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ANALYSIS OF LEARNING OBSTACLE ON CIRCLE MATERIAL AT SMPS NASIONAL AMANAH BANGSA

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Abstract. Students can have learning difficulties during the learning process. Knowing learning difficulties is one of the teacher's tasks. This study aims to analyze the learning obstacle experienced by students of SMPS Nasional Amanah Bangsa on circle material. The types of learning obstacles identified are epistemological obstacles, ontogenic obstacles, and didactic obstacles. Research methods are used qualitatively descriptive. The study sample included three students in class IX who had studied circles with low, middle, and high ability categories. The research sample was selected to categorise students' abilities based on PAS results and subject teacher recommendations. Research instruments are written learning obstacle tests, student interviews, teacher interviews, teaching materials analysis, and RPP analysis. The study results obtained students experienced epistemological obstacles, ontogenic obstacles, and didactic obstacles in the circle material. Based on the results of this study can be used to design learning based on learning difficulties experienced by students.

Keywords: *Learning Obstacle, Mathematics, Circle*

Abstrak. Selama proses pembelajaran dimungkinkan siswa mengalami kesulitan belajar. Mengetahui kesulitan belajar merupakan salah satu tugas guru. Tujuan penelitian ini untuk menganalisis *learning obstacle* yang dialami oleh siswa SMPS Nasional Amanah Bangsa pada materi lingkaran. Jenis *learning obstacle* yang diidentifikasi yaitu *epistimological obstacle*, *ontogenic obstacle*, dan *didactic obstacle*. Metode penelitian yang digunakan kualitatif deskriptif. Sampel penelitian yaitu 3 orang siswa kelas IX yang sudah mempelajari lingkaran dengan kategori kemampuan rendah, sedang, dan tinggi. Sampel penelitian dipilih berdasarkan pengkategorian kemampuan siswa berdasarkan hasil PAS dan rekomendasi guru mata pelajaran. Instrumen penelitian yaitu tes tertulis *learning obstacle*, wawancara siswa, wawancara guru, analisis bahan ajar, dan analisis RPP. Hasil penelitian diperoleh siswa mengalami *epistimological obstacle*, *ontogenic obstacle*, dan *didactic obstacle* pada materi lingkaran. Berdasarkan hasil penelitian ini dapat digunakan untuk mendesain pembelajaran yang didasarkan pada kesulitan belajar yang dialami siswa.

Kata Kunci: Kesulitan belajar, Matematika, Lingkaran

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INTRODUCTION

The world of education has an important subject, namely mathematics. Identical to formulas and calculations that are mathematics (Manalu et al., 2020), but actually, mathematics is a means to improve the ability to think at high levels. Mathematics studies

cover geometric materials. Geometry is an important element in the study of mathematics because geometry is closest to the reality of human life (Choi & Park, 2013). Geometry requires a high-level thought process, and this aims so that students can develop their thinking skills (Clement & Bright, 2003).

Circle material is a geometric element learned at the junior high school level. A circle is defined as a flat wake shape based on a point equidistant from the outside of the circle to the centre of the circle. A circle is closely related to everyday life, reinforced by (Manalu et al., 2020) that in solving everyday problems, one of them is by applying the concept of circles. In this study, the material of the circle will be limited to the basic competence of the elements of the circle, the length of the arc, and the area of the jurying and its interrelationships.

In real situations, during the learning process, students can have learning difficulties that will affect and hinder the development of knowledge at a later stage. The field of mathematics that is considered difficult compared to other fields is geometry (Nur'aini et al., 2017). Students have a mindset that mathematics is complex abstract learning and full of formulas. According to the statement (Ruseffendi, 2006) math lessons are considered difficult, complicated, and trapping. According to (NCTM, 2000) the objectives of mathematics learning include communication skills, reasoning, problem-solving, connections, and the formation of positive attitudes. In fact, in completing mathematics, students still have difficulty reaching the stage of a high-level thinking process, one of which is problem-solving. This is reinforced by the research (Latifah & Afriansyah, 2021) that students have difficulty solving problem-solving problems appropriately.

A decrease in learning achievement characterizes learning difficulties compared to before. Based on the 2018 PISA test report results, Indonesia in the math category experienced a decrease in score of 379 compared to PISA in 2015, which received a total score of 386 (Suryadinata, 2020). This situation is called a learning obstacle. Learning obstacles are grouped into three factors (Brousseau, 2002), namely: (1) obstacle of ontogenic origin: student limitations caused by development, (2) obstacle of didactical origin: insanity in the learning system performed, (3) obstacle of epistemological origin: limited knowledge in a particular context.

The learning obstacles experienced by students will reduce the absorption of knowledge. The impact of the goals of learning mathematics and basic competencies proclaimed cannot be achieved. Learning outcomes will experience obstacles if students experience learning problems (Ardila & Hartanto, 2017). Research Diana et al., (2019) identified epistemological learning obstacles experienced in geometry learning, including (1) line and angular material,

(2) the breadth and volume of prisms, and (3) the circumference and area of the circle.

Learning obstacles are experienced because each student has different abilities. Students have different levels of mathematical ability (Men, 2017). Many learning obstacle factors may occur in circular materials during the mathematical learning process. The importance of knowing the learning obstacles experienced by students is the teacher's job as an educator, according to the statement (Muhaiba et al., 2020) that help students with learning difficulties is a teacher's responsibility. So the author decided to research the form of analysis that aimed to find out the learning obstacles of three factors, namely ontogenic obstacle, didactic obstacle, and epistemological obstacle in the circle material experienced by students of SMPS Nasional Amanah Bangsa. Hopefully, learning obstacle analysis can be used for learning evaluation and structure learning based on the obstacles experienced by students.

METHOD

Research is conducted using descriptive qualitative methods. This is because researchers want to describe learning obstacles faced by students through deep exploration in students of class IX of SMPS Nasional Amanah Bangsa. The study participants were 3 students of class IX (1 person in the low category, 1 person in the middle category, and 1 person in the high category) and a teacher of mathematics subjects. Students who are a sample of the study are selected based on categorizing the abilities and recommendations of the subject teacher. Sampling techniques use nonprobability sampling, a purposive technique because each individual does not have the same opportunity but is chosen based on certain considerations. Quoted from (Masrurotullaily et al., 2013), this study used 3 levels of ability of students whose classification divisions are as follows:

Table 1. Student Ability Categories

Score	Category
$0 \leq TKS \leq 60$	Low
$60 < TKS \leq 75$	Middle
$75 < TKS \leq 100$	High

LO analysis was conducted using tests to identify epistemological obstacles with as many as 3 questions of description containing basic concepts and non-routine questions of circle material in class VIII, student interviews to identify ontogenic, didactical, and epistemological obstacles for the results of lo test work, and teacher interviews to identify

ontogenic and didactical learning obstacles. Data collection techniques are also carried out by analyzing RPP and teaching materials used by teachers. Data analysis techniques using models (Miles & Huberman, 1994) are data reduction, presentation, and conclusion withdrawal. A team of experts validated LO tests and interview guidelines, namely 2 lecturers of Universitas Media Nusantara Citra and 1 teacher of mathematics subjects of SMPS Nasional Amanah Bangsa. Results of LO tests, interviews, RPP analysis, and analysis of teaching materials are transcribed and then reviewed by a team of experts and experts. After that, an analysis was done.

RESULTS

Data from learning obstacles results were obtained after 3 students representing each category completed a written test totalling 3 problems completed with a duration of 60 minutes, student interview results, teacher interview results, teaching material analysis results, and RPP analysis results. Test and interview results data are analyzed to find out the learning barriers experienced by students. The results of the learning barrier analysis are classified based on the type of learning obstacle, including:

Epistimological Obstacle

The epistemological obstacle is found because of the limited context experienced by students, incomprehension of the use of formulas, or miscalculation of concepts. The epistemological obstacle is found in each problem number, following the analysis:

Number 1

In a playground, there is a circle-shaped Bianglala. Identify what circle elements do you know? Along with his characteristics! 	Di sebuah taman bermain terdapat Bianglala yang berbentuk lingkaran. Identifikasi unsur-unsur lingkaran apa saja yang kamu ketahui? beserta ciri-cirinya! 

Problem number 1 is a problem that will show the basic concept of circles owned by students. Students should be able to identify what elements are in the circle and explain their

characteristics based on their knowledge. Based on written tests conducted, obtained the following student answer data:

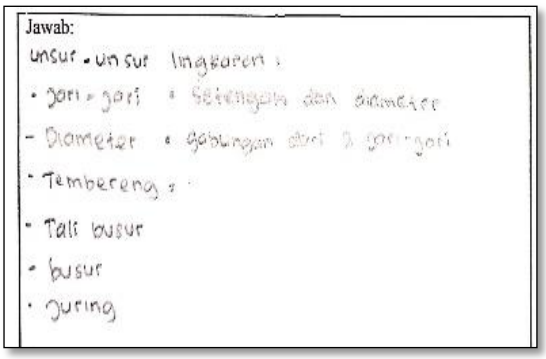
	circle elements: - fingers = half of the diameter - diameter = combined of 2 fingers - a segment of a circle - bow strap - bow - section of a circle

Figure 1. Answer question number 1 in students' high ability

The work results found that students can only identify some elements of the circle and do not write down the characteristics of the elements as a whole. This is a basic concept that students must have after studying circle material in class VIII. To deepen researchers through interview activities. Here are the results of interviews conducted with highly skilled students:

X : For number 1, you can identify the 6 elements of the circle and can only explain its characteristics in two elements; why?
S1 : It's hard to say.
X : For other elements, can you identify them?
S1: I remember there was a picture of a circle with a centerline in the circle, but I forgot its name.
X : Well, try to give a picture and identify the elements and their characteristics. (Researchers present images that display circle elements)

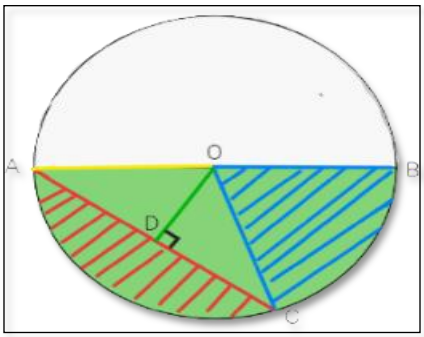


Figure 2. Elements of circle

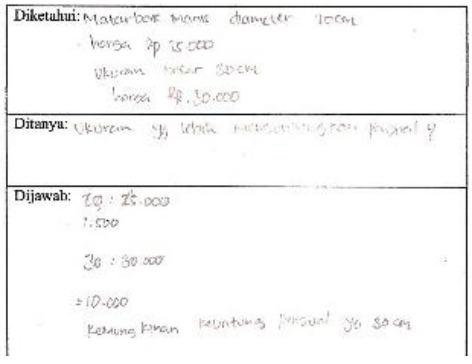
S1 : Fingers are AO lines, diameters on line AB, tembereng on areas shaded in red, bow straps on AC lines, bows on the curved sides of the AC, jurying on the shaded area of blue.
X : Are there any other elements that can be identified?
S1: There is an apotema that lines OD. The last element forgets.
X : Other elements relate to the large region of the circle. Remember? That's the angle.
S1 : Forgot Mrs, oh yes, the corner of the circle.

The interview clearly shows that students experience epistemological obstacles where students experience limited context (Yusuf et al., 2017). he given problem describes a circle with a bianglala, while students can identify the elements of the circle if depicted with the element of a direct circle (Figure 2). If students face different contexts, they will have difficulty using their knowledge. This is because students are not familiar with non-routine problems. Reinforced by the statement that students will experience learning obstacles and reasoning is not trained if students are not used to solving non-routine problems (Rismawati et al., 2018).

Number 2

A sweet martabak shop provides two different sizes of martabak, but with the same taste and thickness. If noted, a small sweet martabak has a diameter of 20cm sold for Rp25,000, while a large size has a diameter of 30cm sold for Rp30,000. Which size is the seller's sale more profitable?	Sebuah kedai martabak manis menyediakan dua buah ukuran martabak yang berbeda, namun dengan rasa dan ketebalan yang sama. Jika diperhatikan, martabak manis ukuran yang kecil memiliki diameter 20cm dijual dengan harga Rp25.000 sedangkan ukuran yang besar memiliki diameter 30cm dijual dengan harga Rp30.000. Penjualan martabak dengan ukuran manakah yang lebih menguntungkan penjual?

Problem number 2 is a problem that requires the basic concept of a broad circle in its completion. Students should be able to analogize the broad interrelationship of the circle to the sale price. This problem also requires reasoning to compare which sizes are more favourable. Here are the results of the student's answers:

	It is known: sweet martabak diameter of 20cm price Rp25,000—large size of 30 cm price Rp30,000. Did we ask for a more favourable size to the seller? Answer: 20 : 25.000 1.500 30 : 30.000 =10.000 possible seller profit of 30cm

Fugure 3. Answer question number 2 in students with low ability

Based on the answer results, students can identify the information in the problem and write in the known column. Then, students can also identify what is being asked about the question. However, skilled students are not writing it down on worksheets. After the

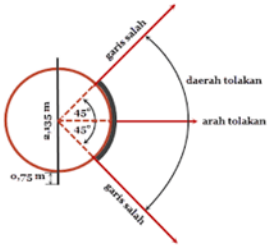
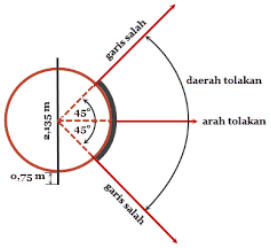
interview, it turned out that the student could not interpret what needed to be written in the column asked which size was more favourable. In the answered column, if noticed, all students have the same completion flow that uses the logic of the concept of comparison without using the mathematical formula of the circle. With these comparisons, highly skilled and skilled students are drawing the right conclusions. However, low-skilled students did not get the right conclusions. So, to deepen, an interview is conducted. Here are the results of interviews with low-skilled students:

X : Why would you do a solution like this?
S3: It's hard to explain, Mrs.
X : ctually, the concept of comparison has been done leads to the truth. But there is a less precise calculation that is 20:25.000, which is 1:1.250 and 30:30.000, which is 1:1.000.
S3: That's right, Mrs.
X : Then, to compare, we can use the concept of circles. What do you think?
S3: Around the circle.
X : Imagine, if you sell martabak what is sold only on the outskirts of martabak or its contents?
S3: Oh yes, using the concept of a wide circle.
X : What is the circle area formula?
S3: Phi is multiplied around the circle.
X : The exact formula of the circle area is πr^2

From the interview seen on Epistemological Obstacle, students do not understand the process of using the formula (Unaenah, 2017). Students have difficulty calculating using comparative concepts. In addition, students are not even precise in mentioning the circle area formula that should be used in comparing two circle sizes on a problem. This may occur due to an error in writing a broad circle formula in the student's teaching material described in the didactical obstacle. Teaching materials are the components that determine the success of learning implementation (Agustina & Oktavia, 2019).

Number 3

The bullet repellent game can be seen in the following image: 	Permainan tolak peluru dapat dilihat pada gambar berikut: 

The game of bullet repellent performed on the field can be illustrated as follows:  Determine the area of the section of a circle and the longbow of the arc formed by the angle of the wrong line and the reused area!	Permainan tolak peluru yang dilakukan di lapangan dapat diilustrasikan sebagai berikut:  Tentukan luas juring dan panjang busur yang terbentuk oleh sudut garis salah dan daerah tolakan!

Problem number 3 is a problem that contains indicators of the area of jurying and arc length in the circle material. Students must be able to identify the information on the problem to make a settlement. This problem applies the concept of circles in everyday life. Here are the results of the student's work:

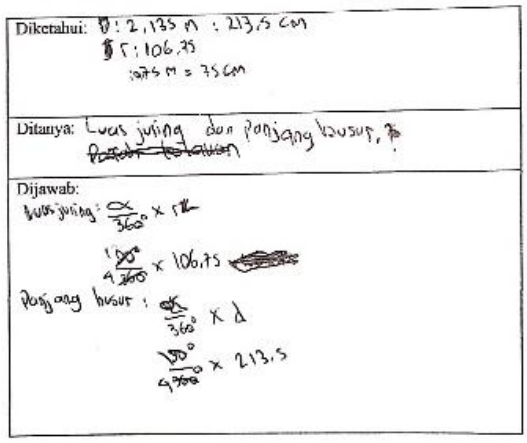
 	Known: D = 2,135 m = 213,5 cm r = 106,75 = 0,75 m = 75 cm Have I asked: about the area of the section of a circle and the length bow? Answer: the section of a circle = $\frac{\alpha}{360°} \times r$ $\frac{90°}{360°} \times 106,75$ the length bow = $\frac{\alpha}{360°} \times d$ $\frac{90°}{360°} \times 213,5$

Figure 4. Answer question number 3 in student's medium ability

Based on the results of student work, students are highly skilled and can identify the information on the problem. At the same time, low-skilled students cannot identify information in the form of diameter and angle needed to complete. Then, for the question asked, all students correctly wrote it. In the process of completion, there are various variations of student answers. To analyze it more deeply, the interview was conducted. Here are the results of interviews with skilled middle students:

X`: In doing the solution, the formula used by you is half correct, which uses the ratio of angles with total angles. In the solution, you multiply it by the fingers. However, in looking for the area of jurying related to the area of the circle or the circumference of the circle?

S2 : Relates to the area of the circle.

X : So, the jurying area formula is to multiply the ratio of angles by the total angle and area of the circle. What circle area formula?
S2 : Forgot Mrs.
X : The circle area formula is πr^2. Then, to find the length of the bow related to what?
S2 : Related to the circumference of the circle.
X : So, to use the arc length formula is to multiply the ratio of angles by the total angle and circumference of the circle.

From the interview, it can be known that students experience an epistemological obstacle, which is a misuse of concepts (Yanti et al., 2020). The broad formula of the circle is connected with the circle area formula, but the student only multiplies it with the fingers. In contrast, the circle's circumference should connect to the circle length formula, but the student only multiplies it by diameter. Students do not have a strong circle concept base, so there are errors in using broad formulas and arc lengths. The concept of the next lesson will be easier to understand if students already understand the previous concept correctly (Radiusman, 2020).

Ontogenic Obstacle

The ontogenic obstacle is influenced by the development and readiness of students' learning. This can also be spelt out in identified errors in problem work and student interviews. The findings of the Ontogenic Obstacle on each number are described as follows:

Number 1

Based on the results of student work, it is predicted that all students experience the Ontogenic Obstacle. Namely, students do not understand the concept (Yusuf et al., 2017). It is shown that students can only identify most circle elements without explaining their characteristics. Strengthened through interview activities, each student said they forgot about the other circle elements. For students to have a complete understanding, a didactic design needs to be made (Suryana et al., 2012).

Number 2

As a result of the analysis of student work, researchers predict that all students experience the Ontogenic Obstacle, which is a mistake caused by not knowing what concepts and formulas should be used in solving problems (Yusuf et al., 2017). It is seen that students only use the concept of comparison without being connected with the broad concept of circles. Then, based on interview activities, identified that students do not yet have strong

prerequisite material related to the material prerequisites of the circle area. Prerequisite materials are part of a student's initial ability. Initial ability is part of the internal factors influencing learning success (Lestari, 2017). Middle-skilled and low-skilled students forget the broad formula of the circle. In addition, low-skilled students identified ontogenic obstacles, such as difficulty performing algebraic calculations (Yusuf et al., 2017). As seen in, the calculation of the comparison is not accurate. Simplifying algebraic forms and solving equations are basic algebraic skills (Wijaya, 2016).

Number 3

Completion by moderate and low-skilled students obtained predictions that the Ontogenic Obstacle experienced is a lack of prerequisite knowledge regarding the area of the circle and the circumference of the circle. Interviews show that the student forgot about the formula (Yusuf et al., 2017). Confirmed through interview activities, the subject teacher has strengthened the prerequisite material through pre-test activities before the learner begins. Low-skilled students also have difficulty understanding the intent of the problem and do not know what formula to use (Yusuf et al., 2017). It is known that students cannot understand the problem. According to (Pramono, 2017), researchers monitor the understanding of the problem by asking students to reveal what is understood in the problem. It turns out that students cannot understand the purpose of the problem and cannot arrange a series of problem-solving.

Didactical Obstacle

The didactical obstacle is a difficulty encountered by the learning system's impact. It is identified based on teaching materials and RPP used by subject teachers. Didactical obstacle found in teaching materials is a misstatements of teaching materials (Yanti et al., 2020). Concept errors in book content are found due to reasoning errors (Rohim, 2020). The circular area formula $2 \times \pi \times r^2$, the formula that should be πr2. From these errors, the prediction that arises in students is that students do not understand the material prerequisites of the broad circle. This is evidenced by the work of written tests and interview activities conducted. RPP analysis found didactical obstacle that the traces of teaching material is incomplete (Yanti et al., 2020). It is written that the basic competencies to be studied, 4.7 Solving contextual problems related to the circumference and area of the circle, the proper KD should be 4.7 Solving problems related to the central angle, the angle of the circumference, the length of the arc, and the area of the circle, as well as its relationship.

From this, it is predicted that the consequences that arise in students are students learning material that is not for learning should be. Beyond that, based on the results of interviews with students, students feel that teachers' learning methods are too fast. I cannot continue to the next material at the next meeting. After being confirmed through interviews with subject teachers, the material continued. At least 50% of the students already understood the material studied. They are judging from the post-test results if less than 50% of the material will not be continued. In addition, it is explained in student interviews that teachers often invite students to construct formulas instead of just giving formulas.

CONCLUSION

Based on research and the results of the discussion conducted, it was concluded that the learning obstacle encountered in the circle material, namely: (1) Epistemological Obstacle: mistakes due to the context of different problems than usual, a mistake because they do not understand the process of using formulas, and mistake in the use of concepts. (2) Ontogenic Obstacle: mistake caused by not knowing the formula to be used, mistake for not understanding the concept as a whole, mistake because it does not know the concepts needed in solving problems, difficulty in performing algebraic calculations, and lack of prerequisite knowledge regarding the area of circles and circle circumference. (3) Didactical Obstacle: Misrepresentation and incomplete teaching materials.

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