Didactical design to overcome learning obstacles in cuboid volume

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Abstract

This study aims to produce an empirical didactic design designed to overcome didactic barriers experienced by students on beam volume material. Didactical design research is a design in this study that contains three stages of analysis, namely prospective analysis, metapedadidactic analysis, and retrospective analysis. 25 9th-grade junior high school students and one mathematics teacher were selected using purposive sampling techniques to become subjects. Observation, tests using diagnostic tests, and interviews are techniques in data collection. The collected data is analysed and interpreted qualitatively using interpretive and critical paradigms. The results of this study show that through three stages of analysis, an empirical didactic design was obtained that contains four didactic situations: action situations, formulation situations, validation situations, and institutionalisation situations. However, the limitations of presenting problems in institutionalisation situations have an impact on the occurrence of other learning barriers, namely epistemological concepts. Thus, this limitation becomes an improvement material in empirical didactic design.

Keywords: cuboid volume; didactic design; learning obstacle


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Introduction

The goal of mathematics learning is that students can obtain complete knowledge from the learning process. When students can acquire knowledge, it means that students can demonstrate the systematicity of their thinking processes and can demonstrate the accuracy of the knowledge they have built. However, one factor that can hinder the process of acquiring this knowledge is the existence of learning obstacles. The nation of obstacles appears fundamental to the consideration of the problem of scientific knowledge (Brousseau, 2002). A learning obstacle is a condition where a person cannot follow the learning process properly, which is characterized by the presence of certain obstacles in achieving learning outcomes (Brousseau, 2002; Suryadi, 2019).

Suryadi (2019) states that learning obstacles are caused by three factors. First, ontogenic obstacle, namely a learning obstacle related to mental readiness and cognitive maturity in receiving knowledge. Suryadi (2019) revealed that ontogenic obstacle can be indicated through three factors which include: (a) ontogenic psychological, namely learning obstacles related to students' psychological aspects such as motivation and interest in certain topics, (b) ontogenic instrumental, namely learning obstacles related to technical processes in learning, and (c) ontogenic conceptual, namely learning obstacles related to concepts in the learning process that are not by students' experiences in learning. Second, epistemological obstacles, namely learning obstacles caused by limitations in certain contexts due to not obtaining complete knowledge. According to Nuban, et al. (2020), epistemological obstacles are caused by three indicators which include: (a) epistemological conceptual obstacles, namely obstacles where students are unable to explain and demonstrate a basic concept, (b) epistemological procedural obstacles, namely obstacles where students cannot solve problems in their simplest form and the way to solve the questions instructed is not appropriate, and (c) epistemological operational technique, namely obstacles where students make mistakes in writing and calculating the value of an arithmetic operation. Third, didactical obstacles are obstacles caused by errors in teaching materials that are not by students' thinking processes.

The study of learning obstacles is one of the research topics that is often carried out by several researchers, such as Sari et al (2019) in their research conducting learning obstacle analysis on triangle material, Andani et al (2021) in their research regarding learning obstacle analysis on the concept of geometric series, as well as other researchers like Purnama (2023), and Mahmud et al. (2023). Analysis of learning obstacles for 9th-grade students in cuboid volume material has also been carried out by Priskila et al (2023) in their preliminary study. A total of 2 diagnostic test questions have been given: (1) If the block-shaped mask box is known to have a length of 13 cm, a width of 8 cm, and a volume of 1.456 cm$^3$, then what is the height of the block?; and (2) A block-shaped pool has a length of 80 dm, a width of 75 dm, and a depth of 10 dm. If 3/4 of the pool is filled with water, then what is the volume of water in the pool?
Based on the diagnostic test results, the following results were obtained:

![Student answer to question number 1.]

\[ V = P \times l \times t \]
\[ V = 8 \times 13 \times 1456 \]
\[ V = 151,924 \text{ m}^2 \]

So, the height of the box is 151,924 \text{ m}^2

**Figure 1.** Student answer to question number 1.

Based on the results of the interview, it was found that the low motivation and ability of students in learning mathematics, and the limitations of students in carrying out the completion procedure were caused by limited understanding of the concept of block volume. From the results of tests and interviews, it was obtained that there are obstacles to student learning, namely ontogenic psychological and epistemological concepts.

![Figure 2. Student answer to question number 2.]

\[ V = l \times w \times h \]
\[ V = 3 \times 13 \times 1456 \]
\[ V = 151,924 \text{ m}^2 \]

So, the height of the box is 151,924 \text{ m}^2

Based on the results of the interview, it was found that students' limitations in completing the completion procedure correctly were caused by students not knowing how to simplify number counting operations. In addition, it was also found that there was an inability of students to associate this material with material on number counting operations caused by the limited presentation of prerequisite material, namely number counting operations. This information indicates learning barriers in the form of epistemological concepts, epistemological operational techniques, and didactic obstacles.

To overcome or minimize the occurrence of these learning obstacles, it is necessary to develop a didactic design that is based on these needs. This is in line with the opinion of Khoeruroziqin (2019), Rahmawati et al. (2021), and Jamilah and Winarji (2021), who found that didactical designs designed based on analysis of learning obstacles were proven to be successful in overcoming and minimizing the occurrence of learning obstacles, both ontogenic obstacles, didactical obstacles, and epistemological obstacles.
Similarly, in learning cuboid volumes, it is necessary to develop a didactic design to overcome or minimize the occurrence of learning obstacles. Therefore, in this follow-up study, researchers conducted research, namely the development of a didactic design on cuboid volume material which could not only overcome or minimize learning obstacles but could also facilitate students in gaining knowledge of the concept of cuboid volume as a whole. In contrast to the research of Khoeruroziqin (2019) and Rahmawati et al. (2021), the DDH designed in this research is based on the didactic situation theory which presents 4 didactic situations (Brousseau, 2002) and the theory of didactic transposition through analysis of the transposition of knowledge from scholarly knowledge and knowledge to be taught to taught knowledge (Chevallard & Bosch, 2014).

**Methods**

Didactical Design Research (DDR) was chosen as the design in this research. This research design was relevant to the needs of this research, where with an interpretive and critical paradigm, the researcher designs a hypothetical didactic design based on the results of the analysis of students' learning obstacles and after implementation the researcher will again carry out an analysis of the students' learning obstacle so that in the end suggestions for improvement will be obtained. To formulate an empirical didactic design, DDR contains 3 steps (Suryadi, 2010; 2013), as in Figure 3.

At the prospective analysis stage, the preparation of a hypothetical learning trajectory (HLT) and hypothetical didactic design (DDH) is carried out. The preparation of HLT and DDH is based on the findings of student learning barriers in previous beam volume learning. DDH was developed to overcome or minimize the occurrence of obstacles for students. Furthermore, DDH implementation was carried out on cuboid volume learning. At the metapedadidactic analysis stage, an analysis of the results of DDH implementation is carried out based on the didactic triangle point of view. This analysis is carried out by looking at the relationship between teacher and student (pedagogic relationship), the relationship between student and material (didactic relationship), and the relationship between teacher and material (pedagogic didactic anticipation). In the final stage, namely the retrospective analysis stage, an analysis is carried out based on the results of reflection and evaluation by looking at the relationship between prospective analysis and metapedadidactic analysis. Specifically, an analysis was carried out to see the suitability between the didactic situation designed in the hypothetical didactic design with the didactic situation that occurred during the implementation of the didactic design, as well as to see the compatibility between the HLT design and the learning trajectory (LT) that occurred during implementation (Jamilah, 2021). The final result of this analysis will be obtained from empirical didactic design formulation (DDE).
Furthermore, using the principle of positive sampling, 25 9th-grade students were obtained as the subjects of this research and a mathematics teacher who taught volume of cubes and cuboids (Moleong, 2012; Creswell, 2012; Freankel et al. 2012). Data collection techniques consist of observation, in-depth interviews (Marshall & Rossman, 2016; Moleong, 2012), and tests (Cohen et al, 2007) with data collection tools consisting of observation guidelines, interview guidelines, and diagnostic tests. Furthermore, the data was processed through the managing and transcription process, analyzed, and then interpreted (Marshall & Rossman, 2016). The data validity technique used is data and theory triangulation techniques (Mok & Clarke, 2015).

Results

The results of this research are presented based on the steps of this research, namely: prospective analysis, metapedadidactic analysis, and retrospective analysis.

Prospective analysis

The results of the analysis in a preliminary study previously carried out by Priskila et al. (2023) became the basis for this researcher in formulating a hypothetical learning trajectory (HLT) and hypothetical didactic design (DDH). After conducting a study of the concept of cuboid volume based on scholarly knowledge and the material presented in the curriculum, the HLT was then formulated as presented in Table 1.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Didactic Step</th>
<th>Learning Activity</th>
<th>Learning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite Concepts</td>
<td>Explore initial understanding of the concept of number calculation operations and algebraic calculation operations.</td>
<td>Through question-and-answer activities, students are presented with problems related to number calculation operations and algebraic calculation operations.</td>
<td>Students can recall and understand the concept of number calculation operations and algebraic calculation operations and relate them to the concepts they will study next.</td>
</tr>
<tr>
<td>Concept</td>
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| Prerequisite Concepts | Exploring students' initial understanding of the concept of volume, the concept of cuboid based on the differences in characteristics with cubes. | 1. Through question-and-answer activities, students are presented with problems regarding the definition of volume.  
2. Through group discussions, students are presented with a problem (Problem 1) to understand the concept of cuboids based on their characteristics and differences with cubes. | Students can recall and understand the concepts of volume and cuboid and use this understanding in studying the concept of volume of cuboid. |
| Core concept  | Determining the Volume of a Cuboid                                           | Students are presented with a problem (Problem II), namely determining the volume of block ABCD.EFGH if the length, width, and height are known. | Students can determine the cuboid volume.                                              |
| Core concept  | Determine the formula for the length of one edge of the cuboid.               | Students are presented with a problem (Problem III) namely determining the length of edge BF of beam ABCD.EFGH if the volume, edges AB, and BC are known. | Students can reduce the formula for the volume of a block into a formula for the length, width, or height of a block using algebraic operations. |
| Core concept  | Resolving contextual problems related to cuboid volume                        | Students are presented with contextual problems (Problem IV and Problem V) and are asked to solve the problem using the concept of cuboid volume that has been studied. | Students can develop their knowledge of the concept of cuboid volume by solving a variety of relevant contextual problems. |

The HLT created is the basis for formulating DDH (see Figure 4). This DDH is presented in the form of a Learning Implementation Plan which is equipped with a Student Worksheet. The didactic situations presented in this lesson plan contain 4 didactic situations, namely action situations, formulation situations, validation situations, and institutionalization situations. In action situations and formulation situations, students are presented with 3 problems (problems I, II, and III) which guide students to construct their knowledge about the cuboid volume and implement them in solving problems.
Didactical design to overcome learning obstacles in cuboid volume

The Hypothetical Learning Trajectory (HLT) map is presented in Figure 4.

Figure 4. Hypothetical Learning Trajectory (HLT)

**Problem I.** Look at the following picture!

![Picture](a) ![Picture](b)

Based on the two pictures above, determine which of the objects above is a block? Determine the reason!

Problem I is given to explore the basic concept of cuboids by identifying the differences between cuboids and cubes based on their characteristics.
Problem II. If one of the image objects in problem I is block ABCD.EFGH which is known to be $AB = 2 \text{ cm}$, $BC = 3 \text{ cm}$, and $BF = 4 \text{ cm}$, then how to determine the volume of block ABCD. EFGH?

Problem II is given to stimulate students in constructing the concept of cuboid volume.

Problem III. If a block ABCD.EFGH has a volume of $120 \text{ cm}^3$, length $AB = 5 \text{ cm}$, and $BC = 6 \text{ cm}$, so what is the length of $BF$?

Problem III is given to stimulate students' thinking to determine the length of one edge on a beam if the volume is known and the length of the other 2 edges using the concept of algebraic arithmetic operations. This problem is presented to minimize the occurrence of epistemological concepts as happened in previous research, where students had difficulty solving problems like this due to the limitations of the concepts being studied.

In the validation situation, students are asked to present their learning results in solving problems I, II, and III given. This didactic situation is presented to validate the concept construction process that students have carried out. The validation process is also carried out after students have completed problems IV and V.

Furthermore, in the institutionalization situation, students are presented with 2 new problems, namely problems IV and V.

Problem IV. A block-shaped bathtub is $3/4$ filled with water. If the length of the pool is $80 \text{ cm}$, the width is $75 \text{ cm}$, and the height is $10 \text{ cm}$. So, what is the volume of water in the bathtub?

Problem V. A tub in the form of a block measuring $150 \text{ cm} \times 75 \text{ cm} \times 60 \text{ cm}$, filled to the brim with water. It turns out that the bathtub was leaking so the water level was $35 \text{ cm}$, so how much water was lost?

Problems IV and V are given to stimulate students' thinking processes in implementing the concept of cuboid volume in solving problems with a variety of contextual problems.

**Metapedadidactic analysis**

At this step, an analysis of the didactic situation during the implementation of DDH was carried out by looking at the didactic triangle relationships, namely: didactic relationships (HD), pedagogic relationships (HP), and pedagogical didactic anticipation (ADP).

**Action situation**

In this situation, students are given 3 problems, namely problems I, II, and III as explained in the previous section.
**Formulation situation**

In this situation, students in groups are asked to solve 3 given problems. The problem I am given with the aim is that with the initial knowledge they have regarding the concept of a cube, students can understand the concept of cuboids by comparing the different characteristics of cuboids and cubes. Furthermore, Problem II is given to make students able to construct their knowledge regarding the concept of cuboid volume. Meanwhile, problem III is given with the aim that students can develop their knowledge using the knowledge they have regarding the concept of cuboid volume. In this case, students are asked to be able to determine the formula to calculate one edge length if the volume and length of the other edge are known.

**Validation situation**

To ensure the accuracy of problem-solving and the accuracy of the concepts constructed by students, the results of student work need to be validated. This validation process is carried out both during group discussions and during presentations. In solving problem I, students did not experience difficulties. This is possible because, before the problem I was given, the teacher had first explored students' initial knowledge about the concept of cubes and their characteristics. This didactic situation can help students to more easily identify the characteristics of cuboids based on their differences with the characteristics of cubes. From the validation process carried out, it was found that students understood: "A cuboid is a 3-dimensional geometric shape that has 3 pairs of opposite sides, and each pair of opposite sides is the same size."

Furthermore, based on the validation process in solving problem II, it was found that students understood that volume is the amount of space contained in an object. Based on their initial knowledge of the concept of cube volume, students understand that the volume of a block is the product of the length, width, and height of the geometric figure. However, in the process of solving problem II, student responses showed that students were still wrong in naming spatial shapes as seen in Figure 2, resulting in errors in determining the cuboid volume both conceptually and procedurally. In the question, the length of BC is the width of the beam, but based on the representation of students' answers, the length of BC is the diagonal of the plane of the beam. Based on the student's responses, the teacher provides scaffolding as ADP by conducting questions and answers to help students represent the ABCD.EFGH block image according to the correct writing rules, as in Figure 5.

![Figure 5](image)

*Figure 5. (a) Representation of the ABCD.EFGH cuboid according to students; (b) Representation of the expected ABCD.EFGH cuboid*
Based on the validation process for solving problem III, it was found that students did not experience problems in solving the problem. This is possible because at the beginning of the lesson, the teacher reminded us of the concept of algebraic calculation operations which is the basic concept for solving problem III. By using the concept of algebraic arithmetic operations, students can modify the formula:

\[ v = p \times l \times t \] to become 
\[ t = \frac{v}{p \times l} \] or 
\[ p = \frac{v}{i \times l} \] or 
\[ l = \frac{v}{p \times t} \] \hspace{1cm} (1)

with \( v \): cuboid volume, \( p \): cuboid length, \( t \): cuboid height, and \( l \): cuboid width.

**Institutionalization situation**

After students can formulate the concept of cuboid volume and validate it as knowledge, in this situation the teacher gives problems IV and V which aim to develop students' thinking abilities in implementing the concept of cuboid volume in various problems. From the results of solving problems IV and V, there were no difficulties experienced by students. This condition can be seen from the students' answers as in Figure 6. This condition is because the potential difficulties that students can experience in solving problems IV and V have been anticipated by the teacher by providing scaffolding in the form of questions and answers to stimulate students' reasoning.

\[
V_{\text{pool}} = p \times l \times t \\
= 80.75.10 \\
= 60.000 \text{ cm}^3
\]

\[
V_{\text{water}} = 60.000 \times \frac{3}{4}
\]

\[
V_{\text{water}} = 45.000 \text{ cm}^3
\]

(a)

\[
V_1 = p \times l \times t \\
= 150 \times 75 \times 60 \\
= 675.000 \text{ cm}^3
\]

\[
V_2 = p \times l \times t \\
= 150 \times 75 \times 60 \\
= 393.750 \text{ cm}^3
\]

\[
v_1 - v_2 = 675.000 - 393.750 \\
= 281.250 \text{ cm}^3
\]

(b)

**Figure 6.** (a) Results of solving problem IV; (b) Results of solving problem V
After implementing the DDH, a diagnostic test was carried out to measure students' understanding of the knowledge they had on the concept of cuboid volume, as well as to measure the extent to which the hypothetical didactic design minimized the occurrence of learning obstacles. 2 description questions are given as the diagnostic test.

**Question 1.** Look at the picture below!

![Diagram](image)

If the volume of block ABCD.EFGH is 1,350 cm³, the length of AE = 15 cm, and the length of EH = 9 cm. What is the length of the HG?

**Problem 2.** If a block-shaped tub has a width of 16 cm, a height of 10 cm, a volume of 1,600 cm³, and half of the tub is filled with water, then what is the length of the tub of water?

The results of diagnostic tests given to 25 of 9th-grade students after learning showed results related to student understanding. Based on the test results, students can solve the problem in question number 1. This is because, in the learning process, students have gained learning experience to be able to solve similar problems. However, it is different from the problem in question number 2. Students still found difficulties in solving question number 2. Some student test results are shown in Figures 7 and 8.

![Figure 7](image)

**Figure 7.** Diagnostic test results for undergraduate students on question number 2

Figure 7 shows that students are not yet complete in solving the problems given. Even though the final result is that the student's work shows the correct answer, conceptually there are still errors. S1 is limited to determining the length of the water tank with a normal (full) volume size. After conducting interviews, information was obtained that S1 was not detailed enough in identifying the information provided from the questions and S1 had not optimally represented the editing of the questions into mathematical sentences. S1 does not understand how long the water tub is by using the information "half of the tub is filled with water". Based on this, it was found that the learning obstacle that occurred was the epistemological concept.

![Figure 8](image)

**Figure 8.** S2 student diagnostic test results on question number 2
Furthermore, Figure 8 also shows errors in solving the given problem, both conceptually and procedurally. In the context of this problem, the length of the water tank should remain 10 cm. If the water tank is half filled with water, then the variables that remain constant in value are width and length, while the variables that change in value are volume and height. If the water tank is only half filled, then the initial volume \( V_0 \) is 1,600 cm\(^3\) to \( V_a = 800 \) cm\(^3\), and the height of the tank \( t_0 \) 10 cm becomes \( t_a = 5 \) cm. Thus, the length of the water tank after being filled with water up to half the tub is

\[
P_a = \frac{V_0}{(l \times t_a)}
\]

(2)

After conducting interviews, information was obtained that this student’s difficulties were caused by never having faced such a problem. This shows the existence of epistemological concepts and also didactic obstacles.

**Retrospective analysis**

At this step, an analysis is carried out to see the suitability between the didactic situation in the hypothetical didactic design (prospective analysis) and the didactic situation during the implementation of the hypothetical didactic design (metapedadidactic analysis), as well as an analysis to see the suitability between HLT (prospective analysis) and the existing learning trajectory (LT) arise during the implementation of a hypothetical didactic design (metapedadidactic analysis).

**Learning obstacle**

At prospective analysis, learning obstacles occur when given a diagnostic test with problem types such as problems III and IV: Ontogenic physical, epistemological concept, epistemological operational technique, and didactic obstacle. While at metapedadidactic analysis, learning obstacles that occur when given problems I, II, III, IV, V: none. Learning obstacles that occur when given a diagnostic test with a higher level of difficulty (test question number 2): epistemological concept and didactic obstacle.

**Learning trajectory**

Overall, the LT that occurred was by the HLT that had been designed. However, to improve the prerequisite concepts, it is necessary to check and re-understand how to write the names of geometric shapes correctly (eg block ABCD.EFGH), as well as how to change word problems into mathematical sentences.

**Didactic situation**

Overall, the didactic situation that occurred during implementation was the designed didactic situation. During implementation, 4 didactic situations (action situation, formulation situation, validation situation, and institutionalization situation) went according to design. However, in preparing improvements to the empirical didactic design, several things need to be added: 1) response predictions and ADP are added according to the student responses that emerge when implementing the hypothetical didactic design, 2) if the didactic situation and problems presented in the hypothetical didactic design are successful in overcoming learning, obstacles
Didactical design to overcome learning obstacles in cuboid volume

that occurred previously, then for didactic situations and problem presentation in empirical
didactic design it is necessary to present more complex problems and non-routine problems so
that students get a more complete learning experience and can encourage students to develop
reasoning abilities as well as an effort to minimize the emergence of new learning obstacles

Discussion

This research was carried out through three steps of analysis contained in DDR. At the
prospective step, HLT and DDH have been designed based on the need to minimize the
occurrence of obstacles to student learning, as occurred in the previous learning of cuboid
volumes. In previous cuboid volume learning, it was found that there were student learning
obstacles including ontogenic physiological obstacle, epistemological concepts,
epistemological operational technique obstacle, and didactic obstacle. This learning barrier is
considered to be the cause of students' learning obstacles in obtaining complete knowledge.

Apart from being based on the need to overcome students' learning obstacles, HLT and
DDH were also designed based on the results of researchers' studies on the presentation of
concepts according to scholarly knowledge and the presentation of material according to the
school curriculum through a didactic transposition process. This is important so that the
concepts learned and understood by students do not have gaps with their formal concepts. This
is in line with what was stated by Jamilah et al (2021) who stated that didactic transposition
analysis became the basis for compiling a new HLT which will serve as a framework for
designing didactic situations in the form of didactic designs.

The designed DDH contains four didactic situations which refer to the didactic situations
proposed by Brousseau (2002), namely action situations, formulation situations, validation
situations, and institutionalization situations. Jamilah & Winarji (2021) found that through four
didactic situations, students were facilitated to carry out the triadic cycle, and students were
able to build mathematical objects consisting of concepts and proof of the concept of the arc
length of a circle. On the other hand, Sumita et al. (2022) found that not implementing four
didactic situations properly had an impact on the occurrence of epistemological obstacles. So
by presenting 4 didactic situations in DDH, students are facilitated in gaining knowledge of the
cuboid volume.

After HLT and DDH were designed and implemented, findings were obtained which
showed that the four didactic situations presented were able to present didactic situations that
could help students to construct their knowledge on the concept of cuboid volume well. These
results can be seen from the student's ability to understand the concept of cuboid volume,
modify the cuboid volume formula, and solve various problems (problems I to problem V)
given during the learning process. Another finding is that the implementation of DDH can
overcome learning obstacles that occurred in previous cuboid volume learning. In other words,
in learning the cuboid volume there are no ontogenic physiological obstacles, epistemological
concepts, epistemological operational technique obstacles, and didactic obstacles. The results
of this research are in line with research proposed by Pramuditya et al (2021) which found that
didactical situations designed through didactic design can anticipate students' learning obstacles in algebraic form material and facilitate students' thinking process.

After presenting the 2 problems in the diagnostic test again, it was found that students were able to understand and solve the first problem using the concept of cuboid volume that had been studied, but students had difficulty solving the second problem. Where in solving the second problem, students are faced with a didactic situation that requires them to carry out a thinking and reasoning process. Meanwhile, in the learning process, students have not been intensively exposed to these didactic situations. This shows that there are learning obstacles caused by limited problem contexts presented during the learning process yang (epistemological concept) and limited didactic situations that can facilitate students to develop high-level thinking skills (didactical obstacle) (Sulastri, et al. 2022; Sidik, et al. 2021).

Therefore, to complement the didactic design that was developed, the empirical didactic design was supplemented with the presentation of a variety of more complex problems to facilitate students developing high-level thinking skills.

Conclusion
This research has shown that DDR obtained an empirical didactical design (DDE) which contains four didactic situations including action situations, formulation situations, validation situations, and institutionalization situations. This DDE has facilitated students to construct their knowledge on the concept of beam volume. The implication of implementing DDE is that student learning barriers such as ontogenic psychological, epistemological operational techniques, and didactical obstacles can be overcome.

The results of this study also show that there are still limitations in the presentation of problems in institutionalization situations which then have an impact on limitations on students in developing their knowledge, especially in solving various problems related to block volume. In other words, the limited presentation of this problem is a factor causing the occurrence of epistemological concepts. The limitation of the presentation of this problem is a supplementary note for improvements in the formulation of this DDE.

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Conflicts of Interest
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Author Contributions
Jamilah: Conceptualization, writing - original draft, editing, and visualization; Priskila: Writing - review & editing, formal analysis, and methodology; Dwi Oktaviana: Validation and supervision.

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Didactical design to overcome learning obstacles in cuboid volume
