Vol. 14, No. 1, pp. 167-182, 2024 DOI: 10.23960/jpp.v14.i1.202413

Jurnal Pendidikan Progresif

e-ISSN: 2550-1313 | p-ISSN: 2087-9849
http://jurnal.fkip.unila.ac.id/index.php/jpp/

Learning Obstacles Hindering Junior High School Students Understanding of Surface Area of a Prism

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Received: 11 March 2024 *Accepted: 05 April 2024* *Published: 27 April 2024*

Abstract: Learning Obstacles Hindering Junior High School Students Understanding of Surface Area of a Prism. Objectives: to reveal the learning obstacles experienced by students in learning the surface area of prisms. **Methods**: using a qualitative method with a phenomenological design on grade IX junior high school students in Bandung as many as 29 students. Data were analyzed with the stages of data reduction, data presentation, and conclusion drawing. **Findings**: The results showed that students did not understand the prerequisite materials needed to understand the concept of prism surface areas such as the area of flat buildings and the Pythagorean theorem. Teachers also do not familiarize students with practicing non-routine problems so as not to spur students to form their knowledge acquisition maximally. **Conclusions**: students experience learning obstacles that are ontogenic, didactic, and epistemological in solving mathematical problems regarding the concept of prism surface area. The implications of this research can be utilized by educators, prospective educators, or researchers in the future to provide solutions to student learning obstacles in understanding the concept of prism surface area.

Keywords: concept of prism surface area, geometry, mathematics, learning obstacles.

To cite this article:

Siahaan, E. Y. S., Dasari, D., & Suryadi, D. (2024). Learning Obstacles Hindering Junior High School Students Understanding of Surface Area of a Prism. *Jurnal Pendidikan Progresif*, *14*(1), 167-182. doi: 10.23960/jpp.v14.i1.202413.

INTRODUCTION

One of the subjects that school students must study is mathematics. By learning mathematics, students' competencies can be improved. The competencies that need to be possessed by every student are problem-solving, communication, connection, reasoning, and representation skills. The five abilities are referred to as mathematical power (NCTM, 2000). Mathematics can help to think more systematically (Marliani, 2015), develop logical thinking (Kenedi et al., 2019), practice arithmetic (Litkowski et al., 2021), train the ability to make deductive conclusions (Makowski, 2021), and also math teaches us to be more thorough, careful, and patient. Mathematics teaches students to get used to making decisions and conclusions based on logical, rational, critical, careful, efficient, and effective thinking (Subekti, 2011).

One of the applications of mathematics in everyday life is geometry. Geometry is one of the most important branches of mathematics in the mathematics curriculum in various parts of the world (Serin, 2018). Geometry studies the relationship between visualization, and the relationship between mathematics and life, and describes abstract phenomena (Putri, 2017). Geometry has many links and benefits for life (NCTM, 2000). In everyday life, several professions use geometry in their work such as scientists, architects, artists, and engineers (Itoh et al., 2019; Sholihah & Afriansyah, 2017). Geometry can teach us how to appreciate the world. This is because geometry can be found not only in the structure of the solar system, but also in natural phenomena such as geological formation, rocks and crystals, plants and flowers, and even animals (Cherif et al., 2017).

However, students' ability in geometry material is still considered low, especially in Indonesia and students still have difficulty understanding some concepts in geometry (Yunianta et al., 2023). The results of the study (Budiarto & Artiono, 2019) concluded that geometry problems are successively problems related to logic skills, drawing skills, visual skills, verb skills, and applied skills.

In geometry material, especially flat-sided spaces, ontogenic and epistemological barriers are found in the geometry learning process (Cesaria & Herman, 2019). Ontogenic obstacles occur when students do not have an adequate understanding of the material provided while epistemological obstacles occur when the material provided is not per the individual characteristics of students.

The results of research in several secondary schools in West Java show that students have difficulty in identifying problems, understanding, finding, and applying the concept of prism surface area (Aziiza & Juandi, 2021; Mardia et al., 2021; Sudirman & Martadiputra, 2020; Suprayo et al., 2023). In addition, research conducted at one of the junior high schools in Medan concluded that students did not correctly understand how to determine the surface area of a prism and had difficulty distinguishing diagonal planes and spaces (Hasibuan, 2018).

Research conducted by Hasanah & Yulianti (2020) concluded that students could not present prisms and made mistakes in using the prism surface area formula. Research in South Africa (Chiphambo & Mtsi, 2021) also concluded that students made mistakes in calculating and using the prism surface area formula.

Brousseau (2002) identified that there are three types of learning obstacles experienced by students in learning, ontogenic obstacles, didactical obstacles, and epistemological obstacles. These factors have a significant impact on student learning outcomes, so teachers as educators need to understand and identify these learning barriers. With a good understanding of these factors, it is expected that students can gain better knowledge and more easily understand the material taught by the teacher in the learning process.

Ontogenic obstacles are learning barriers that occur due to students' mental unpreparedness for learning. The lack of mental readiness of students when learning results in an incomplete understanding of the concepts obtained by students. Suryadi (2019b) also notes that this barrier is related to the mismatch between the demands of learning design and students' capacity. Didactical obstacles are barriers that are closely related to the mismatch in the didactical situation (learning process) applied. Didactical obstacles are related to the order of presentation of material in the learning process so this discrepancy can interfere with the smooth thinking process of students or result in errors in understanding concepts. Suryadi (2019a) explains that the sequence of material is structurally (which represents the relationship between concepts) and functional (which reflects the continuity of the thinking process), as well as the level of thinking.

Epistemological obstacles are learning barriers that arise due to students' limited understanding and mastery of mathematical concepts related to the problems given. Moru (2007) revealed that epistemological obstacles relate to aspects of understanding a concept or knowledge where there is an incorrect way of understanding new knowledge. This type of learning obstacle can be seen when students can answer problems by the examples and forms given by the teacher or sourcebook but have difficulty when the problem is given in a different context or form. Students who experience this obstacle may have an incomplete understanding of the concept.

Therefore, based on the problems that have been described, it is necessary to conduct more in-depth research on the learning barriers experienced by students in learning the concept of prism surface area. After knowing the types of student learning barriers, teachers can apply a necessary treatment and can be considered by such as using certain learning models or methods to improve learning.

METHODS

Participants

The participants were purposively selected based on the criterion that students have learned the concept of surface area of prisms. The study population amounted to 185 ninth-grade students divided into 6 classes in one of the public junior high schools in Bandung, West Java. In this study, the author narrowed the population into a sample, namely one class IX consisting of 29 students. The sample selection was based on the recommendation of the math teacher with the consideration that the class could be used as a representation of learning outcomes on the material under study.

Research Design and Procedures

The qualitative phenomenological research design was used to gain in-depth insight into the difficulties faced by students in learning mathematics on prism surface area material. Before giving test questions and conducting interviews with students, researchers asked permission from the school to research students. Then, the researcher was accompanied by the math teacher at the school to explain the objectives, potential risks, and benefits of the research. In addition, students were also informed that data recordings, such as test results and audio recordings during interviews were treated with the utmost confidentiality.

The researcher administered the test to 29 students and then based on the test answers, the researcher selected four students to conduct in-depth interviews. The interviews were conducted in-depth with a set of open-ended questions so that other questions may emerge from the conversation between the researcher and students to enrich information and details about the difficulties experienced by students in learning mathematics. This aims to ensure that the data obtained is thorough as needed and helps researchers in drawing quality conclusions. The data collection techniques used are tests, interviews, and observations.

Instrument

The instruments in this study consisted of main instruments and supporting instruments. The researcher is the main instrument in this qualitative research. Researchers as the main instrument will collect, process, and interpret data (Creswell, 2014). The supporting instruments are test questions and interview guidelines. The test questions are 5 description questions that aim to determine the characteristics of learning obstacles that students may experience following the learning achievement indicators in the Merdeka Curriculum (Kustiana, 2023) with a processing time of 80 minutes. The questions given are tested first by an expert lecturer to ensure that the identification of student learning obstacles can be obtained correctly and by two mathematics teachers who have teaching experience and have an educator certificate to ensure that the use of grammar and question types are by the abilities of junior high school students.

Learning obstacles are categorized into three parts, namely ontogenic obstacles (students psychobiology), didactical obstacles (teaching materials), and epistemological obstacles (mismatch of teaching materials with students' level of knowledge) (Suratno, 2016). The indicators of questions and learning obstacles used by researchers in the study are presented in the following Table 1:

Table 1. Problem indicator and learning obstacle

Problem Indicator	Question Number	Learning Obstacles	Learning Obstacles Indicator
Mastering the prerequisite material for learning the surface area of prisms, namely the area of two-dimensions and the Pythagorean theorem.	1	Ontogenic	Students' limited knowledge of prerequisite materials, namely the area of flat buildings and the Pythagorean theorem.
Making prism nets	2	Ontogenic	Students' limited knowledge of flat shapes in prisms
Solve problems related to prism nets in non-simple form	3	Didactical	Students are not well facilitated in interpreting the concept of the surface area of prisms due to the provision of problems that are not varied by the teacher.
Using the concept of surface area of flat-sided spaces to solve mathematical problems	4	Epistemological	Students experience problems solving non-routine problems on contextual problems due to their limited understanding.
Solve daily problems related to the effect of proportional changes in the shape of a space on the surface area of a prism.	5	Epistemological	

The researcher meticulously crafted an assessment rubric tailored to each test question, assigning a maximum score of 5 points for proficiency. These provisions were meticulously outlined to ensure consistency and fairness in evaluating student responses:

Table 2. Assessment rubric

No	Category	Score
1	Successfully and accurately utilize the prism surface area concept to solve the problem	5
2	Employ the prism surface area concept to solve problems, albeit with procedural mistakes	4

3	Attempt to apply the prism surface area concept but fail to complete the task	3
4	Provide answers that demonstrate the application of the prism surface area concept	2
5	Offer answers that deviate from the prism surface area concept	1
6	Did not give an answer	0

Data Analysis

The data obtained were then analyzed with the stages of data reduction, data presentation, and drawing conclusions (Creswell & Poth, 2016). After the data is collected following the research focus, data reduction is then carried out. Data reduction involves simplifying and transforming raw data to extract important information. Data that has been reduced will provide a clearer picture. Data presentation is done by systematically organizing information through tables to effectively communicate insights. The final stage is concluding the whole series of research. Miles dan Huberman (1994) in his book states that validity in qualitative research is credibility, transferability, dependability, and certainty.

RESULTS AND DISCUSSION

The following description explains the learning obstacles experienced by students in solving prism surface area problems accompanied by interview transcripts of four students. Based on the assessment rubric, the researcher obtained data on the test results of 29 students which are presented in Table 3 below:

Table 3. Student test scores

Name	Learning Obstacles					Total Score	Student Value
	Ontogenic		Didactical	Epistemological			
	1	2	3	4	5		
S1	3	5	1	1	0	10	40
S2	5	5	5	0	0	15	60
S3	5	5	4	1	0	16	64
S4	5	5	1	1	0	12	48
S5	5	5	5	4	4	23	92
S6	5	5	5	4	5	24	96
S7	5	5	1	0	0	11	44
S8	5	4	0	0	0	9	36
S9	5	4	1	0	0	10	40
S10	1	5	0	0	0	6	24
S11	2	5	0	0	0	7	28
S12	2	5	0	0	0	7	28
S13	1	1	0	0	0	2	8
S14	1	0	0	0	0	1	4
S15	1	1	0	0	0	2	8
S16	5	1	1	1	0	8	32
S17	5	1	1	1	0	8	32
S18	0	2	0	0	0	2	8

S19	0	4	1	0	0	5	20
S20	0	4	1	0	0	5	20
S21	0	4	1	0	0	5	20
S22	1	5	0	0	0	6	24
S23	0	5	0	0	0	5	20
S24	0	2	0	0	0	2	8
S25	1	1	0	0	0	2	8
S26	0	0	0	0	0	0	0
S27	1	0	0	0	0	1	4
S28	1	0	0	0	0	1	4
S29	0	0	0	0	0	0	0

Based on the data in the table above, it can be seen that many students are not able to answer the test questions properly. Almost all questions some students do not answer. This can be interpreted that students experience learning obstacles based on the results achieved. Problem numbers 1 and 2 contain indicators that can be used to identify student learning barriers in the form of ontogenic learning obstacles. Problem number 3 identifies didactic learning obstacles. While Questions 4 and 5 identify epistemological learning obstacles.

Question Number 1: Two-dimensional Shapes and Pythagorean Theorem

The administration of this question aims to see whether students master the prerequisite material in learning the surface area of prisms consisting of rectangular area and Pythagoras theorem.

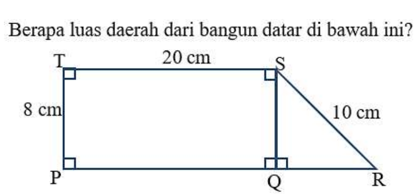


Figure 1. Question number 1

Based on the table of student test scores, information was obtained that only 10 out of 29 students were able to solve test question number 1 properly and correctly. The researcher selected one of the students' answers who made mistakes as shown in Figure 2.

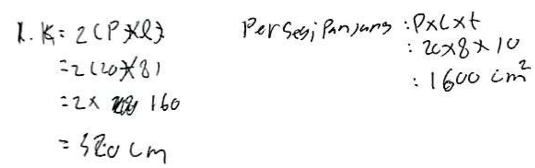


Figure 2. Students' answers to question number 1

Transcript of interview between Researcher and Student :

Researcher : Do you know what the picture in question number 1 consists of?

Student : I know ma'am, this is a rectangle and this is a triangle. Pointing to the student's answer

Researcher : Why did you give this answer? Pointing to the student's answer

Student : I forgot the formula for the area of rectangles and triangles, ma'am, so I just wrote down the formula that I remembered.

Researcher : Why did you forget?

Student : It's been a long time since I learned it, I also don't understand the material (rectangular area).

Researcher : Have you ever learned the Pythagorean theorem?

Student : I have, but I forgot. So I did problem number 1 according to the formula that I remember and the numbers in the problem.

Based on the test results and interviews with students that have been presented, it shows that students lack understanding of the prerequisite material, namely rectangular area, triangular area, and Pythagorean theorem. When given a problem that requires students to apply the meaning of the concepts they receive, students experience confusion and difficulty answering the questions given. From the interview, information was also obtained that students were lazy to do the test questions. Figure 2 is the answer of one of the students using the beam volume formula to find the rectangular area. Students wrote the area of the rectangle = length × width × height and also the perimeter: K = 2 (p × l).

The difficulties experienced by students in working on problem number 1 are due to students (1) still not being able to identify the problems in the picture presented, (2) still experiencing errors using the rectangular area formula so that students use the volume formula in the beam, (3) only operating the numbers contained in the problem, not identifying first. This is also supported by research (Lutfi, Juandi, & Jupri, 2021) which says that students experience ontogenic obstacles in flat shapes such as lack of interest in the learning process and not understanding well based on their learning experience.

Question Number 2: Nets of Prism

Following the Learning Outcomes (CP), students are expected to be able to make a net of a space that aims to help students calculate the surface area of a prism.

This question requires students to be able to visualize the prism space so that they can make the nets of each prism. But in reality most students were not able to. It can be seen from the score table that 5 out of 29 students did not even try at all to draw the prism nets, and only 12 out of 29 students drew each net correctly.

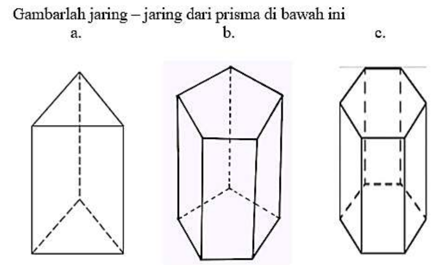


Figure 3. Question number 2

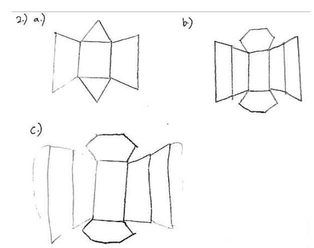


Figure 4. Students' answers to question number 2

From the picture above, it is clear that students do not know what flat shapes make up a prism. This can be an obstacle for students in calculating the surface area of a prism. The following are the results of interviews between researchers and students who gave these answers.

Reseacher : What do you think is a building?

Student : That's ma'am, uh, a space is an object that has space.

Reseacher : Try to give an example

Student : A tissue holder ma'am

Reseacher : Good, your answer is correct. Do you know the characteristics of a prism?

Student : I know ma'am

Reseacher : What are the characteristics? Let's mention them

Student : The base and lid are the same shape, and there is a blanket.

Reseacher : Do you know what shape the blanket is?

Student : I don't know, that's why I drew it like that. While pointing to her answer on the answer sheet.

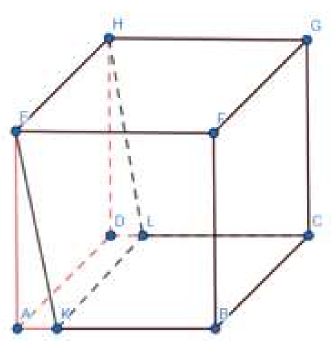
A net is a pattern of a shape or a combination of flat shapes that if connected will form a space (Serra, 2008). So that one of the techniques for finding the surface area of a prism can use its net. Based on the results of the test questions and interviews, the researcher concluded that there were ontogenic learning barriers because students could not make the nets of each prism correctly. Students only know that prisms have the same base and lid shape but do not know the flat shape on the upright side of the prism, which is rectangular. Research by Bariyyah dan Amelia (2020) also found that students made mistakes in making nets of prisms. Similar things also occur even at the student level as shown in research (Pratama & Nurmeidina, 2021) which concluded that students have difficulties and errors in drawing nets.

Research conducted in Japan on learning mathematics, especially building space with a research focus on designing tube nets and then assembling them which aims to make students learn concretely and interactively about the structural components of tubes. This can increase students' curiosity and train their creative and imaginative thinking skills (Isoda et al., 2007). Because learning that starts with real objects in everyday life with interaction between students and the environment, can improve students' understanding of mathematical concepts and minimize the misconceptions that occur to students (Huang et al., 2019). According to Brousseau (2002), learning obstacles are errors that are not only caused by ignorance, uncertainty, or coincidence, but also the effects of prior knowledge and errors in the process of acquiring knowledge.

Question Number 3: Unsimple Form of Prism

The researcher wants to know how students' ability to come up with ideas to solve problems related to the concept of prism surface area in an unsimple form.

Sebuah kubus ABCD.EFGH dengan panjang rusuknya 15 cm dipotong menjadi dua bagian sehingga terbentuk sebuah prisma dengan alas berbentuk trapesium. Tampak seperti pada gambar di bawah ini.



Perhatikan bahwa "alas" dan "tutup" prisma masing – masing pada gambar ABFE dan DCGH. Jika panjang AK = DL = 4 cm, maka hitunglah luas permukaan prisma.

Figure 5. Question number 3

In this test question, only 3 out of 29 students managed to use the concept of prism surface area correctly. On the other hand, 9 out of 29 students tried to answer the test question even though it was outside the concept of prism surface area, while 17 students did not try at all.

The figure above is the answer of a student who tries to answer test question number 3

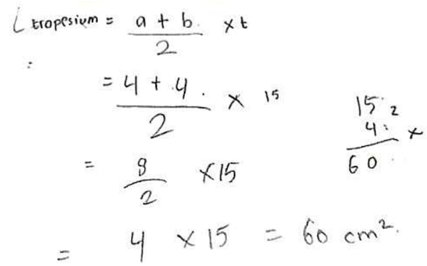


Figure 6. Students' answers to question number 3

according to the formula that is remembered. In the question, it is known that the prism formed is a prism with a trapezoidal base and lid, so students try to find the area of the trapezoid with the formula they remember. Seeing this answer, the researcher explored more information from the student.

Reseacher : What do you think question number 3 means?

Student : Honestly, ma'am, I don't understand prism material. I also forgot a lot of formulas.

Reseacher : Does that mean you're not very interested in learning math?

Student : I actually like learning math if I know the formula, but if I forget and the questions are difficult, I become lazy to do it.

Reseacher : That means test question number 3 is difficult for you?

Student : It's really hard mom

Reseacher : In learning about prism material, do teachers often not give examples of problems or assignments (homework) like this? Researcher while pointing to test question number 3

Student : Usually the teacher gives examples of problems that are the same as the book, just change the numbers. It's just that in test questions such as midterms and final exams, there can be forms of problems that have never been taught in class, ma'am.

Reseacher : What is the shape of the prism given by the teacher?

Student : Triangular prism ma'am

Reseacher : What about other shapes like test question number 3?

Student : We have never been taught or given assignments with the form of questions like that ma'am.

From the test results shown in Figure 6 as well as the interviews conducted, it was revealed that students experienced a number of difficulties in understanding the material presented, especially related to the concept of prism surface area in non-routine problems. Apparently, students faced difficulties in linking the information provided with the questions asked, as well as difficulties in building connections between these concepts. One of the main factors causing this is the lack of practice on non-routine problems, both in the form of sample problems and tasks given by the teacher. As stated by Suryadi (2019a), the importance of the structural order of material that reflects the relationship between concepts, along with the way of presentation that pays attention to functional aspects and the level of detail of the material, has a significant impact on the student learning process. It is not surprising then that students experience didactic learning barriers, as described by Alawiyah et al. (2018).

This suggests the need for a more holistic and structured approach in the learning process to help students overcome their learning difficulties. By paying attention to these aspects, it is hoped that the learning process can be more effective and meaningful for students, so that they can develop a deeper understanding of the material being taught.

Question Number 4: Mathematical Problem

Test question number 4 aims to see students' ability to use the concept of prism surface area to solve mathematical problems.

Prilly akan memberikan sebuah coklat berbentuk prisma segitiga sama sisi kepada temannya yang akan ulang tahun. Prilly akan membungkus coklat tersebut dengan kertas kado agar terlihat lebih indah. Sisi segitiga pada coklat adalah 4 cm dan panjang coklat adalah 15 cm. Berapa luas kertas yang akan digunakan Prilly?

Figure 7. Question number 4

Based on the students' scores in table 2, it was found that only 6 out of 29 students tried to answer test question number 4. Then 2 out of 6 students were able to answer using the concept of prism surface area but there were procedural errors as in figure 8 below.

After examining students' answers to test question number 4, the researcher saw that students were able to describe the shape of the prism in question. However, students made mistakes in calculating the base area in the form of an equilateral triangle. Students consider that

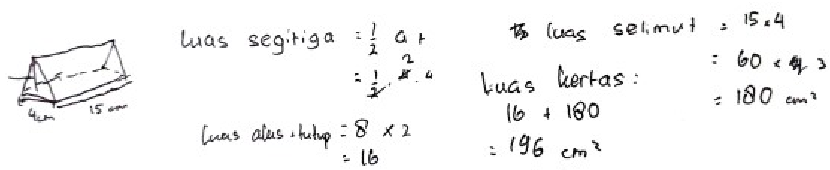


Figure 8. Students' answers to question number 4

the height of the triangle is the same as the length of the side in the triangle. Therefore, the researcher traced students' answers more deeply through interviews.

Reseacher	: From your answer, it shows that you have understood the prism material. However, try to look at the triangle again. What triangle is given in the problem?
Students	: Equilateral triangle ma'am
Reseacher	: Is an equilateral triangle the same as a right triangle?
Students	: Different ma'am
Reseacher	: Why is it different?
Students	: Because a right triangle has right angles and the height is the one with the elbows. The height of the right angle is the height of the right triangle.
Reseacher	: Well, this equilateral triangle has a height yet? Pointing to the triangle drawn by the student on the answer sheet
Students	: Oh there is no yes ma'am. The height line should be drawn
Reseacher	: That's right. You've actually done it. It's just that one step is missing. Have you ever learned the pythagorean theorem? Pointing to the student's answer.
Students	: Ha, that means you should find the height using the pythagorean theorem, right?
Reseacher	: Right, so in this problem the height of the triangle is unknown and because the triangle given is an equilateral triangle so we use the pythagorean theorem.

The test results in Figure 8 show students' proud achievements in their ability to describe and determine the size of a triangular prism according to the information provided in the problem. However, through a series of in-depth interviews, a deeper understanding of the learning barriers faced by students in the epistemological domain can be obtained. One of the difficulties that arose was students' limitations in applying the concept of prism surface area to a particular context, especially to triangular prisms. From the results of this interview, it was revealed that students have difficulty in determining the area of a triangle if the shape of the given triangle is equilateral. This highlights the importance of understanding the concept thoroughly and applying it in various contexts, as part of a deeper learning process (Holmes et al., 2013). In this context, a learning approach that allows students to relate concepts to real-world situations can be an effective strategy to strengthen their understanding. Thus, through this research, we can strengthen awareness of the importance of supporting students inovercoming epistemological learning barriers as revealed in this analysis.

Question Number 5: Proportional and Surface Area of a Prism

In test question number 5 students are asked to solve daily problems related to the effect of proportional changes in the shape of the space on the surface area of the prism.

Brian memiliki dua buah prisma tegak segitiga dengan alas berbentuk segitiga siku – siku yang diberi nama Prisma A dan Prisma B. Pada prisma A, panjang sisi siku – siku segitiga adalah 3 cm dan 4 cm, sedangkan tinggi prisma adalah 10 cm. Panjang sisi pada prisma B adalah dua kali ukuran prisma A. Brian akan membungkus seluruh permukaan prisma – prisma tersebut. Berapakah luas kertas yang akan digunakan Brian untuk kedua prismanya?

Figure 9. Question number 5

The students' test results showed that only 2 out of 29 students answered where one student solved the problem using the concept of the surface area of a prism properly and correctly, while the other student solved the problem using the concept of the surface area of a prism but there was a procedural error seen in Figure 10.

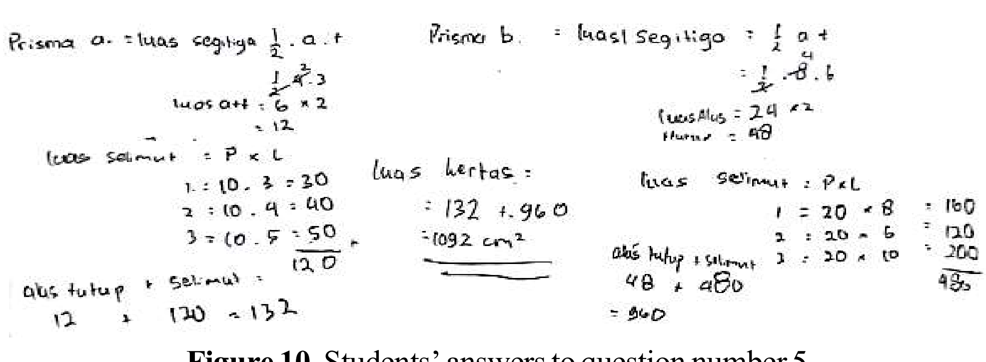


Figure 10. Students' answers to question number 5

From the answers above, it can be seen that students are mistaken to perform the addition operation so that the results are not correct. Based on the score table there are 27 out of 29 students who did not work on test question number 5 at all. Therefore, the researcher conducted interviews with students who did not answer the questions.

Reseacher : What concepts do you think are used in question number 5?
Student : Don't know ma'am
Reseacher : Do you understand what the question asks?
Student : I understand ma'am, question number 5 asks us to find the surface area of two prisms. But there is a comparison ma'am. I don't remember the comparison material and I also forgot how to calculate the area.
Reseacher : Then why don't you try to answer this question? Pointing to question number 5 and student answer sheet
Student : Yes, that's because I forgot about comparison and finding the area.

Through an in-depth interview process with students who could not answer test question number 5, the researcher has explored more deeply the epistemological learning barriers faced by students in the context of learning the surface area of prisms. The findings indicate that students face significant challenges in applying mathematical concepts to everyday life situations, particularly in relation to understanding proportionality. This conclusion highlights the importance of recognizing and overcoming epistemological learning barriers as part of efforts to improve mathematics learning (Nugraha, Sa'dijah, Susiswo, & Chandra, 2023). From the interviews, it appears that students have difficulty in understanding how the length of two prisms can affect their surface area proportionally. Understanding this concept is crucial in developing students' mathematical literacy, which can provide a solid foundation for the application of mathematics in everyday life. Therefore, efforts to strengthen students' understanding of the concept of proportionality, especially in the context of prism surface area, can be a strategic step in improving the quality of mathematics learning. Thus, this study makes an important contribution in deepening our understanding of the challenges and strategies to overcome epistemological learning barriers in the context of mathematics learning.

In this regard, making a learning design that can meet the needs and conditions of students is very necessary. The existence of this design is to support teachers in designing appropriate learning activities to be carried out by students. The learning design should include learning objectives and plans to achieve these objectives in such a way that students can develop their abilities, and include conjectures on student learning activities based on initial understanding and student characteristics to achieve the expected learning understanding (Jahnke & Liebscher, 2013). The existence of a thorough description and analysis related to student learning barriers is expected to be a reference for the development of learning designs that can minimize student learning barriers henceforth, so that students can fully understand the material of the concept of chance which is the basic concept for mastering subsequent concepts.

CONCLUSIONS

Based on the results and discussion, it can be concluded that there are student learning barriers, namely ontogenic, didactic, and epistemological learning barriers. Ontogenic barriers experienced by students in learning the surface area of prisms are shown by student responses, namely students experience confusion between the formula for the area of a rectangle and the volume of a block, and students' knowledge of prisms is limited to that prisms have the same base and lid shape. However, they experience difficulties on the upright side of the prism. Students did not know the flat shapes on the upright side of the prism. Didactic barriers were obtained more clearly when students were interviewed. Students stated that teachers rarely give non-routine problems during practice problems or homework assignments so that students are unable to come up with ideas to solve varied problems. Meanwhile, the epistemological learning barriers identified were due to students having limitations in a particular context to solve daily problems related to the effect of proportional changes in the shape of the space on the surface area of the prism.

To overcome the learning obstacles encountered in learning the surface area of prisms, there are many solutions that can be done. One of them is to create a hypothetical learning trajector based on the learning barriers that have been found and the expected learning objectives on the topic of prism surface area. In order for teachers to facilitate different learning sequences, teachers must be able to predict various possible student responses based on the didactical situation developed so that HLT can be used as the main reference for learning (Suryadi, 2019a). Therefore, this HLT can be used as a solution to overcome learning barriers on geometry topics. The interaction pattern between students, teachers, and materials needs to be developed in a learning plan. Learning tools must be made in accordance with student responses and characteristics so that learning activities are more effective, this is called didactical design.

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