




Analysis of Learning Difficulties in Junior High School Students on Two-Dimensional Space

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Abstract

Purpose: This research aims to analyze the difficulties experienced by junior high school students with two-dimensional space concepts. **Methodology:** This quantitative research employs a descriptive approach. The subjects were 30 seventh-grade students at Pekanbaru Da'wah Middle School, Indonesia. The research object is the students' test results regarding the concept of two-dimensional space. Data collection involved asking students to complete essay test questions. **Findings:** The results show that 50% of students had difficulty with the indicator "Applying concepts to solve problems." For the indicator "Using appropriate formulas and completing calculations correctly and accurately," 43.3% of students (13 out of 30) struggled. Regarding the indicator "Relating problems to everyday life," 30% of students (9 out of 30) experienced difficulties. **Significance:** The next stage is grouping students' abilities according to the indicators. It can be concluded that seventh-grade students at SMPN 1 still experience difficulties with questions on two-dimensional space.

Keywords: learning difficulties, middle school, two-dimensional space.



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Introduction

Mathematics is a systematic form of thinking that enables humans to explore, describe, and understand patterns and relationships between various entities (Kartika et al., 2018). Mathematics provides the foundation for developing models, theories, and algorithms that help humans understand logical connections in various contexts, from natural sciences to social sciences. This knowledge focuses on understanding patterns, structures, space, and quantity using symbols, numbers, and formulas as tools to develop knowledge, solve problems, and create predictions.

In Addition, the objective of mathematics is to meet daily life needs (Eviliasani et al., 2018). The assumption that mathematics is confusing reflects the still-weak mathematical reasoning abilities of students. Therefore, the use of mathematical reasoning in learning mathematics needs to receive more attention (Astuti & Sariningsih, 2018). According to Timutius et al. (2018), students often lack the ability to identify problems and show thoroughness in performing calculations. This reflects the integral role of mathematics in the learning process at the junior high school level, where students need to not only understand basic concepts but also apply their knowledge in real-world contexts, such as explaining daily phenomena or deriving formulas for the area of rectangles.

Students often experience difficulty in communicating mathematics in the real world (Nurainah et al., 2018). Even the most proficient students in mathematics often struggle to effectively communicate their ideas or convey their thinking. If this issue persists, it may lead to students being unable to effectively communicate using mathematics (Nina & Endu, 2019).

Learning mathematics for junior high school students on the topic of two-dimensional space is designed to optimize a deep understanding of concepts without relying on specific sources. This process involves developing skills to understand problems, create mathematical models, solve problems, and interpret solutions (Rosmawati et al., 2018). Common errors made by students include carelessness in answering questions and writing the components of the questions. Students often make these errors due to a lack of thoroughness in answering questions and failing to review their answers (Sumiati & Agustini, 2020). According to Rahayu and Hakim (2021), verbal representation is a method used by students to solve problems using words, especially when presented with word problems. Waluyo and Nuraini (2021) emphasize the importance of understanding concepts in mathematics, particularly in the topic of two-dimensional shapes, and the difficulties faced by students. Therefore, it is necessary to assess the difficulties in learning mathematics, especially regarding the material on two-dimensional space.

Research results for middle school students in the area of two-dimensional space have revealed that, according to Aprilia and Setiawan (2021), students experience difficulties with questions requiring the application of area and perimeter concepts to solve problems. This is evidenced by the fact that 70% of students struggled with such questions, as reflected by their scores being below the minimum competency criteria (KKM). The factors contributing to these difficulties include a lack of thoroughness in reading, understanding, and answering the problems, as well as a lack of spatial ability to visualize two-dimensional shapes. Students are accustomed to solving routine questions that are typically used as examples.

International research results in mathematics and science, specifically the Program for International Student Assessment (PISA) in 2012, showed that Indonesia ranked 64th out of 65 countries. This indicates that students' self-confidence, particularly in their creative thinking abilities, is low. Therefore, this study provides an in-depth picture of the challenges faced by middle school students in understanding two-dimensional shapes and identifies several contributing factors to these difficulties. To enhance students' understanding and mathematical literacy, a more innovative and thorough learning approach is

necessary, along with active teacher involvement to address the identified obstacles.

Achieving strong results in mathematics, especially in mastering two-dimensional shapes, creates a solid foundation for students, making it easier for them to tackle more advanced mathematical concepts in higher education (Afifah et al., 2019). Students' abilities to solve various mathematical problems can be categorized as follows: those who can solve problems accurately and correctly, those who can follow the correct procedure but do not arrive at the right answer, and those who cannot solve the problems accurately or correctly. It is crucial for both teachers and students to understand students' critical thinking abilities in solving mathematical questions for an effective teaching and learning process. Therefore, it is necessary to assess these abilities.

Relevant research on the development of understanding in two-dimensional geometry provides an important foundation for students' mathematical comprehension. A strong grasp of this concept significantly contributes to their success in more complex mathematical material. The quality and quantity of teachers, particularly when teaching two-dimensional geometry, are expected to influence the academic performance of the students studied. Based on research results, students taught with a contextual approach performed better than those taught with conventional methods. A student's academic success is not solely determined by external factors; internal factors (both physiological and psychological) also play a crucial role (Firdaus et al., 2014). The conclusions of this relevant study are expected to provide an in-depth understanding of the dynamics of students' comprehension of two-dimensional geometry. This research aims to better understand the factors influencing students' understanding, thereby paving the way for improvements and the development of more effective teaching methods.

The purpose of this research is to deepen the understanding of middle school students regarding the material on two-dimensional geometry. An important aspect of this study is the development of learning strategies that are not only innovative but also capable of overcoming identified barriers. Difficulties experienced by students in solving problems are influenced by internal factors (motivation, intellectual ability, interests, talents) and external factors (family environment, teachers, friends, study tools) (Jayanti & Hidayat, 2020). The hope is that the findings of this study can positively contribute to the quality of students' understanding and inspire improvements in classroom learning approaches. Additionally, this research aims to contribute to the development of a more adaptive curriculum and teaching materials that meet the needs of students. The goal is to provide better support for enhancing students' mathematical skills, especially in the area of two-dimensional geometry. All these efforts are directed towards creating a positive impact on mathematics learning outcomes among junior high school students. By deeply exploring challenges and potential solutions, this research endeavors to provide insights that are not only comprehensive but also applicable in the field of education.

Method

This study is a quantitative-research with a descriptive approach. Quantitative research is well-suited for uncovering various phenomena emerging in this study. Information obtained is in the form of words, sentences, or visuals, which can provide a deeper understanding than mere numbers or frequencies (Hanan & Alim, 2023). By using a descriptive approach, the researcher aims to uncover and describe the mistakes made by students in solving questions on two-dimensional shapes through the analysis of documents, specifically focusing on mathematical ability tests related to two-dimensional shapes.

The participants of this study are 30 seventh-grade students at Da'wah Middle School in Pekanbaru, Indonesia. The instrument used in this study is a test on the concept of two-dimensional shapes.

Data collection is conducted by asking students to complete essay-type test questions, which are intended to measure the level of difficulty students experience with the material on two-dimensional shapes. Furthermore, interviews are conducted to gain more in-depth insights into the problems through open-ended questions in a face-to-face setting. These interviews are conducted after identifying the difficulties students encounter in the test. Additionally, the documentation in this study includes the evaluation results of students' performance on the essay tests (Apriani & Saputro, 2023).


In this research, the data analysis technique proposed by Miles & Huberman is used by researchers (Fitriyani et al., 2023). It consists of the following three stages: (1) Data Reduction: This stage involves transforming raw data collected in the field by selecting, simplifying, and grouping it. Researchers correct students' work and conduct interviews with several subjects; (2) Data Presentation: At this stage, the organized information allows for drawing conclusions and making decisions. The data, in the form of students' work results, are arranged according to the research objectives. The data is presented as the types of difficulties students encounter in solving problems related to two-dimensional shapes, along with their causes. Findings are then summarized to address the research questions, and (3) Data Verification: This is carried out during the analysis process to reach a final conclusion. By comparing data, researchers can identify the location and cause of errors or difficulties experienced by students (Sunahdi et al., 2022).

In creating the essay test questions, specific indicators are required to identify various difficulties students experience with the material on two-dimensional shapes. This study uses indicators of mathematical learning difficulties. Before formulating the indicators to be used, researchers referenced several experts on the subject. According to Cooney (Pramesti & Prasetya, 2021), there are three indicators of mathematical learning difficulties: (1) Calculation or algebraic operation errors, (2) Inability to determine relevant data, and (3) Inability to apply formulas. These indicators form the basis for developing questions that will be used to measure and analyze students' learning difficulties.

Furthermore, according to Sinaga et al. (2021), relevant research indicators include: (1) Weaknesses in mathematical calculations, (2) Difficulty in transferring knowledge, (3) Difficulty in language and reading, (4) Difficulty in visual perception, and (5) Difficulty recognizing and understanding symbols. In research conducted by Ubudiyah & Amelia (2021), the questions given as tests included the following indicators: (i) Understanding various mathematical concepts and procedures, (ii) Using mathematics in daily life, and (iii) Finding connections between various representations of mathematical concepts and procedures. From the expert opinions above, the authors formulated the indicators to be used to identify the learning difficulties experienced by students with the material on two-dimensional shapes:

Table 1. Indicators and questions

No.	Indicator	Question
1	Apply draft for finish problem	A plot of land is shaped like an isosceles trapezoid. The lengths of the parallel sides are 24 meters and 14 meters, with a distance of 12 meters between them. If a fence is to be made around the land, what is the total length of the fence?
2	Use appropriate formula	A rectangular field measures 120 meters by 80 meters. If Budi runs around the field for a total distance of 4 kilometers, how many laps does he complete?
3	Linking problem with	Mr. Badrul's garden is shaped like a right-angled trapezoid, with one

No.	Indicator	Question
	life daily	parallel side measuring 20 meters and the other 25 meters. The length of the perpendicular side is 12 meters. He plans to build a fence around the garden at a cost of Rp. 25,000 per meter. How much will it cost Mr. Badrul to build the fence completely?
4	Finish calculation with true and correct	Take note of the picture below:  <p>The shape consists of 3 squares that are congruent in shape and size. If the side length of each square is 4 cm, determine the total area and perimeter of the combined shape.</p>

Results and Discussion

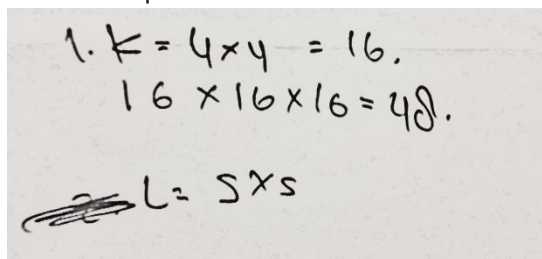
Analysis results descriptive from acquisition answer student based on 4 indicators difficulty Study mathematics that has been given that is:

Table 2. Description difficulty student

Indicator difficulty	Amount	Percentage
Apply draft for finish problem	15	50 %
Use appropriate formula	13	43.3%
Linking problem with life daily	9	30%
Finish calculation with true and correct	13	43.3%

Based on table 2 above on the indicators apply draft for finish the problem above can be concluded below, from 30 students There were 15 students who had difficulties finish question or 50% of student in the classroom No can finish question about application draft Of course his percentage this is the highest between indicator other difficulties. On indicators use according to the appropriate formula, there were 13 students who had difficulty finish question or equivalent with 43.3%. Same goes for indicators finish calculation with true and correct obtain the same percentage with 43.3% of students not can finish question with Good. However , on indicators Linking problem with life daily obtain the smallest percentage that only there are 9 students or 30% of student in a class that doesn't capable finish question Because experience difficulty as well as diverse obstacles. Based on research conducted, found proof congress the difficulties experienced student in do question given test.

1. Difficulty apply draft for finish problem



$$1. K = 4 \times 4 = 16.$$

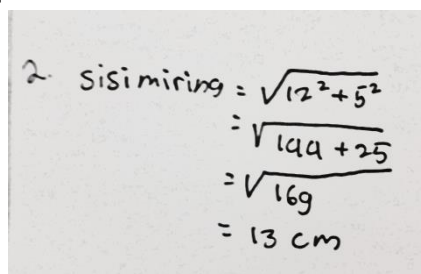
$$16 \times 16 \times 16 = 48.$$
~~$$L = 5 \times 5$$~~

Figure 1. Student answers are based on the first indicator

Based on results the answer above, yes seen that student Not yet can finish problem in a way whole. Student Not yet fully understand the questions given, so no can apply draft for finish problem until end. The problem that arises reason difficulty student in finish problem mathematics started from method read and understand question mathematics (Hasan, 2015). In other words, students Still Not yet understand question mathematics so that there is difficulty in finish problem given mathematics. Learning geometry must involve structure encompassing concept a number activities carried out by students in a way direct than only rely on knowledge transfer or lecture. With so, one student need exists understanding draft math and multiply exercise question mathematics so that student capable apply question mathematics in form sentence easy math understood as well as capable look for solution from problem.

Completion something problem or question mathematics No only just get the result which is answer on question mathematics. But more prioritize processes for solution from problem mathematics. Finish problem mathematics refers to an object no direct mathematics that has studied, namely : principles, facts, concepts, understanding, postulates, holding generalize, think deductive, thinking abstract, and so on (Hasan, 2015). With So, solution problem mathematics is important part in lesson mathematics. So that solution problem mathematics need steps or method certain for obtain correct and perfect results.

2. Difficulty use appropriate formula



$$2. \text{ SiSimiring} = \sqrt{12^2 + 5^2}$$

$$= \sqrt{144 + 25}$$

$$= \sqrt{169}$$

$$= 13 \text{ cm}$$

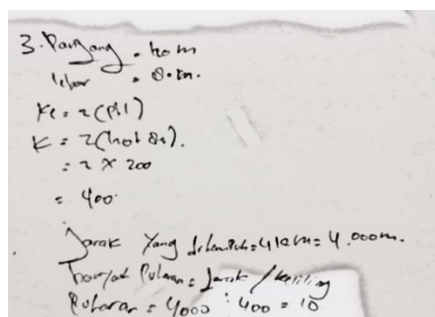
Figure 2. Student answers are based on the second indicator

On indicators use appropriate formula there is students who don't can do question with precise and correct. student the No understand the questions given, so student do the question given in a way random. This data state that difficulty experienced Because student forget with the formula should be used for finish problems faced. If it happens forget means student tend only memorize the formula explained by the teacher during the learning process. Student feel difficulty because not enough understand with Meaning questions and only depend on memorize formula but no can apply formula to in question. Lack of

variation exercise questions can also be done become reason difficulty in finish question because when student faced with different problems with usually, then possibility big difficulty that is not expected will appeared, p this is what happens to students in answer question less conducive class influence concentration participant educate in understand material so that when given question become Confused (Islami et al., 2019).

This usually the teacher makes it method unique learning with use tool as a helpful medium student for remember and memorize formula circumference and area get up flat. Apart from that, teachers are also ordinary use songs with lyrics replaced with formulas circumference and area get up flat. Because singing also becomes one learning medium alternative as implementation of the learning process in schools base. Then with exists innovative songs student capable remember formula the through draft fun song.

3. Linking problem with life daily



Handwritten student work showing calculations for the circumference of a circle. The text is as follows:

$$\begin{aligned} 3. \text{ Panjang} &= 10 \text{ m} \\ \text{lebar} &= 0.2 \text{ m} \\ K &= 2 \pi (r) \\ K &= 2 (3.14) \\ &= 2 \times 200 \\ &= 400 \\ \text{Jarak Yang ditempuh} &= 400 \text{ m} = 4.000 \text{ m} \\ \text{Jumlah Putaran} &= \text{Jarak} / \text{Keliling} \\ \text{Putaran} &= 4000 : 400 = 10 \end{aligned}$$

Figure 3. Student answers are based on the third indicator

On indicators hook problem with life daily only 9 students in the class got it answer question with Good and students Already Can in do it. Whereas other students haven't can describe appropriate answer. Error started from when student compile steps solution in finish question. Based on interviews and observations conducted by researchers difficulty in do question because student feel difficulty in connect question get up flat with other material so student Still assume that material get up flat Still difficult. Hanan and Alim (2023) state that student directed for observe and explore material with use real objects, can seen, and can touched so that student can differentiate get up existing flat.

Need exists attention to students can understand and obtain based on ability knowledge according to opinion himself Alone with through experience in life daily like real things or congress that can observed or understood participant educate past imagine (Evi, 2011). This matter results their knowledge get difficulty in connecting with material other. From the presentation on seen ability students based on high, medium and low levels need improved so that student capable do question get up flat and connect them with other deaths for students No consider that material get up flat No difficult (Ubudiyah et al., 2021).

According to Damayanti (2022) in overcome less students capable hook problem with life everyday, a highly recommended learning model namely the learning model *Problem Based Learning* With using this model, students will trained hook something draft with learning on various problem in life daily. Student can Study connect draft math on the problem with easy because already used to in the learning process.

4. Finish calculation with true and correct.

$$\begin{aligned}
 &4. \text{ Rumus: } AB + BC + CD + DA \\
 &120 + 25 + 12 + 25 \\
 &245 + 37 \\
 &282 \\
 &\text{Jadi banyak nya } 282.000
 \end{aligned}$$

Figure 4. Student answers are based on the fourth indicator

On indicators finish calculation with true and correct there were 13 students who did not can do question with precise and correct. Student the No understand questions given , students Already capable answer with approach Correct with existing information given in the question , however student No write it down return . Many found existing students Correct in application formula . But because lack of accuracy in count multiplication especially in operation caused student not enough understand technique multipli- cation . It can be seen in the picture where the answer is student the direct only to the core of the problem , not enough appropriate in take conclusion with information available in the question . As well as students No capable write return information on the question . With so question No can resolved in a way whole with calculation not enough appropriate.

Inaccurate calculations can cause students to make errors, and accuracy in mathematics is essen- tial and plays an important role. A small error in calculation can lead to ongoing mistakes, resulting in incorrect outcomes. Therefore, thoroughness in solving mathematical problems is crucial. Not only must we be thorough, but we should also stay focused and concentrate on the problem at hand. Practice is essential for improving calculation skills. According to [Napfiah and Haliza \(2023\)](#), students' calculation abilities can be enhanced by using learning media. Learning media can encourage and motivate students to study more diligently and consistently practice their calculation skills. Using visual aids and engaging materials helps improve cognitive processes and sharpens memory.

Conclusions

Based on the research results and discussion, it can be concluded that on the matter of applying concepts, many students still make errors, with 15 out of 30 students (50%) in the class encountering difficulties. Similarly, for questions requiring the use of appropriate formulas and solving calculations cor- rectly, a significant number of students, amounting to 43.3%, made errors. Among the three indicators, the indicator related to applying problems to everyday life showed better results, with only 9 out of 30 students (30%) still experiencing difficulties. This indicates that many junior high school students still face difficulties in learning the material on two-dimensional shapes.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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