Epistemological obstacle on the topic of triangle and quadrilateral

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Abstract. This study aims to investigate how students understanding of triangle and quadrilateral topic. It was part of didactical design research which was conducted on 33 students who have learned about triangle and quadrilateral. Data were collected through the students answers and interview related to how students find solution to problems on the topic of geometry. The result found of the type of learning obstacle that is epistemological obstacle that impact on the concept error in solving the problem. The limited knowledge of students when understanding the basic topics in identify the elements and the properties of a plane figure is a factor causing the emergence of common errors in the topic of geometry.

1. Introduction
Meaningfulness in learning should be part of preparation of teaching. Thinking before, during, and after learning is a form of effort that teachers cannot ignore to achieve meaningful learning goals. Real learning activity is a process to gain an understanding of concept that teachers present in the form of invitations for students to think, not just create a student oriented learning situations memorizing certain theories or formulas. Learning process that is less contextual become one of the learning phenomenon that often occur with the reason of chase the target of the curriculum so as to ignore the meaningfulness of learning that impact on the pattern of imitative thinking that formed in students' thinking [1]. The importance of teachers designing learning trajectory and learning situations to do so in the form of considering the possibility of learning obstacle faced by students is an early stage that teachers must doing, not even just obstacles, the teacher must consider everything possible that can happen in teaching mathematics. This is important to do as part of a tripartite education relationship. The teacher designs the learning trajectory is a potential way to obtain planning in making instruction adjusted to students thinking that will be used in learning, this will support learning and achievement of learning goals [2]. Learning trajectory represents the integration of the relationship between the material being studied with the previous material and the material that follows [3].

One of the obstacles teachers have to consider in teaching mathematics is the epistemological obstacle. The obstacles that often arise in the process of acquiring this new knowledge arise as a result of the limited understanding of students or knowledge in a certain context [4,5]. One of the indication that arise from these obstacles is when students have difficulty in applying concepts or knowledge to different contexts that they did not find at the time of learning.

Geometry is one of the important components to be studied, because by studying geometry allows students to learn to analyze [6]. Triangle and quadrilateral topics are part of the geometry that still finds
obstacles. The emergence of obstacles in the topic of triangle and quadrilateral geometry is a fact of finding that comes from previous learning designs. Several findings in the study mentioned that the students forgot to divide the two multiplication of base with height when using the formula to solve the problem of measuring the area of the triangle, this occurs as a result of the student’s habit of memorizing the formula [6,7]. Not only in the subtopics area of the triangle and quadrilateral, the difficulty in define the parallelogram associated with the concept of plane figure properties identified from the results of research which states that "parallelogram is oblique rectangle" [8]. The concept of drawing does not always indicate the definition of a formal concept, and this can cause problems [9]. Difficulties with the wide area topic have been felt by elementary school students, this comes from the way they get about the tasks about the area that is presented in the textbook [10,11].

Based on the results of research that has been done related to the identification of learning obstacle shows the existence of epistemological obstacle. This research is intended to investigate further about the emergence of these epistemological obstacle. This finding is not only to understand about epistemological obstacle in triangle and quadrilateral topics, but as a first step in developing instructional design. So with the beginning of the obstacles on the topic, then proceeded to make predictions of student’s responses to the design made is expected to create learning situations that can minimize the possibility of the emergence of obstacles in studying triangle and quadrilateral topics.

2. Method
This research is part of a didactical design research that uses two paradigms that are interpretive and critical. The interpretive paradigm is used to identify epistemological obstacle in triangle and quadrilateral topics based on earlier didactic designs, whereas a critical paradigm is used to follow up obstacle findings by designing a new didactic design based on identifying learning obstacle [12].

This research was conducted on 33 students collected from students of class VIII, IX, and X in one of junior and senior high school in Cianjur, Indonesia. Students who attend this research are students who have learned the topic of triangle and quadrilateral. Each student is given a test consisting of four issues related to triangle and quadrilateral. The time provided is 80 minutes. After they complete the test, the researcher observes the student's answers and selects some students for the interview.

3. Result and discussion
Based on the analysis of the students answers to the tests given, the researchers found the type of epistemological obstacle identified from the way students apply the concept of solving problems on triangle and quadrilateral topics. This can be seen from the students answer in figure 1.

Figure 1. Students answer in question number two.
In figure 1 it is seen that the students know the formula used to find the area of triangle and do the problem solving process by divide the area into two parts namely triangle I and II, but in the process of counting the students cannot know the size of the elements contained in the picture. Students assume that the measurements contained in the problem are representations of the elements contained in the plane, without fully understanding the size is a measure of any element. This indicates that the student has not understood the concept of the base and height of the triangle that should always be consistent (the base is always perpendicular to the height) [13]. Some research results on learning related to measurement topics show that in addition to being difficult to understand about volume, students also experience difficulties in measuring topics regarding length and area [14]. As well as with the quadrilateral, students are still mistaken between the high line and the diagonal in determining the height of the parallelogram [15]. The lack of extent of the student context when studying the triangle elements causes the students to experience obstacles in the face of the image context different. This is reinforced by the interview result, the student assumes that the height known to the size of 8 cm is the result of the student’s shadow that rotates the AB side to the FB side and the AC side base with the 2 cm size obtained by assuming the AC side size is equal to the HC side. This indicates the ability of students who have not been optimized because of the limitations of the context and the introduction of the form of questions that hone the ability of students to understand the concepts given when studying the topic, so that when students are faced with no routine problems make students feel difficult.

In addition, the findings obtained regarding the concept of area plane is also found in one of the student answers presented in figure 2 regarding the errors between the area of a plane and the perimeter used in solving the problem.

![Figure 2. Students answer in question number four.](image)

Students answers in figure 2 show that procedurally students can know the initial step to determine the shaded area by dividing the area into two parts, triangle and rectangle. But as it continues to search for the area of each section, students experience a mistake in determining which formula should be used. Students still find it difficult to distinguish the formula for the area and the perimeter. This difficulty is consistent with the results of previous research which mentions that many students are confused between area and perimeter, and height on a plane [7]. This shows that students are easy to have mistaken when working on problems that are not familiar with the problems presented in geometry form. Awareness of
students in determining the formula used in solving the problem seen after the researchers conducted interviews with students as follows.

Teacher: "If \( N \) how to determine the area of the shaded area? divide the two into triangle and rectangle?"
Student: "Yes"
Teacher: "Area of triangle with formula \( \frac{1}{2} \) base \( \times \) height and area of rectangle \( 2 (p) + 2 (l) \)?"
Student: "eta mah keliling atuh pa" (it's a perimeter sir)?

The students statement indicates that at the time of the interview the students realized that the formula used was to search for rectangle perimeter, but at the time of working on the question the student had not realized that the formula used was wrong. This is because students who are accustomed to memorizing the various formulas without fully understanding the difference between the formula used in calculating the area and the perimeter.

Another problem related to the triangle topic is the ability to identify (the properties and special properties) of a plane. The findings from the preliminary study of plane identification are shown in figure 3.

In figure 3 it can be seen that the students answer still shows its weakness in identifying triangle based on the size of the sides and angle types. In contrast to student answers at interviews, on the basis of isosceles triangles and equilateral triangles, students are able to distinguish between isosceles triangle shapes and equilateral triangles, including differentiate the size of the angle by acute, obtuse, and right triangles. Based on the description it is identified that the student has not fully understood the concept.
of the triangle topic in grouping the triangles when working on problems related to grouping of triangle. This is caused by the lack of students in fully understanding the types and properties of the triangles.

The same thing is identified on the question of learning obstacle on the identification of the quadrilateral as shown in Figure 4. In that question the students are asked to conclude whether the three plane drawings given are included in the plane of parallelogram or not?.

![Figure 4](image.png)

**Translation:**
3. Between the figure on the side, which ones are the parallelogram?
   Why?

**Solution:**
- H and I, and J is not parallelogram
- Because H has two equal and parallel sides A=B
- Because I has two equal and parallel sides C=D
- *J is not a parallelogram but a rhombus, because all the sides are equal and parallel*

4. Conclusion
The findings that cause learning obstacle on this topic are the context of the elements and the properties of plane figure that students understand is still limited, thus becoming an obstacle for students in understanding and using concepts to solve geometry problems. This is shown from the way students answer in determining the height, base, or formula that is right with the type of plane in solving problems. This condition will adversely affect students in learning the next topic, because students are not enough to only know the rules/procedures that must be done when planning a settlement. If students do not know the correct concept related to the implementation of procedures in solving problems, then students will error in solving the problem, including no routine problems.
Acknowledgement
We would like to thank the educational institutions who have supported this research. Grade VIII, IX, and X students of SMP and SMA Al-Ma’moen Cianjur and for teachers who have provided opportunities for researchers to use their classes.

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