ICEE-2

Epistemological Obstacle on the Material of Circumference and Area of Plane in Grades 4 and 5 of Elementary School

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Abstract. Geometry is one of the subject matter taught from elementary to higher education, one of the material taught in geometry in elementary school is circumference and area of plane material. This study aims to analyze of epistemological obstacle of fourth and fifth grade students of SD Negeri Asmi 033 Bandung City in answering circumference and area of plane question. This study used an exploratory study in the form of a written description test on the circumference and area of plane material given to fourth and fifth grade students of SD Negeri Asmi 033 Bandung City. The results of the analysis show that there are still many students who experience learning obstacle related to epistemological. This research is expected to be taken into consideration by teachers in seeing students' learning obstacles to be used as material in making didactic designs on the Material of Circumference and Area of Plane in Grades 4.

Keywords: epistemological obstacle, circumference and area of plane, elementary school

INTRODUCTION ~ The contribution of mathematics education in aspects of human life is so great, It is based on that every human being will not be separated from mathematical activities in his daily life, so that mathematics education begins to be taught from elementary education to higher education. According to Baykul in (Unlu, Ertekin, & Dilmac, 2017) mathematics is a very important tool learned by students, mathematics is used to solve problems in science and everyday life, furthermore mathematics will help students think creatively and critically and also be able to understand the world

To prepare students for the 4.0 industrial revolution, the government requires elementary education to understand mathematics and science literacy. So in this case, mastery of mathematical material becomes important for every student, especially in elementary schools in facing

the industrial revolution 4.0. Students need to have the ability to obtain, choose and process information to survive in ever-changing, uncertain and competitive circumstances. The abilities needed by these students include the ability to think critically, systematically, logically, creatively and the ability to work effectively together. This way of thinking can be developed through learning mathematics, because mathematics has a strong and clear structure and interrelationship between its concepts so as to enable students to be skilled in rational thinking (Depdiknas, 2003).

The purpose of learning mathematics according to Kemendikbud 2013 are 1) enhance intellectual abilities, especially students' higher-order thinking skills, 2) shape the ability of students to solve a problem systematically, 3) obtain high learning outcomes, 4) train students in

communicating ideas, especially in writing scientific papers, and 5) develop student character.

One effort to achieve these goals is to create a process of learning mathematics that allows students to build their own knowledge. The teacher has an important role to facilitate students to build knowledge and ensure that students experience a thought process that guides them to achieve the expected learning goals. Teacher's role in teaching mathematics is very important (Ho & Hedberg, 2005), the teacher must be able to teach meaningful learning and correct concepts, because this will affect the meaning contexts obtained by students. Suryadi, (2010a) explained that to create effective learning is to focus attention to optimize the relationship of the three basic elements in learning. The three elements are depicted in a didactic triangle which includes students, teachers and teaching material.
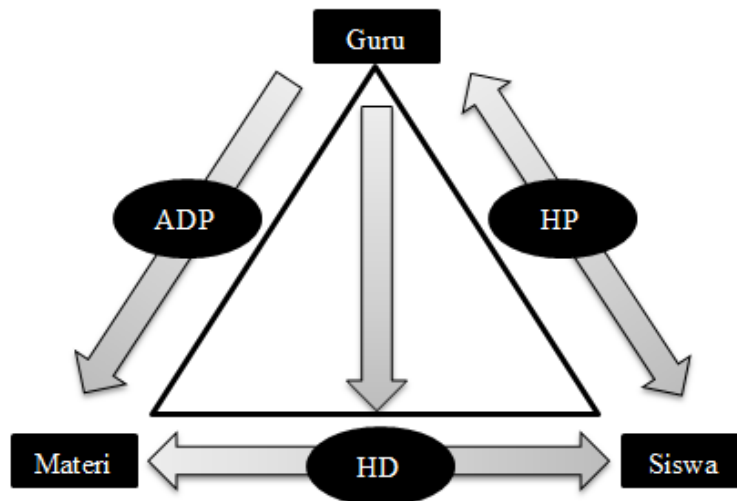

Figure 1. Three Basic Elements in Learning

Based on the picture above that the teacher has a role in creating didactic situations, so that learning processes occur in students. This indicates that a teacher must really master teaching material and have other knowledge related to students.

Learning Mathematics is still considered difficult by students, this is also explained by Putra, et al (2018a) that students do not like math because it is considered difficult to understand. According to Putra, et al (2018b) that the cognitive development stage of the majority of students who are still in the concrete operation stage, this is what makes it difficult for them to understand abstract mathematical concepts directly, plus habits in schools that teach mathematics with theory / definition / theorem, hen given examples and finally given a question exercise (Soedjadi, 2000).

Geometry is one of the fields in mathematics that studies points, lines, fields and space as well as the properties, measurements, and the relation of one to another. when compared with other fields in mathematics, geometry is one of the

fields in mathematics which is considered the most difficult to understand (Nur'aini, dkk., 2017). One of the materials studied in geometry is circumference and area plane.

Based on an interview with an SD Negeri Asmi 033 Kota Bandung that the material that was difficult to learn in grade 4 was about geometry, including the difficulty of students in understanding the circumference and area of plane, the difficulty is caused by the obstacle students face when learning.

According to Sukirno & Ramdhani (2016) when a student finds obstacles in his learning experience, it can be possible the cause is the interaction system, the learning process that occurs, the nature of teaching from the teacher, the nature of the subject matter, genetic factors and personal development. This shows that there are overlaps between various constraints, due to the complex nature of the construction of knowledge.

learning obstacle (LO) According Bousseaou (Suryadi, 2015) divided into three of them are ontogeny obstacle, epistemological obstacle, and didactical obstacle. Hercovics dalam (Nyikahadzoy, Mapuwei & Chinyoka, 2013) using epistemological barriers that refer to existing mental structures or new material

Then the qualitative method is very appropriate to uncover the epistemological obstacle students are

structures. According to them that there are two basic types of epistemological obstacle including 1) students try to assign new material to existing mental structures that apply in other domains but are not appropriate for the material being studied, and (2) obstacle students in understanding new material so that students do not have adequate mental structures that allow students to allow the assimilation of new material.

In this study, researchers will analyze students' epistemological obstacle on geometry material, especially on circumference and area of plane in SD Negeri Asmi 033 Kota Bandung, this research is expected to be a material problem in developing geometry material especially on circumference and area of plane. In addition, this research is expected to be a material consideration in making didactical design based on students' obstacle learning on circumference and area of plane material.

METHOD

This research uses a qualitative approach, Creswell & Clark (Lestari & Yudhanegara 2015) explains that qualitative research are methods for exploring and understanding the meaning that some individuals or groups of people consider as coming from social or humanitarian problems.

concerned with circumference and area of plane material. This study uses exploratory methods to explore deeply

about epistemological obstacle. According to Arikunto (2006) that explorative research is research that aims to explore broadly and deeply about the causes or things that influence the occurrence of something. The subjects used in this study were 26 students in grade 4 and 25 students in grade 5 in SD Negeri Asmi 033 Kota Bandung. The instrument used in this study was a written description test of shape material which also referred to the syllabus of mathematics learning in grade 4 elementary school.

Data collection is carried out as follows (1) Students are asked to answer the test questions about the circumference and area of plane material, (2) student workmanship in a question sheet in the form of scribbles becomes data supporting written test results, and (3) Researchers took several answers of students who had difficulty in working on the circumference and area of plane material to be interviewed.
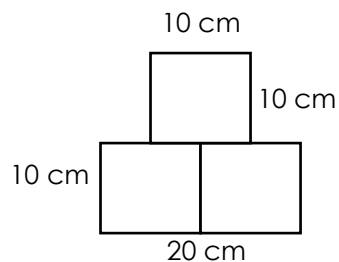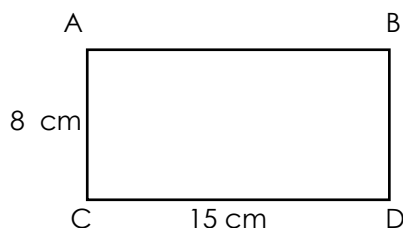
Data analysis conducted in this study was carried out in two stages, 1) identify various types of student learning barriers related to students' epistemological responses to questions circumference and area of plane, and 2) Further analyze the type of epistemological obstacle in the circumferential material and rectangular area.

RESULT

Based on observations made by learning obstacle on the concept of circumference and rectangular area, there are four types of learning obstacle experienced by students, namely:

Type 1: Epistemological related obstacle calculates the perimeter of a rectangle using standard units.

Question 1

The problem given first is about the circumference of plane, Grade 4 students who answer appropriately using standard circumference units are 9 students out of 26 students, and Grade 5 students who answer appropriately using standard circumference units are 1 student out of 25 students.

ICEE-2

Table 1. Epistemological obstacle about calculate the circumference of plane using standard units

Grade 4	Grade 5
1. There are 9 students who answer right but do not use the standard circumference unit	1. There are 2 students who answer right but do not use the standard circumference unit
2. Some students answered that the circumference of the plane is 2 multiplied length multiplied width ($K = 2 \times (p \times l)$)	2. Some student complete circumference using the area formula concept ($K = p \times l$)
3. Students are still confused with the area formula ($K = p \times s$)	3. Some students multiply each side of the plane
4. Some students are still constrained by multiplication counting operations in solving circumference problems	4. 6 students who answer without giving circumference or area answers
5. Students are fixated on the formula that has been taught	5. Students are fixated on the formula that has been taught
	6. 3 students did not answer

The second question given is about the combined circumference, the results show that 4th grade students who answer appropriately using standard circumference units are 4 students out of 26 students, and 5th grade students who answer appropriately using standard circumference units are 1 student out of 25 students.
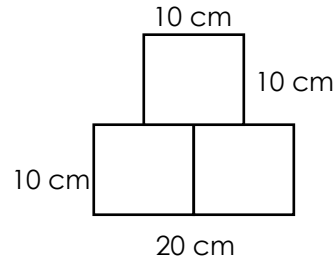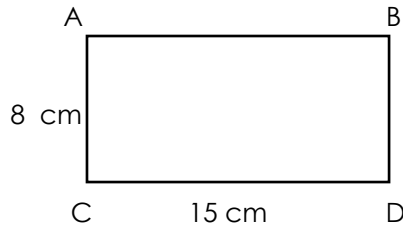
Table 2. Epistemological obstacle about calculate the combined circumference of plane by using standard units

Grade 4	Grade 5
1. Overall students have difficulty when faced with questions that are different from usual	1. Overall students have difficulty when faced with questions that are different from usual
2. Some students only calculate the bottom circumference of plane ($K = 2 \times (10 + 20)$)	2. Some students multiply the sides of the shape
3. There are also students who calculate it using the circumference formula alone or by counting one by one each of the shapes	3. 7 students who answer without giving circumference or area answers
4. There are students who calculate the circumferences one by one and add them up	4. 1 student did not answer

Type 2: epistemological obstacle about calculating the area of **plane** using standard units.

ICEE-2

The problem given first is to find the area of the plane, the results show that the 4th grade students who answer appropriately using the standard unit area are 2 students out of 26 students, and the 5th grade students no one answers correctly.

Table 3. epistemological obstacle about calculating the area of plane using standard units

Grade 4	Grade 5
1. There are 10 students who answer right but do not use the standard area unit	1. There are 8 students who answer right but do not use the standard area unit
2. 9 students answer with the right numbers but use the standard unit area	2. 4 students answer with the right numbers but use the standard unit area
3. Some students are still constrained by multiplication counting operations in solving area problems	3. Student add length to width (L = p + l)
	4. Some students multiply the sides (L = 15 x 8 x 15 x 8) (L = 15 x 15)
	5. Student add length to width and then multiply by length (L = p x (p + l)
	6. 8 students who answer without giving circumference or area answers

The second given question is about combined area of plane, the results show that the 4th grade students who answer appropriately using the standard unit area are 1 student out of 26 students by counting one by one the area of each square, and no grade 5 students answering correctly.

Tabel 4. Epistemological obstacle about calculating combined area of plane using standard units

Grade 4	Grade 5
1. 3 students answer by calculating the area of each square, but the area of each square is not summed to find the combined area	1. There are students who answer right but do not use the standard area unit
2. 3 students who answer by calculating the area of each square	2. Students answer by multiplying the sides

and the default unit using the circumference unit

3. 1 student who answers by calculating the area of a square and plane, the answers do not use standard units, and the area of the two shapes is not summed to find the combined area

4. 6 Students answer by finding the area of a rectangle only (L = 10 × 20 = 200)

5. 4 Students answer by finding the area of a square then adding to the area of plane then adding back to the area of a square (L = 100 + 200 + 100 = 400)

6. Students answer by multiplying the sides

3. 8 students who answer without giving circumference or area answers

Type 3: Epistemological obstacle about the application of the circumference of plane concept in daily life.

Question 2

Pak Andi memiliki satu bidang tanah berbentuk persegi panjang berukuran 85 m × 60 m, tanah tersebut akan ditanami pohon mangga yang berjarak 5 m antara pohon satu dengan pohon yang lainnya, berapa jumlah pohon mangga yang bisa ditanam mengelilingi tanah Pak Andi?

The question given is the application of the concept of circumference of plane in everyday life, the results show that the 4th grade students who answered correctly were 7 students out of 26 students, and the 5th grade students no one answers correctly.

Tabel 5. Epistemological obstacle about the application of the circumference of plane concept in daily life

Grade 4	Grade 5
1. Students find the circumference of plane then multiplied by a distance of 5 meters	1. Students answer by finding the area of plane and then dividing it by a distance of 5 meters
2. Students answer by finding the area of plane	2. Students answer by finding the area of plane
3. Students are still having difficulty with multiplication operations to solve area problems	3. Students do not understand the context of the problem given
4. Students multiplying length by length	

Type 4: Epistemological obstacle about applying area concepts in daily life

> **Question 3**
>
> Paman akan membangun sebuah gudang dengan luas lantai berbentuk persegi panjang berukuran 15 m × 12 m, lantai gudang tersebut akan ditutup oleh keramik. Paman memiliki 2 pilihan, yaitu:
>
> a. Keramik pertama memiliki ukuran 30 cm × 30 cm dengan harga Rp. 5.000,-
> b. Keramik kedua memiliki ukuran 50 cm × 50 cm dengan harga Rp. 12.000,-
>   Keramik mana yang Paman pilih untuk dipasang dalam gudang agar harganya lebih

The problem given is the application of the area of plane concept in daily life, and this problem belongs to the problem with higher order thinking skills because students must find the area of plane, the amount of ceramics needed from each size and multiply it by the total price, then compare lower total price. from these questions the results show that the fourth-grade students who answered right were 3 students out of 26 students, and the 5th grade students no one answers correctly.

Tabel 6. Epistemological obstacle about applying area concepts in daily life

Grade 4	Grade 5
1. Students answer by only finding the size of the land area 2. Students cannot convert centimeters to meter 3. Students conclude that the cheapest is the price of 5,000 compared to 12,000 without proof	1. Students answer by only finding the size of the land area 2. Students cannot convert centimeters to meter 3. Students conclude that the cheapest is the price of 5,000 compared to 12,000 without proof

DISCUSSION

The researcher noted several epistemological obstacle problems found in circumference and area of plane learning are:

1. Students are fixated on the formula given by the teacher, so that when they are not memorized they cannot answer the questions given

2. Students are still confused in understanding the concept of circumference and area, so that in the answer many are exchanged or answered incorrectly

3. Students are still confused by the standard unit circumference and area, many students also do not include the unit or include but are not right

4. Students still have difficulty in arithmetic operations to solve the circumference and area of plane

5. Students are still having difficulty with changing units (*centimeter* to *meter*)

6. When students are presented with different problem contexts from usual, students have difficulty

7. The students' mathematical literacy skills are still low as seen from the difficulty of students in understanding the context of the story questions presented

8. Students are familiar with lower order thinking skill (LOTS) questions

CONCLUSION

Geometry is one of the materials that must be mastered by elementary school students, the principles of learning geometry that are taught must refer to van Hiele's theory of the level / level of geometry material, these materials should be taught in the form of continuity to build a complete understanding of geometric material.

Mathematical learning about the concepts of circumference and area of plane becomes a prerequisite for students in understanding the material that follows, but in its implementation there are still many students who experience epistemological obstacle in understanding the concepts of circumference and area of plane, as evidenced by the discovery of epistemological obstacle students in the concept of circumference and area of plane and completion in daily life.

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