



Implementation of Didactical Design of Circle Material in 8th Grade Junior High School

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History Article

Received: October, 2021

Accepted: March, 2022

Published: June, 2022

Abstract

This study aimed to implement a didactic situation design to overcome learning obstacles in the circumference and area of the circle. The method used is qualitative research with Didactical Design Research which goes through the last two stages, namely metapedadidactic analysis and retrospective analysis. The instrument used is a didactic situation design prepared by Rosita, Maharani, Tonah & Munfi (2020) and interview guidelines. Based on the implementation results, the didactic situation that has been designed has not been able to overcome students' learning obstacles fully. In addition, a new learning obstacle appears in the concept of the circumference of a circle. Not all students can measure the length of the curvature of a circle because there are inaccurate measurement results. In this study, the didactic design was revised regarding the circumference and area of a circle based on metapedadidactic and retrospective analysis.

Abstrak

Penelitian ini bertujuan untuk mengimplementasikan rancangan situasi didaktis sebagai upaya mengatasi learning obstacle pada materi keliling dan luas lingkaran. Metode yang digunakan adalah penelitian kualitatif dengan Didactical Design Research yang melalui dua tahap terakhir yaitu analisis metapedadidaktik dan analisis retrospektif. Instrumen yang digunakan berupa rancangan situasi didaktis yang telah disusun oleh Rosita, Maharani, Tonah & Munfi (2020) serta pedoman wawancara. Berdasarkan hasil implementasi, situasi didaktis yang telah dirancang belum sepenuhnya dapat mengatasi learning obstacle siswa. Selain itu, terdapat learning obstacle baru yang muncul pada konsep keliling lingkaran yaitu tidak semua siswa mampu mengukur panjang lengkungan lingkaran karena terdapat hasil pengukuran yang kurang akurat. Pada penelitian ini, dilakukan perbaikan kembali desain didaktis mengenai konsep keliling dan luas lingkaran yang disusun berdasarkan analisis metapedadidaktik dan retrospektif.

Keywords: Didactical Design, Learning Obstacle, Didactical Situation, Metapedadidactic Analysis, Retrospective Analysis, Circle.

INTRODUCTION

Understanding concepts is fundamental in the learning process and is the basis for solving mathematical problems. Understanding mathematical concepts are essential for students to solve mathematical problems and everyday problems and help students compile their knowledge (Richland et al., 2012; Kholidah & Sujadi, 2018; Agustina, 2016; Laswadi et al., 2016). Andamon & Tan (2018) state that conceptual understanding is the knowledge that involves a thorough understanding of the underlying concepts behind mathematical algorithms. Thus, understanding the concept allows students to be involved in making choices and applying to understand actively. If students have understood mathematical concepts, it will be easier to learn the following more complex concepts (Fitria et al., 2019).

One of the mathematical materials that have many concepts is geometry. Geometry occupies a particular position in the mathematics curriculum because geometry plays a vital role in learning mathematics and is used daily by many people (Nopriana, 2017). Through geometry, almost every everyday problem can be solved (Ulfa & Jupri, 2020). Geometry can be found in objects in balls, tubes, squares, lines, circles and so on (Rosita et al., 2019). Özerem (2012) states that by studying geometry, students are trained to analyze and interpret their environment and equip them with tools that they can apply in other areas of mathematics. Abstractions developed to explain geometric patterns and relationships make geometry an important subject and can be used in various situations (Noto, 2015). Understanding geometry is essential for understanding other areas of mathematics (Jelatu et al., 2018). Understanding geometry contributes to logical reasoning

and spatial relationships (Alqahtani & Powell, 2016). Therefore, understanding the concept of geometry needs to be developed.

But in fact, students' understanding of concepts in geometry has not achieved the expected learning objectives. Most of the geometry learning process in the classroom only emphasizes understanding concepts using teachers transferring knowledge to students without building concepts (Sanwidi & Swastika, 2019). Sholihah & Afriansyah (2017) state that the learning outcomes of geometry are still low. In fact, in studying mathematics, especially those related to geometry, it turns out that many students still find it difficult. Difficulties in learning geometry are possible because students only learn to solve the given geometry problems (Nopriana, 2017). One of the problems in studying geometry is student learning activities. Students only learn to calculate mathematics results but do not learn about the mathematical process (Setiadi, Suryadi & Mulyana, 2017). Various branches of geometry material, one of which is the circle given in class VIII with the circumference and area of a circle which is part of the circle material, is still considered difficult by students. One of the difficulties experienced by students is in solving problems related to the circumference and area of a circle (Budiman, 2014; Supriyanto, 2014). The difficulties experienced by students in the concept of circumference and area of a circle are caused by several factors: lack of use of learning media, application of inappropriate methods, lack of fulfilment of learning needs, low level of student intelligence, and teaching materials and learning designs used by teachers. (Paskoni et.al, 2019; Jayanti & Hidayat, 2020).

A preliminary study conducted on a mathematics teacher at one of the junior high schools in Cirebon showed that the

circle material was also considered complex material, especially regarding the tangent to a circle. Students' answers about tangents are closely related to students' understanding of the concepts of circumference and the area of a circle. They were learning obstacles in studying the material tangent to a circle, namely the lack of understanding of student's concepts of circumference, area of a circle, and tangent to a circle (Rosita et al., 2020). The learning barriers are caused because students do not understand the concept of the material and only rely on formulas to be able to solve a problem. There are several types of learning obstacles in studying circles caused by epistemological obstacles, including (1) learning obstacles related to field concepts caused by errors from the student's point of view, (2) learning obstacles related to geometric representations about the centre angle of the circle. It is caused by the limited knowledge of students about the central angle and the circling rope (Ulfa & Jupri, 2020)

These learning barriers are commonly called learning obstacles. Brousseau (2010) suggests that there are three types of learning obstacles experienced by students, namely: ontogenic obstacles are learning difficulties based on psychology, where students experience learning difficulties due to mental readiness factors and, in this case, the student's way of thinking that has not been entered due to factors age, the didactical obstacle is student learning difficulties that occur due to misrepresentation, and epistemological obstacle is student learning difficulties because students' understanding of a concept is incomplete, only seen from its origin. To overcome this learning obstacle, Suryadi (2013) recommends a research method called *Didactical Design Research* (DDR) which consists of three stages of research, namely: (1) analysis of

the didactical situation before learning. The didactic situation analysis was carried out before learning in a Hypothetical Didactic Design, including ADP. (2) metapedagogical analysis and (3) retrospective analysis. The stage of analyzing the didactic situation before learning was carried out by Munfi (2019) and resulted in a didactic situation in the form of ADP. Gravemeijer & Cobb (2006) stated that the DDR framework relies on the interrelationships of designing learning and learning settings, conducting design trials, and conducting an empirical analysis of the learning process. In addition, Prediger & Zwetzschler (2013) stated that in doing DDR, there are five cycles involving four areas: determining and compiling learning objectives and content, developing designs, analyzing and testing designs in the classroom and developing theories about the teaching and learning process. Several studies in didactic designs have been carried out to improve geometric thinking through ethnomathematics and didactic designs on triangles and quadrilaterals (Alawiyah & Prasetyo, 2018; Ro-haeti et al., 2019; Supriadi, 2019).

Based on the learning obstacles experienced by students, especially in understanding the concept of the circumference of a circle, students need learning that can understand the concepts of circle material well and can reduce and anticipate the emergence of learning obstacles. Prediger & Zwetzschler (2013) recommend the need to implement a learning design that has been prepared.

Therefore, in this study, the researcher implemented the didactic situation Munfi (2019) prepared related to the circumference and area of the circle. Also, the researcher carried out activities to

1. We have provided several circular plane frames on cardboard with diameters of 7 cm, 14 cm and 21 cm.



Measure the length of the curve on the circle and record the result!

2. Based on your activities, what did you measure?
3. What relationship do you get from the activity of measuring the length of the curved lines of these circles?

Figure 1. *Didactic Situation 1*

compare the design of the didactic situation with the results of the metapedadidactic analysis known as the retrospective analysis stage.

METHOD

The method used is didactic design research (Didactical Design Research). There are three stages in didactic design research, according to Suryadi (2013), namely: (1) analysis of the didactic situation before learning in the form of a Hypothetical Didactic Design including ADP, (2) metapedadidactic analysis, and (3) retrospective analysis. A didactic situation analysis has been carried out by Munfi (2019). Therefore, the researchers carried out metapedadidactic analysis and retrospective analysis stages in this study. The subjects in this study were 28 students of class VIII in one of the junior high schools in Cirebon City.

The instruments used in this research are didactic situations designed by Munfi (2019) and interview guidelines. The first stage in this research is to implement a didactic situation for students to confirm what was previously predicted (hypothetical didactical design) with the actual reality. This implementation hopes that it can overcome the learning barriers

experienced by students. After implementation, it can be analyzed by comparing the hypothetical didactic design with the results of the implementation analysis so that it can make design revisions.

RESULT AND DISCUSSION

Result

Metapedadidactic Profile

The study results were obtained by the implementation of the didactic situations that had been prepared. The implementation of the didactic situation is only related to the concept of circumference and area of a circle. The didactic situation was implemented for 28 students formed into seven groups with four students in each group. Researchers implemented it using Student Worksheets (LKS) containing didactic situation problems given to each individual and carried out with group discussions. In the implementation process, the researcher did not help students answer but only gave students directions according to each didactic situation's problems. The following are the results of the implementation and the analysis obtained.

Implementation of the Didactic Situation 1

Students are asked to solve problems 1 to 3 related to the circumference of a circle on the student worksheet in this didactic situation. The following is the problem of didactic situation one shown in Figure 1.

Problem 1. This problem has three circles with 7 cm, 14 cm, and 21 cm. Students are asked to measure all the lengths of the curvature of the circle and record the measurement. The goal is to direct students to be able to describe what is meant by the circumference of a circle. The researchers placed the circles on cardboard. Then, the students measured them using a piece of woollen thread by attaching the woollen thread to the circle's arch. The researcher had previously given the double-sided tape to the three loops of the circle. Then students measure the woollen thread on a ruler to get the length of the arc of each circle. The following are the results of each group's answers based on their level of understanding ability.

- a. Ukurlah panjang lengkungan pada lingkaran yang berdiameter 7 cm, 14 cm, dan 21 cm dan catatlah hasilnya!

Jawaban: Diameter 7 cm = 22 cm → Gambar 1
Diameter 14 cm = 44 cm → Gambar 2
Diameter 21 cm = 66 cm → Gambar 3

Figure 2. Student Answers in the High Group For Problem 1

Figure 2. Explaining the results of student answers in the High group. This group managed to measure the length of all the curvatures of the circle correctly. This group takes measurements carefully and is not in a hurry, and the members work well together.

Students in the high group also took measurements more than once to get the right results. According to this group, measurement activities require accuracy and mutual assistance from one another.

- a. Ukurlah panjang lengkungan pada lingkaran yang berdiameter 7 cm, 14 cm, dan 21 cm dan catatlah hasilnya!

Jawaban: Diameter 7 : 22 cm
Diameter 14 : 44 cm
Diameter 21 : 67 cm

Figure 3. Student Answers in the Middle Group For Problem 1

Students in the medium group managed to measure the length of the two curves of the circle correctly. This group has tried to make measurements carefully. They repeat the measurements on circles of small diameter. This group realized that measuring large diameter circles took patience and repeated measurements to get the right results.

- a. Ukurlah panjang lengkungan pada lingkaran yang berdiameter 7 cm, 14 cm, dan 21 cm dan catatlah hasilnya!

Jawaban:
diameter : 7 = 22 cm
14 = 45 cm
21 = 67,5 cm

Figure 4. Student Answers in the Low Group For Problem 1

Students in the low group only managed to measure the length of one circle curve correctly. They have measured carefully but did not re-measure. They also rushed to measure the wool thread on a ruler not to feel left behind with the rest of the group.

Problem 2. Students are asked to answer what is meant by the measurement activity in this problem. All students can define the length of the curvature of a circle as the circumference of a circle. The following is an example of one of the students' answers to problem 2.

- b. Dari kegiatan yang telah anda lakukan, apa yang sebenarnya kalian ukur?

Jawaban: keliling lingkaran

Figure 5. Answer from Student Representative

All students answered correctly. Students

have no difficulty answering these questions because they know that what they measure is the circumference of a circle.

Problem 3. Students are asked to answer the correct relationship between the activity of measuring the length of the curvature of a circle with the circle's diameter. However, none of the students could answer the question directly. The researcher directed students to remember the value of phi that students had studied by asking students, "have you ever heard of phi in circles? What value of phi do you know?" Then some of the students answered that the value of phi was 3.14 or $22/7$. Because students only know the value and do not know where it came from to get the phi value, the researcher gives direction that the phi value can be obtained from the activities that students have done in problem 1. So, students process the numbers from the circumference and diameter of the circle to get the phi value by dividing the circumference by the circle's diameter. Next, the researcher directed the students to formulate the formula for the circumference of a circle through the phi value approach that had been obtained previously. The following are the results of each group's answers based on their level of understanding ability.

c. Hubungan apa yang anda dapat dari kegiatan mengukur panjang garis lengkung lingkaran diameter tersebut?

Jawaban: Keliling : Diameter
 $22 : 7 = 3,14 \rightarrow$ Gambar 1
 $44 : 14 = 3,14 \rightarrow$ Gambar 2
 $66 : 21 = 3,14 \rightarrow$ Gambar 3
 mendapatkan nilai π
 Rumus keliling $k = \pi \cdot d$

Figure 6. Student Answers in the High Group for Problem 3

This group divides the circumference by the diameter. Because we get the exact circumference measurements of the three circles in problem 1, all the results of dividing the circumference by the diameter they get are precisely 3.14. They

do not have difficulty calculating and writing the division results in decimal form. They also understand the relationship between circumference and diameter to formulate the formula for the circumference of a circle.

c. Hubungan apa yang anda dapat dari kegiatan mengukur panjang garis lengkung lingkaran diameter tersebut?

Jawaban: Keliling : Diameter : $\frac{67}{21} = 3,19$
 $\frac{22}{7} = 3,14$ Keliling : Diameter : $\frac{44}{14} = 3,14$

Figure 7. Student Answers in the Middle Group for Problem 3

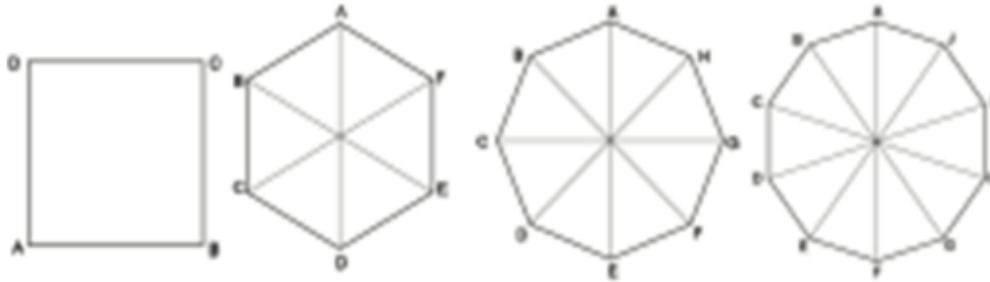
This group also performs the division between circumference and diameter. Since this group only managed to get two correct circumference measurements from the previous problem, they only got two valid values of pi. While one less accurate phi value is 3.19. They also do not have difficulty calculating and writing the division results in decimal form. They have not been able to formulate the formula for the circumference of a circle because they only focus on the process of getting the phi value.

c. Hubungan apa yang anda dapat dari kegiatan mengukur panjang garis lengkung lingkaran diameter tersebut?

Jawaban:
 a. $7 : 21 = 3$
 b. $14 : 44 = 0,318$
 c. $21 : 60 = 0,35$

Figure 8. Student Answers in the Low Group For Problem 3

Unlike the other groups, this group did an inaccurate division because it divided the diameter by the circumference. They have difficulty calculating and writing the division results in decimal form. It causes the results of their calculations not to follow the correct results. They also cannot formulate the formula for the circumference of a circle because they do not understand what they are doing.



Calculate the area of the polygons with the side size you want!

Figure 9. Didactic Situation 2

Implementation of the Didactic Situation 2

In this didactic situation, there is only one problem: four flat shapes, namely 4, 6, 8, and regular 10. Here the problem of didactic situation two is described in Figure 9.

In this problem, students are asked to calculate the area of the four flat shapes by determining the size of the sides. According to Munfi (2019) the goal is for students to explore knowledge and relate it to other materials outside the circle concept. For regular 4- and 6-sided flat shapes, students can determine the size of the sides directly on the condition that one of the properties of regular quadrilaterals is that all sides are the same length so that students only need to determine one size. Students will also apply to each side of the flat shape. Likewise, a regular hexagon is the area of several equilateral triangles where each side is the same length. Students still remember the properties of regular quadrilaterals and equilateral triangles. Students can calculate area of the quadrangle directly and calculate the area of the 6-sided by adding up the area of the isosceles triangle as much as the number of sides. Students must find the correct number in other flat shapes, namely regular 8-sided and regular 10-sided shapes, because they relate to the Pythagorean concept. The researcher again reminded the Pythagorean idea that the previous students had obtained,

then connected it to the area of the regular n -plane shape. The area of the two figures is the area of several isosceles triangles. However, all students felt confused and could not place Pythagoras on the isosceles triangle in the two pictures. Then the researcher directed the students to illustrate an isosceles triangle into a right triangle to determine the appropriate size according to the Pythagoreans. Students could calculate the area of the two flat shapes by adding up the area of the isosceles triangle as much as the number of sides. Based on each group's work results, the researchers grouped them into high and medium ability levels. The answers from students in each group are shown in Figures 10. and 11.

Figure 10 explains the results of student answers in the high group. This group is the group that produces the most appropriate solution from all the existing groups. It's just that there is an error in calculating the area of the rectangle, so the results are not quite right. However, in determining the area of a regular hexagon, 8 and 10, this group could determine the Pythagoreans very well. To calculate the results of the area of each flat shape correctly. In the isosceles triangle found in an 8-sided flat form, this group chose Pythagorean triples 3,4,5. Meanwhile, to calculate the area of a 10-sided flat shape, students use the Pythagorean triple 6,8,10.

Jawaban: Segi - 4 = L = 5 x 5
 $= 6 \times 6$
 $= 36 \text{ cm}^2$

Segi - 6 = $CO^2 = BC^2 - OB^2$
 $CO^2 = 6^2 - 3^2$
 $CO^2 = 36 - 9 = 27$
 $CO = \sqrt{27} = \sqrt{9 \cdot 3} = 3\sqrt{3} \text{ cm}$

$La = \frac{2 \times b}{2} = \frac{3 \times 3\sqrt{3}}{2} = \frac{9\sqrt{3}}{2} \text{ cm}^2$

Total Luas = $6 \times \frac{9\sqrt{3}}{2} = 54\sqrt{3} \text{ cm}^2$

Segi - 8 = Triple Pythagoras = 6, 5, 4
 $La = \frac{2 \times b}{2} = \frac{5 \times 5}{2} = \frac{25}{2}$
 $= 20 \text{ cm}^2 \times 8 = 160 \text{ cm}^2$

Segi - 10 = Triple Pythagoras = 3, 6, 9
 $La = \frac{10 \times 16}{2} = \frac{60}{2}$
 $= 30 \text{ cm}^2 \times 10 = 300 \text{ cm}^2$

Figure 10. Student Answers in the High Group For Didactic Situation 2

Figure 11 explains the results of student answers in the medium group. This group cannot determine the Pythagoreans in isosceles triangles. They worked out the area of the triangle without finding the height of the triangle that should have been obtained through Pythagoras. They mention the Pythagorean triple, but it is incorrect because they only say it naturally without proving it with the Pythagorean concept. When interviewed, they were only sure of the answer on the square picture.

Retrospective Profile

Based on the implementation results, it turns out that the facts that occur in the field are that the student responses given are not entirely by the predictions of student responses, according to Munfi (2019). By predicting student responses consisting of 3 types in each situation, it can be concluded that student responses with correct answers include students with a high level of ability. In contrast, student responses with almost correct answers include students with moderate ability levels, and student responses with incorrect answers include students with a

high level of ability and low ability. Therefore, the researchers grouped students into high, medium, and low abilities according to the predicted student responses in each didactic situation.

The difference between predicted student responses and metapedadidactic responses in didactic situation 1 is as follows:

First, the prediction of the response of students with a high level of ability is by the metapedadidactic response. Namely, students can measure the length of the curvature of a circle, define the circumference of a circle and formulate the formula for the circumference of a circle correctly.

Second, the predicted response of students with a medium ability level is not following the metapedadidactic response obtained. Students have not been able to measure the length of the circle's curve because there are less accurate measurement results. However, students can define the circumference of a circle but still cannot correctly formulate the formula for the circumference of a circle.

Third, the predicted response of students with low ability levels is also not by the metapedadidactic responses obtained. Students have not been able to

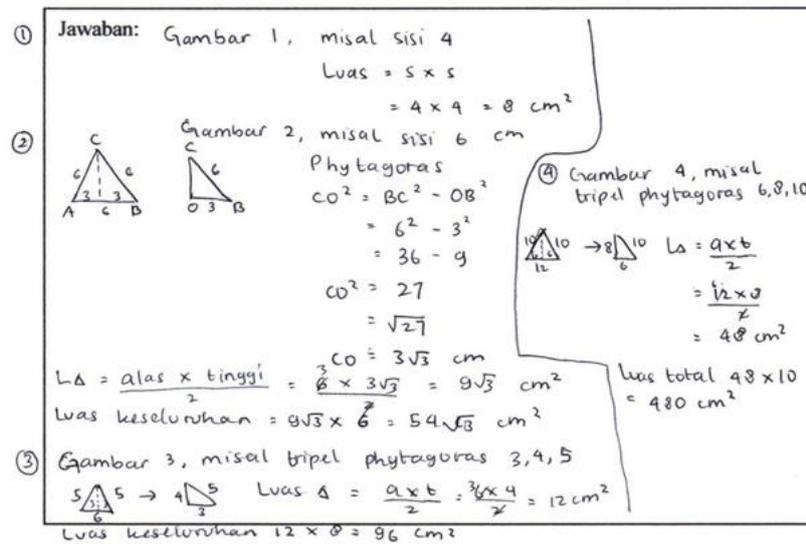


Figure 11. Student Answers in the Middle Group For Didactic Situation 2

measure the length of the circle's curve because there are less accurate measurement results. However, students can define the circumference of a circle but cannot formulate the formula for the circumference.

It can be concluded that while measuring the curvature of a circle, many students still have difficulty because of the media used. In addition, in didactic situation 1, no part instructs students to be able to formulate the formula for the circumference of a circle, so almost all students do not formulate the formula for the circumference of a circle.

The difference between predicted student responses and metapedadidactic responses in didactic situation 2 is as follows:

First, the prediction of the response of students with a high level of ability is by the metapedadidactic response. Students can determine the Pythagorean triple in a right triangle formed from an isosceles triangle on a regular n-sided shape and correctly calculate the area of the n-sided shape.

Second, the prediction of students' response with a medium ability level cannot be measured whether it is appropriate

or not because there is no metapedadidactic response whatsoever.

Third, the prediction of students' responses with low ability levels is by metapedadidactic responses. Students cannot determine the Pythagorean triple in a right triangle formed from an isosceles triangle on a regular n-sided shape and cannot correctly calculate the area of the n-sided shape.

In didactic situation 2, students are expected to be able to determine the Pythagorean triple formed from an isosceles triangle on a regular n-dimensional shape. Also, calculate the area of the n-sided shape correctly. However, students do not understand the problem, so they cannot find the concept of the circle area. From this explanation, it can be said that these two didactic situations have not been fully able to overcome the existing student learning obstacles. So that there needs to be a slight design revision so that students no longer experience the next learning obstacle. Revision for didactical situation one that the researchers compiled related to the concept of the circumference of a circle is described in Figure 13.

Please provide several glasses with different diameters! Measure the diameter and circumference of the Glass, then record the results in the following table.

No	Object	Diameter (d)	Circumference (K)	$\frac{K}{d}$
1	1 st Glass			
2	2 nd Glass			
3	3 rd Glass			
Average				

Is the value of $\frac{K}{d}$ for each circle close to the same (fixed) number?

The value of $\frac{K}{d}$ known as π , so $\frac{K}{d} = \pi$

The closest value of π is

While $\frac{K}{d} = \pi$, so the formula of the circumference (K) is

While $d = 2 \times r$ (radius), the formula of the circumference (K) is

So, the formula of the circumference (K) using diameter is

$$K = \text{_____}$$

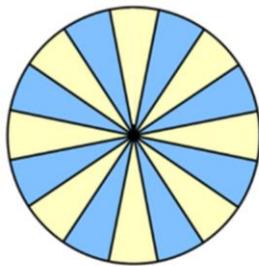
Or using radius (r) is

$$K = \text{_____}$$

Figure 12. Design Revision 1 Regarding the Concept of Circumference of a Circle

Revision for the didactic situation two that researcher compiled related to the concept of the area of a circle is described in Figure 13.

Cut the following circle and arrange its parts into an isosceles triangle!



If it has been formed into an isosceles triangle, calculate the area of the triangle with the base of the circle and the height of the radius of the circle!

Figure 13. Design Revision 2 Regarding the Concept of Area of a Circle

Discussion

Metapedadidactic analysis based on Munfi's (2019) design shows a new learning obstacle to didactic situation 1 related to the circumference of a circle. Several learning obstacles that arise from didactic situations 1 include: **First**, students have not been able to measure the length of the curvature of the circle because there are less accurate measurement results. Students can define the circumference of a circle but still cannot correctly formulate

the formula for the circumference of a circle. **Second**, students have not been able to measure the length of the curvature of the circle because there are less accurate measurement results. Students can define the circumference of a circle but cannot formulate the formula for the circumference.

It is concluded that by applying didactic situation 1, students who have not been able to formulate the formula for the circumference of a circle are students who understand that the result of dividing the circumference by the diameter of a circle produces a phi value. Still, they do not formulate the circle formula because of time constraints. Furthermore, students who cannot formulate the formula for the circumference of a circle are students who do not understand what is meant by dividing the circumference by the diameter of the circle that they have done, some of the results of student work show errors in dividing it. However, based on the two types of learning obstacles, students can define the curvature of a circle as the circumference of a circle even though the measurement results are less accurate.

Furthermore, in didactic situation 2, Munfi (2019) uses a triangle area approach as the concept of the area of a circle. In this situation, almost all students cannot understand the meaning of the problem. It is because students are required to find the Pythagorean triple before calculating the area of the triangle. So that students only focus on the Pythagorean, not the concept of the circle area.

After conducting a metapedadidactic analysis, a design revision was prepared in the hope that no more learning obstacles would arise. There are two design revisions related to the circumference of a circle and the concept of the area of a circle. The design revision refers to Bruner's learning theory. In the design re-

vision, there are student activities in connecting ideas to find new knowledge. Bruner (in Dahar, 2011) says that students should learn through active participation with concepts and principles to gain experience and conduct investigations to discover the principles themselves.

The revision of the didactic situation design in the first 2 parts is that students can find the approximate value of π and determine the formula for the circumference of a circle by measuring a concrete object in a glass. The use of the glass context plays an essential role in supporting learning the concept of the circumference of a circle (Nurdiansyah & Prahmana, 2017). In the revision of the didactic design 2, there are 3 activities that students must do to find the approximate value of π and determine the formula for the circumference of a circle. In the first activity, students were asked to draw the surface of the glass by tracing the glass on paper and then cutting it out. Next, the circle image on the form is folded according to the axis of symmetry and then measured using a ruler, and students record the results. The result obtained is known as the diameter of the circle. The second activity is that students are asked to measure the rim of the glass using a tape or rope, which is then measured using a ruler. The measurement result is the circumference of the circle.

The third activity is that students are asked to calculate the division between the circumference and the circle's diameter (K/d). Students are asked questions regarding the results of the calculations. The result of dividing the circumference by the circle's diameter approximates the π value ($K/d = \pi$). After that, students were asked questions about the approach to the value and asked to determine or formulate the formula for the circumference of a circle by dividing the circumference by the circle's diameter. The learning

trajectory consists of showing the circular part of the glass and its circumference, measuring the circumference of the upper and lower circles on the glass with a string, filling in the table to determine the ratio of the values of $K : d$ and concluding that $\pi = 3,14$ or $\frac{22}{7}$. $K = \pi \times d$ or $= 2\pi r$ (Sari, 2015). The student learning trajectory in studying the circumference and area of a circle according to Rosita et.al (2019) is to start with discovery activities, so to find out the circumference of a circle students need to know the value of π .

The second part of the revision of the didactic situation design is that students can find the concept of the area of a circle. The concept of the area of a circle can be obtained from various approaches to the area of a flat shape. In this revision, the concept of the area of a circle is proven through the approximation of the area of a triangle. To form a circle into a triangle, that is by making a circle in which there are 4, 9, or 16 squares/sections. Researchers used a circle with 16 squares to find out how students think to arrange the parts of the circle into triangles. The surface of the circle is presented using cardboard to help students think more creatively. The design revision is in line with the student's learning trajectory in determining the area of the circle, as stated by Rosita et al. (2019). To generalize the formula for the area of a circle, starting with selecting the area of a square, then a polygon, so that students can generalize the formula for the area of a circle. The use of media can form a new idea for students to quickly solve problems in learning mathematics to optimize their creative thinking skills (Anawati & Isnaningrum, 2019).

CONCLUSION

Based on the metapedadidactic and retrospective analysis that the researchers have done, it can be concluded that the

two didactic situations that have been implemented have not been fully able to overcome the students' learning obstacles. There are also new learning obstacles that appear in didactic situation 1 related to the circle's circumference. In addition, in didactic situation 2 associated with the concept of the area of a circle, no new learning obstacles appear. Still, almost all students cannot solve problems in a didactic situation.

The researcher made a design revision based on metapedadidactic and retrospective analysis results. There are two design revisions compiled. Design revision 1 related to the concept of the circumference of a circle with the hope that students can find the approximate value of (π) and determine the formula for the circumference of a circle. Through the context of a glass where students find their circumference and diameter, then find the π value approach and formulate the formula for the circumference of a circle. Design revision 2 is related to the concept of the area of a circle through an area approach to a flat shape in the form of a triangle. There is a circle with 16 sections/sections where students need to cut the grids and arrange them into a triangle, so students are expected to be able to find the concept of the area of a circle through the area of a triangle approach.

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