model, namely: data reduction, data presentation, and drawing conclusions.

4. RESULTS AND DISCUSSION

This research was conducted at SMPS Deli Murni Bandar Baru with the aim of exploring the use of the traditional musical instrument Keteng-Keteng in teaching the concept of the surface area of a cylinder. Data collection was carried out through observation, direct measurement practices, and interviews with teachers and cultural figures. The research results are divided into two main focuses: the geometric characteristics of Keteng-Keteng as a learning medium, and stakeholders' responses to the implementation of this approach.

Geometric Characteristics of Keteng-Keteng

Keteng-Keteng is a traditional Karo musical instrument whose physical form resembles a cylindrical tube. In this study, Keteng-Keteng was used directly as a concrete object to help students recognize the geometric elements of a cylinder. Based on classroom observations: The Keteng-Keteng used have smooth and symmetrical surfaces, with varying lengths and diameters, but still maintain the basic cylindrical shape. Important elements of a cylindrical geometric shape such as the base (bottom circle), lid (top circle), height of the cylinder, and side cover/tube can be directly identified by students. Some Keteng-Keteng have distinctive decorations on their surfaces, but they do not interfere with the basic geometric shape. In fact, these motifs enrich class discussions by opening up interdisciplinary spaces between art, culture, and mathematics. Through direct interaction with this musical instrument, students can connect abstract concepts with real objects, so they can more easily understand the position and function of each part of the cylindrical geometric shape. This visual and tactile understanding provides concrete reinforcement of concepts that they have only seen in pictures or formulas.

Responses from Teachers, Students, and Traditional Leaders

The implementation of this culture-based learning received positive responses from various parties involved in the learning process. Student Response. Based on the results of the survey and learning reflection: As many as 92% of students stated that the use of Keteng-Keteng made it easier for them to understand the concept of the surface area of a cylinder. This is because students can see, touch, and even directly measure objects that are used as examples of geometric shapes. 88% of students successfully calculated the surface area of the cylinder correctly, using the data from their measurements of Keteng-Keteng. They appeared more confident and active in solving problems compared to when using conventional approaches. In addition to conceptual understanding, students' motivation to learn mathematics also increased. They stated that learning felt interesting, fun, and not boring because it involved familiar local culture.

Teacher Responses. The math teachers involved reported that this approach brought positive changes to classroom dynamics. Some key notes from the teachers: Learning became more lively, participatory, and interactive. Students who were usually passive in math lessons began to show interest and courage in discussions. Teachers felt that this type of contextual learning aligns with the Independent Curriculum, which emphasizes the relevance and meaningfulness of learning for students.

Responses from Traditional Leaders. Interviews with local traditional leaders revealed support and appreciation for the use of traditional musical instruments as a learning medium. They stated that this approach: Helps preserve local cultural values among the younger generation. Increases students' awareness of the importance of their own culture as part of their identity and source of knowledge. Demonstrates that traditional culture has high educational value, not just a ceremonial symbol or artistic performance. Overall, the

results of this study confirm that Keteng-Keteng is not only a musical medium, but also an effective educational tool in helping students understand spatial geometry material, especially the surface area of a cylinder. The positive response from students, teachers, and the local community strengthens the belief that the ethnomathematics approach is worthy of being implemented and further developed in schools in culturally rich communities. The results indicate that the use of the traditional Keteng-Keteng musical instrument in learning the concept of the surface area of a cylinder has a significant positive impact on the student learning process and outcomes. Mathematics learning, which is generally considered difficult, abstract, and boring, can be transformed into a fun, meaningful, and engaging experience when presented through a contextual approach based on local culture.

Strengthening Conceptual Understanding through Real Objects

The direct use of Keteng-Keteng in the learning process provides concrete experiences for students to observe, touch, and measure directly objects that resemble cylindrical geometric shapes. This interaction is very important in building conceptual understanding, because students not only memorize the formula, but also understand the meaning of each component in the formula (base, lid, and cylinder cover) As explained by Bruner (1960) and Piaget (1972), learning will be more effective if it is adapted to the child's cognitive development stage, and children at the concrete operational stage will more easily understand mathematical concepts if they are given through real objects rather than symbols or numbers alone.

Increasing Student Interest and Engagement

This approach has also proven to be effective in arousing students' interest and curiosity, which is often a challenge in conventional mathematics learning. When students realized that the musical instruments they usually see or hear in traditional ceremonies could be used to learn mathematics, they became more enthusiastic and active in the learning process. Activities such as measuring the diameter, height, and surface area of Keteng-Keteng created an interactive and enjoyable learning atmosphere. This increased interest in learning is in line with the theory of learning motivation, which states that interest in learning materials will encourage students to be more diligent and active in participating in learning (Deci & Ryan, 1985). When interest and meaning meet in learning, the chances of learning success are higher.

Integrating Cultural Values in Learning

One of the main strengths of this approach is its ability to present a familiar cultural context to students. Keteng-Keteng is not just a learning tool, but also a representation of Karo cultural identity. By incorporating it into their learning, students not only learn mathematics but also indirectly appreciate and preserve local culture. This aligns with the Independent Curriculum, which upholds the spirit of providing education relevant to students' social, cultural, and geographic environments. Cultural integration in learning also reflects the values of the Pancasila Student Profile, particularly those concerning "global diversity" and "faith, devotion to God Almighty, and noble character."

Theoretical Foundation: Constructivism in Contextual Learning

The findings of this study are supported by constructivism theory, developed by figures such as Jean Piaget and Lev Vygotsky. In this theory, learning is considered effective when students construct their own knowledge through active, interactive, and meaningful learning experiences. Keteng-Keteng, in this case, functions as a manipulative tool that supports students' construction of meaning. Piaget emphasized the importance of concrete experiences in children's cognitive development, while Vygotsky emphasized the importance of social and cultural interaction in the learning process. Therefore, learning with Keteng-Keteng not only supports students' individual understanding but also encourages collaboration, discussion, and the exchange of meaning within the classroom.

Implementation Challenges and Practical Implications

Despite the positive results, implementing this approach still presents challenges that need to be considered. Teacher readiness is a key aspect. Teachers need creativity, an understanding of local culture, and the ability to design ethnomathematics-based learning. Without sufficient understanding, this approach can become merely symbolic without deeper meaning. The availability of cultural learning resources is also a crucial factor. Not all schools have access to traditional musical instruments like the Keteng-Keteng, so collaboration with cultural communities or external parties is necessary to provide them. Support from institutions such as school principals, education offices, and the surrounding community is essential to ensure this approach is not just a one-off experiment, but part of a sustainable culture-based education movement.

An ethnomathematics-based approach using Keteng-Keteng has proven to have high pedagogical and cultural value. It bridges the gap between mathematics as an exact science and culture as an expression of local identity. If implemented consistently and supported by an education system open to local diversity, this approach has the potential to create holistic, contextual learning that is deeply rooted in students' real lives.

5. CONCLUSION

Based on the results of research conducted at SMPS Deli Murni Bandar Baru, it can be concluded that the use of the traditional musical instrument Keteng-Keteng as a learning medium for the surface area of a cylinder has been proven to have a significant positive impact on improving students' understanding of mathematical concepts, especially in the realm of geometric solids. Keteng-Keteng, which is physically shaped like a cylinder, functions as a concrete medium that bridges the abstract concept of the surface area of a cylinder with real reality that can be observed, touched, and measured by students. This approach not only activates students' conceptual and procedural understanding of the surface area formula of a cylinder, but also provides a more meaningful and grounded learning experience. The success of this approach is supported by the theory of constructivism, which emphasizes that students build their knowledge through direct experience and interaction with their environment. In this case, Keteng-Keteng becomes a medium that allows students to *experiencing mathematics*, not just *memorize it.* The results of the study indicate that the majority of students became more active, engaged, and able to connect the lesson to their own cultural context. Furthermore, the integration of local culture into mathematics learning not only impacts cognitive aspects but also strengthens students' identity and cultural values. Students learn to appreciate their own cultural heritage, seeing it as a legitimate, relevant, and valuable learning resource. Thus, this approach simultaneously supports the achievement of the Pancasila Student Profile, especially in the dimensions of "global diversity" and "local wisdom." From a pedagogical and cultural perspective, this ethnomathematics-based approach is an innovative solution in creating interdisciplinary, contextual, and character-based mathematics learning. In addition to improving academic achievement, this approach also supports the development of education that respects cultural diversity, as emphasized in the policy direction of the Independent Curriculum. Therefore, the use of Keteng-Keteng or other local cultural objects is highly recommended for widespread implementation in schools located in areas with abundant cultural richness. Developing culture-based learning not only enriches teachers' teaching methods, but also elevates local wisdom as a strong foundation in creating authentic, meaningful, and sustainable learning.

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