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# Learning obstacle analysis on area of the triangle

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**Abstract:** The purpose of this study is to analyze and find out the learning obstacles experienced by students regarding the material of the area of the triangle. As research subjects, this study took 5 students who had studied triangular material, 3 grade VII students and 2 grade VIII students. Qualitative methods are used in this study because they are relevant to the purpose of the study. In this study, the data collection technique used a written test in the form of description questions and also interviews to each student who had taken the test. The research that has been conducted produces two learning obstacles experienced by students, namely ontogenic obstacles and epistemological obstacles.

## INTRODUCTION

According to Law No. 20/2003 on the National Education System, learning is the process of interaction between students and educators and learning resources in a learning environment. Learning is a systematic and systemic activity or process that is interactive as well as communicative between educators and students, learning resources, and the environment to create conditions that enable student learning actions (Arifin, 2009).

Mathematics is one of the subjects that has a very important and useful role in education and for life. Based on Permendikbud (No. 21, 2016), mathematics consists of several aspects of study including numbers and operations, algebra, geometry, measurement, data analysis, and probability. From each of these aspects, has its own role in mathematics and also in everyday life. The study of geometry is one of the materials studied by students from elementary school. Oladosu (2014 in Kemp & Vidakovic, 2021) explains that geometry is a central aspect of the school mathematics curriculum and is considered very important to provide facilities for students to develop spatial abilities as well as geometric thinking skills. Geometry is a part of mathematics that discusses points, lines, shapes, relationships between lines, perimeter, area, volume, and others, Baykul (1999 in Biber et al., 2013). In geometry, there is a discussion of triangles. Triangles are polygons that have three sides (DATAR, n.d.). Likewise with (Nurfadilah et al., 2022) which says a triangle is a flat shape bounded by three sides and an angle point and has a base. So it can be said that a triangle is a polygon that has three sides whose sides form 3 corner points.

(Sinaga, 2016) said that rectangles and triangles are basic materials that students must understand because they are closely related to everyday life. According to the Ministry of

Education and Culture (2016) also suggests that triangles are a basic concept in geometry that begins to be taught to school students in grade 4 elementary school and grade 7 junior high school. From this statement it can be said, triangle material is important material and must be learned by every student, because this material is related to the next material, and is also important in the application of everyday life. Seeing the importance of triangle material, therefore, researchers take triangle material that focuses on the triangle area as the material chosen in this study.

But in reality, there are still students who do not fully understand triangle material ranging from concepts, procedures, to triangle calculations. In addition, students experience learning obstacles in solving triangle problems. Some researchers show that there are still students who experience learning obstacles in triangle material. In a study conducted by (R. R. Sari & Roesdiana, 2020) showed that there were still errors when solving problems regarding the triangle area. Supporting research conducted by (P. W. Sari et al., 2019) states that students experience epistemological obstacles, namely student knowledge that has a limited context, as well as in (Muzaky, 2017) the results of the study state that students experience errors in concepts, procedures, and calculation operations. (Anisa et al., 2023) also conducted research which stated that students experience ontogenic obstacles, which are obstacles related to a person's mental readiness, epistemological, namely student knowledge that has a limited context, and didactical is an obstacle related to teaching materials, or learning presentations used by teachers. From some of these studies, researchers concluded that there are still many students who experience learning obstacles or learning obstacles in triangle material.

According to Istiqomah (2012 in Mardiana et al., 2014), "Learning obstacles are situations experienced by students naturally in the learning process". Suryadi, D. (2018 in Andani, 2021) said that students often experience difficulties (learning obstacles) and misconceptions about material during the learning process in class, this situation is referred to as learning obstacles, abbreviated as LO.

According to Brousseau (2002: 86 in Rohimah, 2017), Learning obstacles experienced by students when learning a material in learning are categorized into three types. (1) The first obstacle, ontogenic obstacle, is the mismatch between the level of thinking of students and the learning provided by educators, so that student difficulties arise in the process of understanding a material. (2) The second type of obstacle is epistemological obstacle, which is difficulty during the learning process, this occurs as a result of the context known by students is still limited. (3) The last obstacle is didactical obstacle, this difficulty occurs due to the delivery or the way educators conduct learning.

Based on this, for this reason, researchers will analyze student learning obstacles that narrow down learning on the material of the triangle area, so that researchers raise the title "Learning Obstacle Analysis on Area of The Triangle".

## METHOD

In this study, qualitative research methods were used by researchers. According to Sugiyono (2016 in Noor, 2011), qualitative research methods are methods based on the philosophy of postpositivism, this method is used in research that focuses on natural object

conditions. By using qualitative research, the results obtained emphasize the meaning of generalization. This research design uses a case study approach. The case study approach is a qualitative research where researchers examine a limited case in a certain period of time, case studies are conducted by collecting data in depth from various sources such as observations, interviews, audio recordings, and report documents, (Creswell, 1998 in Assyakurrohim et al., 2022). This research focuses on finding learning obstacles, thus this method is in accordance with the research objectives, namely being able to find out the learning obstacles of students in the triangle area material by conducting interviews.

This study took 5 students who had studied triangle material as research subjects, consisting of 3 seventh grade students and 2 eighth grade students. The data collection technique uses instruments in the form of description questions that refer to research (Paoletti et al., 2018 in Rosita et al., 2021), The description question consists of 3 questions about the area of a triangle which has the aim of knowing the ability of each student. Furthermore, interviews were conducted with five students who had completed the written test to identify and obtain more supportive information related to the learning obstacles experienced by some of these students.

## RESULTS AND DISCUSSION

The purpose of this study was to find out the learning obstacles of some students related to the material of triangle area. The data used was obtained from 5 students, consisting of 3 seventh grade students and 2 eighth grade students who had studied triangle material and had conducted a test on the triangle area by the researcher. The proposed test consists of 3 questions as follows:

1. You know a triangle has an area of 86.8 $cm^2$ , the length of the base of the triangle is 14 cm. What is the height of the triangle?
2. Take a look at the following triangle!

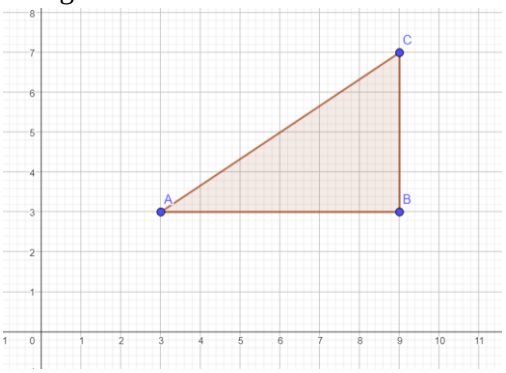


Figure 1. Problem number 2

What is the area of the triangle? In cm (centimeters)

3. You have the following triangle:

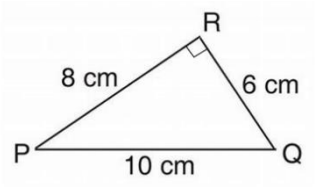


Figure 2. Problem number 3

What is the area of the triangle?

The following are the completion results and interview results of some students who have done the test and found learning obstacles in some of these students.

**a. Ontogenic Obstacle**

Ontogenic obstacles, namely the mismatch between the level of thinking of students and the learning provided by educators, so that student difficulties arise in the process of understanding a material, Brousseau (2002: 86 in Rohimah, 2017).

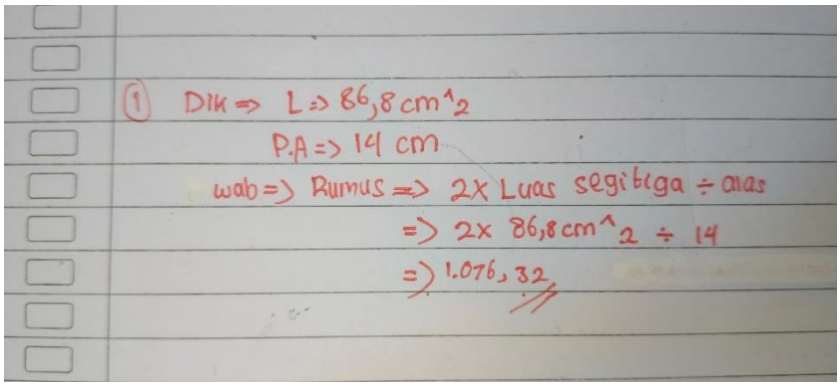


Figure 3. Ontogenic obstacle of student a on number 1

Seen in the picture, students can already know how to find the height of a triangle whose area and base length are known, but the student is still wrong in using mathematical calculation operations. Researchers have conducted interviews with related students.

Researcher : Do you know where the formula you used came from?
Students : From the triangle formula ma'am
Researcher : Well, what's the formula?
Students : I googled it mom
Researcher : Ohiya then, now try to recalculate the work
Students : I don't know how to sum it up mom
Researcher : Try to calculate one by one, 2×86.8 =
Students : This is mom? I'm too lazy to take a picture (sending a screenshot of the calculation result from the calculator with the correct result)
Researcher : Yes, that's right, so you miscalculated before.

In interviews with related students, students experience ontogenic obstacles, students do not know the origin of the formula for finding the height of a triangle, students are also lazy to calculate manually when asked to recalculate.

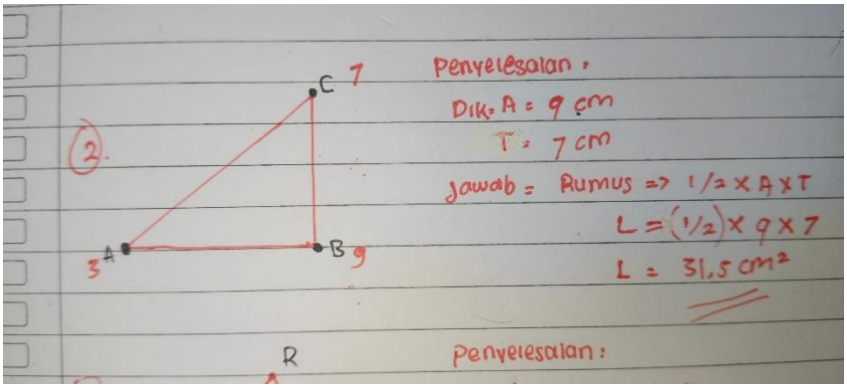


Figure 4. Ontogenic obstacle of student a on question number 2

It can be seen in the student's answer, the student cannot determine the length of the base and also the height of the triangle. Students know and are able to calculate the triangle area but are less

precise in determining the length of the base and height. The researcher conducted an interview with the student.

| | |
|---|---|
| Researcher | : How did you determine the base length of 9 cm and the height of 7 cm? |
| Students | : From point B, which is parallel to the number 9, to point C, which is parallel to the number 7. |
| Researcher | : Oalah |
| Students | : Is it wrong mom? |
| Researcher | : Still not right, because you didn't pay enough attention to point A. |
| Students | : I answered carelessly |
| Researcher | : Do you remember learning about number lines? |
| Students | : Remember a little |
| Researcher | : How long do you think AB and AC are? (the researcher gives an example of another triangle drawing, AB=4, AC=3) |
| Students | : AB = 5, AC = 4 |
| Researcher | : Try to count the number of boxes, to make it easier |
| Students | : AB = 4, AC = 3 |
| Researcher | : Well, that's right |

From the answers and interviews that have been conducted, students experience ontogenic obstacles, students are still careless in answering and less careful in determining the length of the base and height of the triangle, students also have not mastered the prerequisite material regarding the number line. Judging from interviews with students, after being given examples of other drawings, students still answered incorrectly. Students also stated that they remembered little about the number line.

**b. Epistemological obstacle**

Epistemological obstacle, difficulties during the learning process, this occurs as a result of the context known by students is still limited, Brousseau (2002: 86 in Rohimah, 2017).

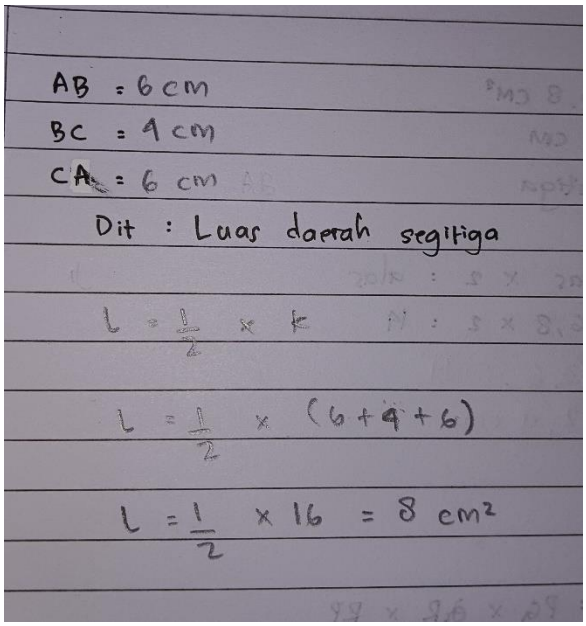


Figure 5. Student b's epistemological obstacle on question number 2

Students' answers that are seen, students make mistakes in determining the length of one of the triangles. Students are also still incorrect in finding the triangle area. Researchers conducted interviews with related students.

| | |
|---|---|
| Researcher | : Do you know how to find the area of a triangle? |
| Students | : I use the formula ½×base×height, if the perimeter is known, I use the formula ½×perimeter of the triangle. |
| Researcher | : According to you, in question number 2, which is the base and height? |
| Students | : The base is AB, the height is BC |
| Researcher | : Right, why did you use that formula? |
| Students | : Because the perimeter formula is AB+BC+CA, add up the lengths of the sides |
| Researcher | : Why don't you use ½×base×height, AB as the base and BC as the height |
| Students | : Duh, yes, that time I was fooled by the number of the hypotenuse. |
| Researcher | : How did you determine AB 6 cm and BC 4 cm and CA 4 cm? |
| Students | : In the photo, AB is the distance from 3 to 9 that is 6 counts, then BC is from 3 to 7, CA is from 3 to 7. |
| Researcher | : Now determining the length of CA is still not right |
| Students | : Oh, so you have to use the pythagorean formula, right? |
| Researcher | : That's right. |

From the interviews that have been conducted, students experience epistemological obstacles where students are fooled by the picture in the problem and also forget to use the pytagorean formula that students already know. Students are also mistaken in finding the triangle area and also using the triangle area formula.

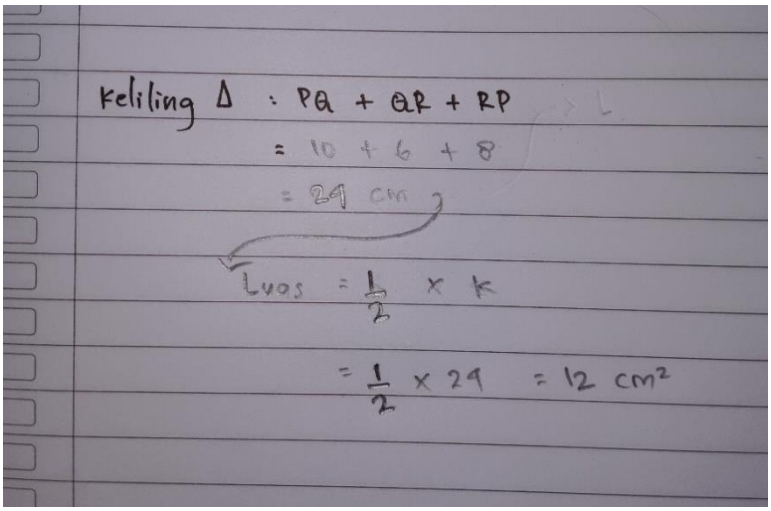


Figure 6. Student b's epistemological obstacle on question number 3

From the picture seen, students have been able to determine the length of each side of the triangle, it can be seen that students plan to use the heron formula in finding the area of the triangle. The researcher conducted interviews with related students.

| | |
|---|---|
| Researcher | : In question number 3, which do you think is the base and height? |
| Students | : The base is 10 cm, if the height I'm confused, because it's like a hypotenuse. |
| Researcher | : So you used the other formula because you were confused? |
| Students | : Yes ma'am |

Researcher : If the picture is reversed so this, what is the length of the base and the height? (The researcher rotates the triangle so that the QR position is below)

Students : The one with a base of 6 cm and a height of 8 cm

Researcher : Well right, so don't be fooled, because the base is not always below, if the base is 10 cm, the height is not 6 cm, but perpendicular to the base towards the apex of the triangle (researcher draws auxiliary line). The elbow mark can be a benchmark if the side next to it is perpendicular because the angle is $90^o$ , so both sides next to it can be used as base and height

Students : Yes ma'am

Researcher : For this triangle, what are the lengths of the base and the height? (the researcher shows a triangle with the lengths of each side 3, 4, and 5 cm with the position 5 cm below).

Students : The base is 3, the height is 4

Researcher : Right, I understand now

Students : Yes, ma'am, I understand, thank you, ma'am.

Researcher : Ohiya to use the formula ½×the perimeter of the triangle is indeed there, but there is still a continuation

k : perimeter of the triangle

k = a+b+c

s = ½k

$L = \sqrt{s(s-a)(s-b)(s-c)}$

Students : That means rooted yes ma'am

Researcher : Root Yes

Students : Ohiya ma'am, thank you very much

In the interview, the student experienced an epistemological obstacle because the student was still confused in determining the length and height of the triangle. However, the student overcame this by using the heron formula that the student knew even though the formula used was still incomplete .

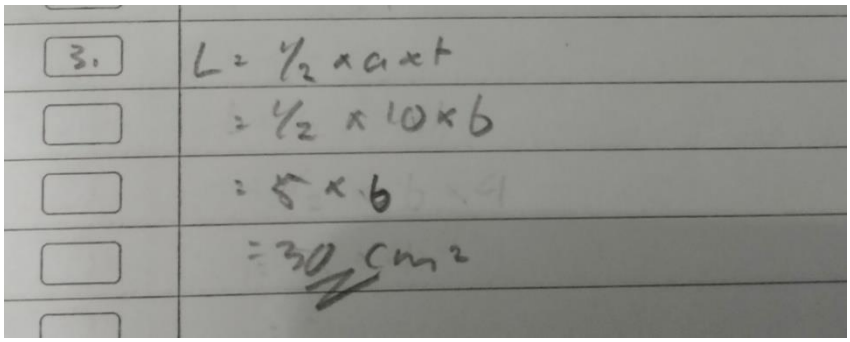


Figure 7. Student c's epistemological obstacle in question number 3

From the answer, it can be seen that students are less precise in determining the base and height. But in using arithmetic operations and also the use of the triangle area formula, students are able and correct. Furthermore, interviews were conducted with related students.

Researcher : In your opinion, in question number 3, which is the base and height?

Students : I think the base is 10 cm and the height is 6 cm.

Researcher : If the picture is reversed so this, what is the length of the base and the height? (The researcher rotates the triangle so that the QR position is below)

Students : The base is 6 cm high by 8 cm wide

Researcher : That's right, so the base is not always below, if the base is 10 cm, the height is not 6 cm, but perpendicular to the base towards the apex of the triangle (researcher draws auxiliary line). The elbow mark can be a benchmark if the side next to it is perpendicular because the angle is 90$^o$ , so the two sides next to it can be used as base and height

Students : Ohiya ma'am

Researcher : For this triangle, what are the lengths of the base and the height? (the researcher shows a triangle with the lengths of each side 3, 4, and 5 cm with the position 5 cm below).

Students : 3 and 4 ma'am

Researcher : Right, now you understand

Students : Yes, ma'am, I understand

After the interview, it can be concluded that students experience epistemological obstacles because they still instill the concept that the base is always below. So that students make mistakes in determining the height of the triangle.

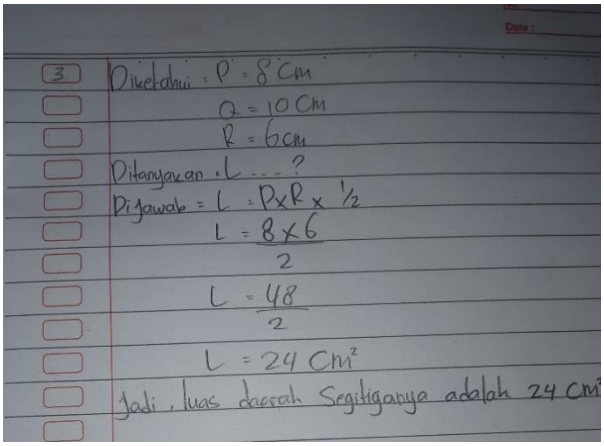


Figure 8. Student d's epistemological obstacle on question number 3

In the answers seen, students are correct in determining the length of the base and height, students are also able to calculate and use the triangle area formula. But during the interview, the student experienced epistemological obstacles like other students.

Researcher : Why did you take 8 cm and 6 cm as the base and height?

Students : I don't know ma'am, I was helped by a friend.

Researcher : From the picture, which do you think is the base and the height?

Students : The base is PQ, the height is QR

Researcher : Still not right, if the picture is reversed so this, what is the length of the base and the height? (The researcher rotates the triangle so that the QR position is below)

Students : Then PQ is the height and RQ is the base.

Researcher : Still not right, if the base is QR, the height is PR, so the base is not always below, if the base is 10 cm, the height is not 6 cm, but perpendicular to the base towards the apex of the triangle (researcher draws auxiliary line). The

elbow mark can be a benchmark if the side next to it is perpendicular because the angle is $90^o$ , so the two sides next to it can be used as the base and height.

Students : Oh I see ma'am

From the interviews that have been conducted with related students, students experience epistemological obstacles because in fact students do not know the reason for taking the base and height because they are helped by friends. When asked again, students are wrong in determining the base and height.

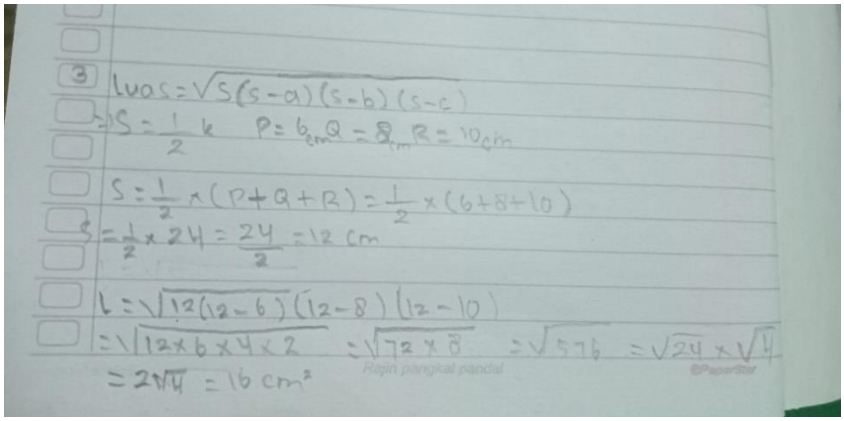


Figure 9. Student e's epistemological obstacle in question number 3

The picture shows that students use the heron formula in solving the problem, students are also correct in using the formula and using arithmetic operations, it's just that when calculating at the end, students make mistakes in converting the root form to the natural number form. Researchers conducted interviews with related students.

Researcher : Do you know what the formula you used is called?

Students : Heron formula ma'am, right ma'am?

Researcher : That's right, if in question number 3, which do you think is the base and the height?

Students : I don't think the height is known, if it's the 10 cm base

Researcher : Right, because you don't know the height, so you use the heron formula, right?

Students : Yes ma'am

Researcher : If $\sqrt{576}$ is expressed as a whole number, how much would it be?

Students : 24?

Researcher : Right, so you miscalculated yesterday?

Students : Yes

Researcher : If the picture is reversed so this, what is the length of the base and the height? (The researcher rotates the triangle so that the QR position is below)

Students : Height 10 cm base 6 cm?

Researcher : Not

Students : So which one is right, ma'am?

Researcher : 6 cm base, 8 cm height

Students : Ohh

Researcher : The elbow mark can be a benchmark if the side next to it is perpendicular because the angle is $90^o$ , so the two sides next to it can be used as the base and height

Students : Ohiya ma'am

From the interview that has been conducted, the student is indeed mistaken in expressing the root form to an integer, so the final result is not correct. After being asked further questions, the student experienced epistemological obstacles as experienced by other students, the student was still mistaken in determining the base and height when the triangle was rotated, but the student could overcome this by using the Heron formula in finding the area of the triangle.

**c. Didactical obstacle**

Didactical obstacle, this difficulty occurs due to the delivery or the way educators conduct learning, Brousseau (2002: 86 in Rohimah, 2017). After conducting tests and interviews with 5 students, researchers did not find the five students experiencing didactical obstacles. Researchers also did not conduct document studies due to time constraints and the distance between researchers and research subjects.

## CONCLUSION

Based on this explanation, it can be concluded that the five students who conducted written tests and interviews still experienced 2 types of learning obstacles, namely ontogenic obstacles and epistemological obstacles. Students experience ontogenic obstacles because students do not understand the prerequisite material of the number line so that they are mistaken in determining the length of the base and height, and students feel lazy in calculating. Epistemological obstacle is experienced by students because students are still mistaken in determining the base and height, students still instill the concept that the base is always below, this makes some students also mistaken in determining the height because they have not embedded the concept that height is a line perpendicular to the base towards the apex of the triangle. Some students also did not use the Heron formula to anticipate errors in finding the triangle area. Didactical obstacles were not found in this study, in the interviews there were no statements from students that supported the existence of didactical obstacles, researchers also did not conduct document studies due to limited time and distance from the research subjects.

For future researchers, researchers have suggestions to also analyze the factors that influence the existence of these learning obstacles, so that the research conducted can be deeper. Educators are also expected to be able to instill the concept of triangles more deeply so that students do not experience many mistakes in solving triangular area problems. The Heron formula can also be introduced so that students can anticipate mistakes in solving problems when students are confused in determining the base and height.

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