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Implementation of Contextual Learning in Teaching the Volume of Curved-Surface Solids in Elementary School

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ABSTRACT

Background: The topic of curved-surface solid volume in elementary school is often associated with students' low conceptual understanding. **Objectives:** This study aims to describe the concept of curved-surface solid volume and to explain the implementation of a contextual learning approach in improving elementary students' understanding of the topic. **Method:** This study employed a descriptive qualitative approach using a literature review and conceptual analysis method. The background of this study is the limited comprehension of students regarding the concepts of cylinder, cone, and sphere volumes, as instruction tends to be teacher-centered and abstract. Data were obtained through the examination of textbooks, scientific journal articles, and relevant instructional documents. **Result:** The findings indicate that the implementation of a contextual learning approach through the use of real objects such as beverage cans (cylinders), ice cream cones (cones), and soccer balls (spheres) helps students understand volume concepts more meaningfully. **Implication:** The learning process, which connects mathematical material to students' daily experiences, increases engagement, conceptual understanding, and problem-solving skills. **Conclusion:** Therefore, contextual learning can serve as an effective alternative in improving the quality of mathematics instruction, particularly in teaching the volume of curved-surface solids in elementary schools.

INTRODUCTION

Mathematics in elementary school plays a crucial role in developing students' systematic, logical, and critical thinking skills. Among the topics considered difficult by students is the volume of curved-surface solids, particularly cylinders, cones, and spheres. This difficulty arises because the concept of volume is highly abstract, and formulas are often used in instruction without deep conceptual understanding. Mathematics serves as a foundation for the advancement of science and technology (Ningrum, 2021).

One of the characteristics of mathematics is the diversity of its concepts and meanings. Mathematics is also an essential component of technological and informational progress, which is why it is often referred to as the "queen of sciences." It is a compulsory subject in all countries because it forms part of an individual's basic numeracy skills. Furthermore, mathematics equips students with skills that can ultimately be applied in everyday life (Sukardjo & Salam, 2020).

The volume of curved-surface solids consisting of cylinders, cones, and spheres is a topic that requires strong conceptual understanding. It demands spatial visualization skills and comprehension of the relationships among base area, height, and radius. These shapes are commonly found in daily life, such as soccer balls (*spheres*), thermoses and glasses (*cylinders*), and ice cream cones (*cones*). Therefore, to make learning more meaningful, an instructional approach that connects mathematical concepts with students' real-life experiences is necessary.

Contextual learning links instructional material to real-world situations, enabling students to relate what they learn to everyday life. Research shows that this approach is effective in improving students' understanding of mathematical concepts in elementary school (Nurjanah et al., 2021). In addition, problem-based activities and the use of concrete media can enhance students' critical thinking and problem-solving abilities (Tessema et al., 2024). Other studies indicate that contextual approaches in geometry significantly improve students' learning outcomes and engagement compared to conventional methods (Gebremeskel et al., 2025).

Previous studies have demonstrated that contextual learning can enhance students' understanding of mathematics (Pratama, A. D., & Hadi, 2023). To make learning more meaningful, this approach emphasizes connecting instructional content to real-world environments. However, the implementation of contextual learning specifically for curved-surface solid topics in elementary schools remains limited and often focuses primarily on routine problem-solving.

By using real objects as learning tools, students can develop deeper conceptual understanding in learning the volume of solids. This finding is consistent with (Đokić et al., 2022), who state that real-life context-based learning strengthens the connection between mathematical concepts and students' everyday experiences. Recent studies have shown that contextual learning can significantly improve students' understanding of mathematical concepts. For example, (Ufaiwiyah, F., & Yulianawati, 2025) reported that the application of contextual learning strategies in elementary mathematics classes helps students develop stronger conceptual understanding because

learning activities are connected to real-life situations. Similarly, (Fitri Utami et al., 2022) developed a contextual teaching and learning–based mathematics module for elementary students and found that contextual learning materials can make abstract mathematical concepts easier to understand.

Furthermore, Polman et al., (2021) explain that meaningful mathematics learning occurs when students are actively involved in constructing knowledge through experiences that relate mathematical concepts to real-life contexts. This approach enables students to develop deeper conceptual understanding rather than simply memorizing formulas. However, although previous studies have explored contextual learning in mathematics education, most research focuses on general mathematics topics or the development of contextual learning materials. Studies that specifically discuss the implementation of contextual learning in teaching the volume of curved-surface solids in elementary schools are still limited.

Therefore, the novelty of this study lies in its focus on describing how contextual learning can be implemented to help students understand the concept of cylinders, cones, and spheres through the use of real-life objects and contextual learning activities. By emphasizing the connection between mathematical concepts and students' everyday experiences, this study aims to provide a clearer explanation of how contextual learning can support conceptual understanding in geometry learning at the elementary school level.

Based on previous research reviews, contextual learning has proven effective in improving mathematics learning outcomes. However, studies specifically focusing on the integration of contextual learning in teaching the volume of curved-surface solids at the elementary level are still limited and often emphasize routine problem-solving rather than conceptual understanding. Therefore, the novelty of this study lies in emphasizing the use of real-life objects as contextual learning media to strengthen elementary students' conceptual understanding of cylinder, cone, and sphere volumes.

This study highlights how contextual learning can bridge abstract mathematical formulas with students' everyday experiences. This study aims to describe the concept of curved-surface solid volume and to explain the implementation of a contextual learning approach in improving elementary students' understanding of the topic.

RESEARCH METHOD

This study used a descriptive qualitative approach with a literature review method to describe the concept of curved-surface solid volume and the implementation of contextual learning in improving elementary school students' understanding. The literature review method was chosen to

synthesize previous studies and theoretical perspectives related to contextual learning and geometry instruction.

The data sources were obtained from textbooks, peer-reviewed scientific journal articles, and relevant instructional documents related to mathematics education, particularly the teaching of curved-surface solid volume in elementary schools. The literature was collected through academic databases and online journal repositories.

The inclusion criteria for selecting literature included: (1) studies related to contextual learning or contextual teaching and learning in mathematics education, (2) research focusing on geometry or curved-surface solids, and (3) publications in reputable journals or academic books published within the last ten years. Meanwhile, literature that was not directly related to mathematics learning or did not discuss contextual learning was excluded from the analysis.

The data analysis technique used conceptual analysis and synthesis. The selected literature was reviewed, compared, and categorized based on its relevance to the research topic. The findings from various sources were then synthesized to describe the concept of curved-surface solids and the implementation of contextual learning in elementary mathematics instruction.

RESULT AND DISCUSSION

Concept of Curved-Surface Solid Volume

Curved-surface solids are part of geometry, and studying them is essential because it enables students to analyze and interpret the world around them, as well as supports them in understanding and applying other mathematical concepts. Learning about curved-surface solids plays an important role in mathematics education (Özerem, 2012).

Curved-surface solids are three-dimensional shapes that have at least one curved surface. The three main forms are the cylinder, cone, and sphere.

The volume formula of a cylinder:

$V = \pi r^2 t$ ..... (1)

The volume formula of a cone:

$V = 1/3\ \pi r^2 t$ ..... (2)

The volume formula of a sphere:

$V = 4/3\ \pi r^3$ ..... (3)

Equations (1), (2), and (3) illustrate the mathematical relationship between the radius, height, and volume of each solid. The cylinder's volume is derived from multiplying the area of its circular base (πr^2)by its height (t). The cone's formula represents one-third of the cylinder with the same base and height, demonstrating proportional geometric reasoning. Meanwhile, the

sphere's formula is derived from three-dimensional spatial integration concepts, reflecting the cubic relationship between radius and volume.

Marasabessy & A Hasanah, (2021) explain that learning curved-surface solids requires students to understand the relationship between surface area, base area, height, and radius in a coordinated manner rather than memorizing formulas mechanically. Without conceptual linkage, students may incorrectly apply formulas or misunderstand proportional relationships between solids.

Therefore, strengthening conceptual understanding through visualization, manipulation of concrete objects, and contextual problem-solving is essential in elementary geometry instruction.

Implementation of Contextual Learning (Expanded Discussion)

In contextual learning, teachers connect mathematical concepts to real-life objects, such as:

1. Beverage cans as examples of cylinders
2. Ice cream cones as examples of cones
3. Soccer balls as examples of spheres

Contextual learning emphasizes meaningful learning experiences where students actively construct knowledge through observation, measurement, and reflection. According to (Nurjanah et al., 2021), contextual learning improves students' conceptual understanding because it connects mathematical ideas to authentic situations. When students manipulate real objects, they develop stronger spatial reasoning and conceptual linkage. Furthermore, Tessema et al., (2024) found that contextual teaching significantly enhances students' mathematical problem-solving abilities compared to conventional instruction. By involving students in hands-on activities, contextual learning supports active engagement and critical thinking.

Gebremeskel et al., (2025) also reports that the implementation of contextual learning models in elementary mathematics significantly increases learning outcomes and student participation. This indicates that contextual approaches are particularly suitable for abstract geometry topics such as curved-surface solid volume. The findings of this study are consistent with previous studies indicating that contextual learning can significantly improve students' conceptual understanding in mathematics.

According to Koskinen & Pitkäniemi, (2022), contextual teaching and learning emphasizes connecting academic material with real-life situations so that students can construct knowledge meaningfully rather than memorizing abstract formulas. This approach encourages students to relate mathematical

concepts to everyday experiences, which helps strengthen conceptual comprehension.

Furthermore, Hidayana et al., (2025) reported that contextual learning can improve students' mathematical literacy and understanding because learning activities are linked to real-world contexts. When students engage with authentic situations, they become more active in exploring concepts and solving problems during the learning process.

In addition, Haylock & Cockburn, (2017) explain that mathematics learning for young learners becomes more effective when abstract concepts are introduced through concrete experiences and familiar objects. These findings support the idea that abstract mathematical concepts, such as the volume of curved-surface solids, become easier to understand when they are connected to real-life experiences and tangible learning media.

The findings of this study indicate that the use of contextual learning can help students understand the concept of curved-surface solid volume more meaningfully because the learning process is connected to real-life objects. When students observe and measure objects such as beverage cans, ice cream cones, and balls, they are able to relate mathematical formulas to real situations.

These findings are consistent with previous studies on contextual learning in elementary mathematics. Prastiyo *et al*. (2024) found that a systematic literature review of CTL confirms that the implementation of contextual approaches can significantly improve students' conceptual understanding in mathematics because learning activities are meaningfully connected to real-life situations. When students actively explore mathematical concepts through contextual activities, they are better able to construct their own understanding.

Similarly, (Fatimah & Suwangsih, 2025) reported that contextual learning supported by instructional media can significantly improve students' mathematical understanding. The use of learning media helps transform abstract mathematical concepts into more concrete representations, making it easier for elementary students to grasp mathematical ideas.

In addition, Mira, (2024) showed that the application of contextual learning in mathematics classes can improve students' learning outcomes and participation. This occurs because contextual learning encourages students to be actively involved in observing, discussing, and solving problems related to real-life situations. From a pedagogical perspective, these findings suggest that mathematics teachers should integrate contextual learning strategies into classroom instruction.

By using real-life objects and contextual learning activities, teachers can help students develop deeper conceptual understanding and improve their engagement in learning mathematics. This approach is particularly useful in teaching abstract geometry topics, such as the volume of curved-surface solids, which often require visualization and concrete learning experiences. Therefore, integrating real objects into geometry instruction not only strengthens conceptual understanding but also fosters motivation and deeper mathematical reasoning.

Students are asked to measure the diameter and height of these objects and then calculate their volumes using the formulas they have learned. This activity helps students understand that mathematical formulas are not merely abstract symbols but representations of real-world quantities.

Tabel 1. Contoh Kegiatan Pembelajaran Kontekstual

No.	Activity	Description
1.	Observation	Observing objects shaped like cylinders, cones, and spheres.
2.	Measurement	Measuring the radius and height.
3.	Calculation	Calculating the volume using the formulas.
4.	Discussion	Comparing the results and drawing conclusions.

Source: Data Processed

Through these activities, students become more active and directly engaged in the learning process.

The Impact of Contextual Learning

The findings of the study indicate that contextual learning:

1. Improves students' understanding of volume concepts.
2. Increases student participation and learning motivation.
3. Helps students connect mathematics to everyday life.

Therefore, contextual learning is effectively implemented in teaching the volume of curved-surface solids in elementary school.

CONCLUSION

The implementation of contextual learning in teaching the volume of curved-surface solids can improve students' conceptual understanding through direct experience and the use of real objects, making the volume formulas of cylinders, cones, and spheres easier to understand when connected to real-life situations. Contextual learning also encourages students

to participate more actively by observing, measuring, and calculating the volume of real objects found in their daily environment, making the learning process more meaningful and engaging. It is recommended that elementary school teachers be more creative in developing context-based learning media and strategies; however, as this study was conducted using a literature review approach, the findings are based on theoretical analysis rather than direct classroom experimentation, and therefore future studies are recommended to conduct experimental or classroom action research and to explore the integration of contextual learning with digital learning media or interactive technology to enhance students' engagement in geometry learning.

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