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ANALYSIS OF LEARNING DIFFICULTIES IN MATHEMATICS REGARDING 3D GEOMETRIC SHAPES MATERIALS AT SDN 2 WERU

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ABSTRACT

This research aims to determine the difficulties of learning cubes and rectangular prisms experienced by 5th grade students. The research method used was quantitative descriptive methods with a sample of 18 students and the 5th grade teachers at SD Negeri 2 Weru. Data collection techniques were carried out by observation and interviews. The results of the research show that: a) Students' ability to draw cubes and rectangular prisms is in the high category with a percentage of 83.33%. This can be seen in the suitability of student work results with the instructions given; b) Students' ability to identify geometric elements in images is in the very low category, with a percentage of 33.33%; c) Students' ability to determine the volume and surface area of a cube is in the moderate category with a percentage of 61.11%; d) Students' ability to determine the volume and surface area of a rectangular prism is in the low category with a percentage of 55.55%; and e) Students' ability to determine the volume and surface area of a rectangular prism based on the image presented is in the very low category with a percentage of 38.89%. Difficulties in learning mathematics faced by students include the inability to distinguish between cubes and rectangular prisms and their elements, difficulty while answering questions and applying formulas, the basics of multiplication are not yet strong, and lack of motivation to learn.

Keywords: Geometric Shapes, Learning Difficulties, Comprehension Ability

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PRELIMINARY

Mathematics has an important role in terms of scientific value, both arithmetic and the application of exact sciences in solving problems in everyday life. Apart from that, the application of mathematical disciplines is also used in various existing subject studies. This is based on the obligation to teach mathematics from elementary school to university level (Fauzy & Nurfauziah, 2021). Even at the kindergarten level, the introduction of mathematical calculations begins to be taught in the form of simple, informal learning (Fauziddin & Mufarizuddin, 2018). Through mathematical calculations, students are expected to be able to improve their ability to express opinions, think logically, careful,

imaginative, hard-working, and supportive toward the development of technology and science. Therefore, it is very important for every student to master basic concepts in mathematics, especially at the elementary school stage (Heryanto et al., 2022).

The success of mathematics education can be measured through students' ability to complete tasks given by the teacher correctly, as well as the extent to which students' answers match the indicators that have been set (Utari et al., 2019). Implementation of the goals of mathematics education is also reflected in daily activities, where mathematics becomes an important element in students' lives (Milkhaturohman et al., 2022). Efforts that can be made by teachers to improve students' thinking abilities are by fostering students' interest in understanding mathematics and making the mathematics learning process a fun activity so that students do not feel bored quickly and experience difficulties in solving mathematical problems. Therefore, to facilitate students' understanding, mathematics learning needs to use specific examples so the students are able to develop and practice their knowledge independently (Silviani et al., 2017).

Mathematics learning activities are often hampered due to students' different abilities (Lilianti et al., 2019). According to Soekarno, the characteristics of students who experience learning difficulties can be seen from: 1) Lack of concentration; 2) Inability to develop and direct learning strategies, organize learning, non-passive learning framework and meta-cognitive functions; 3) Weak motor coordination between fine and brute movements; 4) Perception problems, including: differences in stimulus, frequency, vision and hearing; 5) Lack of skills in language, writing and reading; 6) Difficulty in mathematics, including: deductive and inductive reasoning, counting, time, space, and fact finding; and 7) Social behavior (Asriyanti & Purwati, 2020).

Learning difficulties are a condition that hinders learning activities, especially in mathematics subjects, so that students cannot learn as they should. There are several factors that cause students' difficulties in learning mathematics, namely: 1) Differences in comprehending levels between students, where only some students can easily accept and understand the teacher's explanation about cubes and rectangular prisms, while others experience difficulties; 2) There are differences in the level of student persistence in learning, where only a small number of students are serious and active in studying, while there are also students who tend to be lazy; 3) Lack of attention from parents towards learning difficulties and academic development in their children; 4) Students' difficulties in understanding the material and solving problems related to volume and surface area in geometric shapes; 5) Students' difficulty in distinguishing room diagonals and side

diagonals; 6) Lack of student motivation to learn. All of these problems contribute to low student learning outcomes in mathematics (Hasibuan, 2018).

It is often found that the cause of students' learning difficulties in answering mathematics questions is because the majority of them have problems mastering the material, especially in understanding the material being taught and how to apply formulas to solve the problems (Julya & Nur, 2022). Difficulties in the learning process can also be caused by various factors, namely internal factors related to student characteristics and external factors related to the environment around students (Anditiasari, 2020). Internal factors include students' physical and psychological aspects, such as a lack of enthusiasm in learning mathematics, limited sensory abilities, lack of motivation, and low interest in learning. Meanwhile, external factors involve the social and non-social environment, such as teachers' less varied teaching approaches, lack of support from family, limited availability of media and learning materials, an environment full of distractions, and low levels of education in the surrounding community. Therefore, educators need to realize that each child has unique and different interests, and not all of them will have the same interest in mathematics (Ayu et al., 2021).

Many students at elementary school level consider mathematics to be a boring subject (S. Arifin & Victorina Tobondo, 2021). As a result of this paradigm, many students do not like mathematics which often lead to them having more difficulty understanding the material, furthermore and worse, it leads to poor mathematics learning outcomes. Sieber noted that anxiety can be a factor inhibiting learning performance and disrupting children's cognitive functions, including concentration, concept formation and problem solving (Setiawan et al., 2021).

Currently, material regarding cubes and rectangular prisms is taught in the even semester of grade 5th of elementary school. The results of initial observations showed that the obstacles faced by students include: difficulty distinguishing images of cubes and rectangular prisms, difficulty determining the elements, and difficulty calculating the volume and surface area of cubes and rectangular prisms, both in the form of questions and pictures. Apart from that, the results of interviews with class teachers revealed that mathematics is a subject that is quite difficult for the majority of students to understand. Students often have difficulty understanding and applying formulas, performing multiplication, distinguishing between cubes and rectangular prisms, and recognizing the parts of cubes and rectangular prisms. As a result, teachers often provide more explanations regarding the material and give more questions so that students can understand them easier. However, many students tend to be

passive during the learning and do not listen to the explanations given by the teacher resulting in low learning outcomes.

Based on those problems, researchers would like to find out deeper about students' learning difficulties and the factors that cause them in learning mathematics, especially material regarding cubes and rectangular prisms. It is hoped that this research can provide better insight into the problems and are able to improve mathematics learning achievement in the future.

METHODS

The method used in this research was a qualitative method which was carried out intensively. Recording and making detailed reports found in the field was done thoroughly. According to Sugiono (in Riwayatiningsih & Sulistyani, 2020) states that qualitative research is used to analyze an event, social activity, action, belief, and idea of a person that often occurs in the field by considering all the issues of the topic being studied. In this research, researchers used simple random sampling to involve subjects. Researchers also conducted interviews with class teachers and carried out observations and documentation to analyze the difficulties faced by 5th grade students at SD Negeri 2 Weru when studying the material of cubes and rectangular prisms in mathematics.

The instruments used in the research included observation sheets, interview guides and documentation processes. Researchers conducted interviews with class teachers to collect information regarding the root problems that underlie students' learning difficulties in cube and rectangular prism material. In addition, the researcher also made observations by giving 5 description questions to evaluate the level of students' understanding of the cube and rectangular prism. Students who are able to answer correctly indicate that the students have a high understanding of the material. These questions are aimed to determine that the students have met the achievement indicators (Putra et al., 2018), namely: a) describing cubes and rectangular prisms according to the specified size; b) identifying geometric elements in the images presented; c) determining the volume and surface area of a cube; d) determining a volume and surface area of a rectangular prism; and e) determining the volume and surface area of the rectangular prism in the image presented.

Data analysis was carried out by describing the results of observations and interviews, starting from the planning, implementation and report preparation stages (Dristian et al., 2023). The planning stage includes the process of preparing an instrument for testing the ability to understand mathematics regarding cubes and rectangular prisms,

validating the instrument by involving 2 experts in the field, as well as preparing an interview guide sheet and analyzing solutions with the relevant teachers. After the instrument is declared very valid by the two validators, the implementation stage is then carried out. The researcher carried out observations by giving a test of mathematical understanding of the material on cubes and rectangular prisms, then continued with interviews with the relevant teachers to explore students' learning difficulties in this material, as well as carrying out further analysis of other factors. The final stage is preparing a report by categorizing and reviewing research data. The results of data analysis follow the guidelines for the percentage of learning difficulties criteria below:

Table 1. The Criteria of Learning Difficulties

No.	Category	Score (%)
1.	Very high	100 – 85
2.	High	84 – 75
3.	Moderate	74 – 65
4.	Low	64 – 55
5.	Very low	≤ 54

(Badraeni et al., 2020)

RESULT AND DISCUSSION

Based on observations made, it is known that many students do not understand how to precisely solve the problems. They also have yet to comprehend step by step on how to answer the questions such as distinguishing between cubes, rectangular prisms and their elements as well as applying the correct formulas in calculations. This finding is strengthened by the results of interviews with class teachers, where they explained that the main causes of students experiencing learning difficulties are: a) not being able to differentiate between cubes and rectangular prisms and their elements, b) difficulty solving questions related to volume and surface area in geometric shapes, c) confusing themselves with the formulas, where mistakes were often occurred between using the formula for a volume to measure the surface area and vice versa, and d) the basics of multiplication have not been mastered well in previous classes, resulting in a decrease in children's motivation to learn.

To obtain more in-depth observation results, the researcher carried out a deeper

investigation by giving students a comprehension ability test in the form of a five-question description regarding the cube and rectangular prism geometric material presented in the table below:

Table 2. Results of the Mathematics Ability Test in 5th Grade

No.	Student's Name	Questions				
		I	II	III	IV	V
1.	Ksn	✓	-	✓	-	-
2.	Kdq	✓	-	-	✓	-
3.	Blg	✓	-	✓	✓	✓
4.	Krn	-	-	✓	✓	✓
5.	Frln	✓	✓	✓	✓	✓
6.	Fda	✓	✓	-	-	-
7.	Hfz	✓	✓	-	-	✓
8.	Ksw	✓	-	-	-	-
9.	Ang. A	✓	-	✓	✓	-
10.	Adl	-	-	✓	✓	-
11.	Ang. B	✓	-	-	-	-
12.	Rhm	✓	-	✓	-	✓
13.	Wwn	✓	✓	✓	✓	-
14.	Dwa	✓	✓	✓	✓	✓
15.	Arn	✓	-	✓	-	-
16.	Rsa	✓	✓	-	✓	-
17.	Frd	✓	-	-	✓	✓
18.	Alb	-	-	✓	-	-
Capable (percentage)		83,33%	33,33%	61,11%	55,55%	38,89%
Unable (percentage)		16,67%	66,67%	38,89%	44,45%	61,11%

Notes:

✓ : Able to answer the question

- : Unable to answer the question

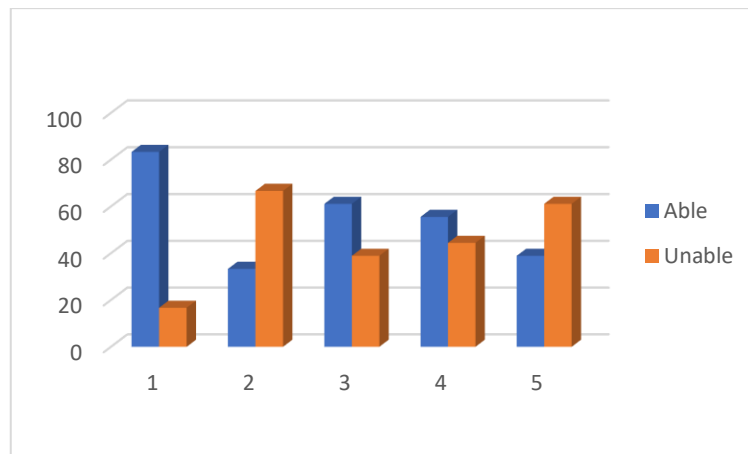


Figure 1. Mathematics Ability Test Results

Based on table 2 and figure 1, as many as 83.33% of 5th grade students are able to describe cubes and rectangular prisms with predetermined sizes so that it can be stated that the first indicator is included in the satisfactory category, and only 16.67% of students are unable to do the first question. The second indicator is categorized in the very unsatisfactory category because only 33.33% of students were able to identify the geometric elements in the cube image and 66.67% of students were unable to answer the second question. In the third indicator, 61.11% of students were able to determine the volume and surface area of a cube so that they were included in the quite satisfactory category and 38.89% of students were unable to answer the third question. The fourth indicator is included in the unsatisfactory category with 55.55% of students able to determine the volume and surface area of a rectangular prism, whereas 44.45% of students were unable to answer the fourth question. For the fifth indicator, only 38.89% of students were able to determine a volume and surface area in a rectangular prism image so they were included in the very low category, while 61.11% of other students were unable to do the fifth question.

From the explanation above, it can be seen that the biggest difficulty experienced by students in studying cubes and rectangular prisms is the activity of identifying geometric elements, as well as determining the volume and surface area of the rectangular prisms on the images presented. This is reinforced by the results of interviews with students, in which students admitted that they were unable to determine and identify geometric elements such as corners, sides, space diagonals and side diagonals as well as length, width and height in rectangular prism images. Moreover, students often experience difficulty in applying formulas and the basic effects of multiplication are not yet strong.

Difficulty distinguishing between cubes and rectangular prisms and their elements

Based on the results of the analysis, it is known that students have difficulty distinguishing between cubes and rectangular prisms. This can be seen when students do the task of drawing a cube with instructions that the length of each side is 3 cm and drawing a rectangular prism with 3 cm long, 2 cm wide and 3 cm high using a ruler. The drawing results for each student are different.

Answer the question below!
 Draw a picture of the following space!
 a. Cube (Side length = 3 cm)
 b. Cuboid (Length = 3 cm, width = 2 cm, and height = 3 cm)

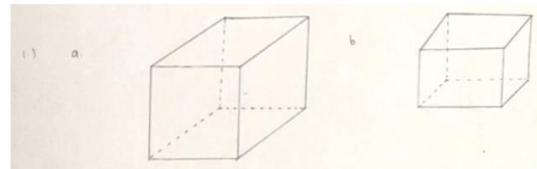


Figure 2. Student X's result on the first question

Judging from Figure 2, students are able to draw a cube and a rectangular prism. However, when he was asked to point the different between the two images, he had difficulty distinguishing between which one is a cube and a rectangular prism. It happened because there are similarities between the two images, where the cube shape looks like a rectangular prism shape and the rectangular prism shape looks like a cube shape. When a cross-check was carried out using a ruler, the student's drawing already used the geometric dimensions according to the instructions in the question.

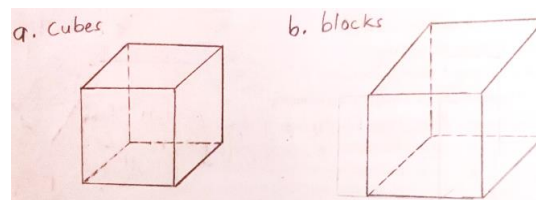
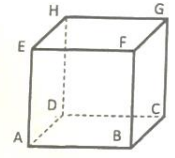


Figure 3. Student Y's result on the first question

Based on Figure 3, it is known that students are able to describe cubes and rectangular prisms, and are able to differentiate the names of the geometric shapes between the two. However, when being cross-checked using a ruler, the side length of the cube did not reach 3 cm, each side was 1 - 0.5 cm less. Meanwhile, on the right and left sides of the rectangular prism image, it exceeds the question instructions by around 1 - 0.5 cm. The reason for students to increase and decrease the length of the right and left sides of the resulting drawing is to make it look more similar to drawings of cubes and rectangular prisms in general. The majority of obstacles students' encountered are they are unable to determine the geometric elements in the images that have been presented. This is related to students' low spatial abilities, namely the students' ability to identify, match, imply, predict, construct and

determine information from visual stimuli (Satriani et al., 2023). Therefore, students who have spatial mathematics skills in the satisfactory category will find it easier to improve their abilities and the process of solving problems related to special material (Arifin et al., 2020) The low spatial abilities of students are also visible in Figure 4, where students are unable to determine geometric elements which include edges, sides, space diagonals and side diagonals in the images presented. This is due to the low spatial abilities of students so that students have difficulty determining the position of the elements in the spatial images that have been presented.

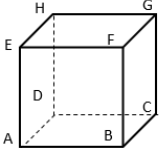
2. Sebutkan bagian-bagian pada bangun ruang disamping!



a. Rusuk = AB, CB, CD, AD, EF, HG, FG, GC, FB, DC = 10
 b. Sisi = 6 = ABCD, BCFG, EFGH, ADEH, DCHG
 c. Diagonal Ruang = ABCD, BCFG ada 6
 d. Diagonal Sisi = 6 ABCD, EFGH, ADEH, DCHG, BCFG

English version

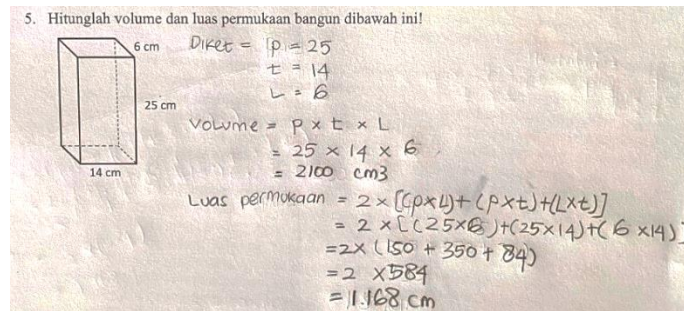
2. Name the parts of the cube on the side!



a. Edge = AB, CB, CD, AD, EF, HG, FG, GC, FB, DC = 10
 b. Side = 6 = ABCD, BCFG, EFGH, ADEH, DCHG
 c. Diagonal of space = ABCD, BCFG there are 6
 d. Diagonal of side = 6 ABCD, EFGH, ADEH, DCHG, BCFG

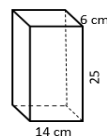
Figure 4. Student's result on the second question

Students' learning difficulties in geometric material (rectangular prism) can be seen from the students' inability to differentiate the length and height of the rectangular prism image. It can be seen from the work results in Figure 5 that students experience misconceptions regarding the "length" of geometric figures. The mindset that students have in identifying the elements is P = the longest line in the picture.



English version

3. Calculate the volume and surface area of the cuboid below!



Know = length = 25 cm
height = 14 cm
width = 6 cm

volume = Length x height x width
 $= 25 \times 14 \times 6$
 $= 2100 \text{ cm}^3$

Surface area = $2 \times [(length \times width) + (length \times height) + (width \times height)]$
 $= 2 \times [(25 \times 6) + (25 \times 14) + (6 \times 14)]$
 $= 2 \times (150 + 350 + 84)$
 $= 2 \times 584$
 $= 1.168$

Figure 5. Student's result on the fifth question

The lack of basics of multiplication mastery

The difficulties often faced by students are related to the concept of multiplication. Weak understanding of the basics of multiplication taught in previous years has an impact on mastering the geometry material. This failure is the root of the problem which makes it difficult for students to solve various questions (Nadhifa et al., 2019). In other words, students have difficulty solving volume and surface area calculation problems because their understanding of multiplication is not yet strong.

3. Hitunglah volume dan luas permukaan kubus jika diketahui panjang sisinya 12 cm!
 $V = s \times s \times s = 12 \times 12 \times 12 = 1728$
Luas permukaan = $6 \times s \times s = 6 \times 12 \times 12 = 362$

English version

3. Calculate a cube's volume and surface area if its side length is 12 cm!

Volume = side x side x side = $12 \times 12 \times 12 = 1728$

Surface area = $6 \times 12 \times 12 = 362$

Figure 6. Student's result on the second question

Figure 6 shows the difficulty experienced by students when working on the second problem, namely not being able to calculate multiplication correctly. At this stage there are several students who have succeeded in applying the formula correctly. However, inaccuracy

in calculating multiplication causes errors in the calculation results. Mathematics learning places more emphasis on understanding in-depth concepts rather than just memorizing. The concept of multiplication is actually a repeated addition operation that has been taught in previous classes. However, what they were dealing with were upper class students (5th graders), the teacher emphasized the importance of students memorizing multiplication by rote.

Difficulty in applying the formula

Students' difficulties in applying formulas are caused by low motivation to learn and a lack of in-depth understanding of formulas so that students quickly forget the material being taught (Fauzi & Arisetyawan, 2020) Students tend to memorize formulas without understanding the concept of formula formation, resulting in forgetting the formulas easier (Ikhsan, 2019). Based on the results of observations, it is known that the majority of students still have difficulty answering correctly questions related to the formula for calculating the surface area of cubes and rectangular prisms. Students also prefer to work on word problems where the length, width and height of the rectangular prisms are determined rather than picture problems which only display numbers without information on the length, width and height of the picture. Apart from that, when students have difficulty working on a problem, they should ask their teacher or classmates. But in reality, students tend not to do this.

4. Sebuah kardus berukuran Panjang 14 cm, lebar 9 cm dan tinggi 11 cm. Hitunglah volume dan luas permukaan kardus tersebut!
- $$V = p \times l \times t = 14 \times 9 \times 11 = 376 \text{ cm}$$
- $$\text{Luas permukaan} = 2 \times p \times l \times t = 2 \times 14 \times 9 \times 11 = 2776 \text{ cm}^2$$

English version

4. A cardboard box measures 14 cm long, 9 cm wide, and 11 cm high. Calculate the volume and surface of the cardboard!
- Volume = Length x width x height = $14 \times 9 \times 11 = 376 \text{ cm}$
- Surface area = $2 \times \text{length} \times \text{width} \times \text{height} = 2 \times 14 \times 9 \times 11 = 2776 \text{ cm}^2$

Figure 7. Student's result on the fourth question

Seen from Figure 7, students experienced difficulties when working on the fourth question because they were unable to apply the formula to calculate the surface area of a rectangular prism correctly. Students are only able to apply the volume formula, but do not understand how to calculate the surface area of a block. This difficulty occurs because students do not understand how to solve problems related to surface area correctly, and do not understand the steps for solving or applying formulas in calculations.

This research was only carried out on mathematical problems related to determining the area and volume of cubes and blocks, where the entire surface of the two geometric shapes is flat (not curved). The questions used for observation are limited to simple problems, where the cube and block elements have been previously determined.

CONCLUSION

Based on the results of observations and data analysis, it can be concluded that students experience difficulties when studying cubes and rectangular prisms. The test results showed that the majority of students had difficulty identifying geometric elements, as well as determining the volume and surface area of spatial figures, even though three-dimensional drawings had been provided. Difficulties that students often experience regarding cube and rectangular prism shapes include: 1) Difficulty in distinguishing cube and rectangular prism and their elements; 2) The lack of basic multiplication mastery from the previous class; and 3) Difficulty in applying the formula.

Researchers suggest that when providing material about cubes and blocks to elementary school students, they should be provided with teaching aids in the form of three-dimensional images and learning media that attract students' attention so that it is easier for them to identify the elements in geometric shapes and understand how to determine the volume formula and correct surface area. Using visual aids will help visualization for students who have low spatial abilities, thus helping students understand the concept of flat shapes. Suggestions for further research include mathematical problems on spatial shapes that involve curved sides and the use of question items where the elements in a spatial structure must be determined and discovered by students themselves before solving problems related to volume and surface area.

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