

STUDENTS' MATHEMATICAL MISCONCEPTIONS ON CIRCULAR MATERIAL USING FIVE-TIER DIAGNOSTIC

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ABSTRACT

This study aims to analyze the level, type, and causal factors of students' mathematical misconceptions in solving HOTS-type problems on circle material. This research method is descriptive qualitative with a case study research design at SMPN 1 Gunung Jati. Data collection techniques include tests and interviews. Data analysis techniques use three stages, namely data reduction, data display, and concluding drawing. The results of the study showed that students who experienced mathematical misconceptions in solving HOTS-type problems were 41.026%. The types of misconceptions were correlational misconceptions of 9.231%, classification misconceptions of 17.949%, and theoretical misconceptions of 13.846%. Students experienced more classification misconceptions with indicators of errors in interpreting problems into mathematical models. This is because students only learn based on explanations from teachers and only use one book as a reference for their knowledge, students also do not repeat learning, and are only accustomed to routine questions given by teachers. The biggest factor that can cause student misconceptions comes from the students themselves, such as preconceptions, wrong intuitions, and the stage of students' cognitive development. Thus, teachers must conduct diagnostics to be able to anticipate the occurrence of students' mathematical misconceptions.

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1. INTRODUCTION

Mathematics learning is a process or activity carried out by teachers and students to create a conducive learning environment for someone to learn mathematics by exchanging information (Ernawati & Sutiarso, 2020). This is in line with the opinion of Hanipah and Purnomo (2018) who stated that mathematics learning according to the constructivist view is an active process for students to build new knowledge about mathematics based on the experience or knowledge they already have.

Thus, it can be said that mathematics learning is an important activity for students, because mathematics learning is not only to obtain information about mathematical competence, students can also build their own knowledge about mathematics through the learning process. In the current mathematics learning process, students only learn standard procedures used to solve routine problems. So, when students are faced with non-routine math problems regarding circle material, some students cannot solve them. Students who are able to solve problems on circle material well indicate that the student understands the concept and has good problem-solving skills. Thus, students are able to utilize the knowledge they have to solve problems. Meanwhile, students who are wrong or unable to solve the problem can indicate that the student does not understand the concept or even has a misconception.

Based on the results of initial observations of the study at SMP Negeri 1 Gunung Jati, students who made mistakes or even could not solve the problems were because most students had difficulty in understanding the problems, students also often could not change the problems into mathematical form or create good and correct mathematical models. In addition, students also often made mistakes in using formulas, doing calculations, and converting units. Based on the average daily assessment results obtained, most of the eighth grade students obtained results below the Minimum Completion Criteria (KKM). The low achievement of student learning outcomes indicates that students make mistakes in understanding the material or solving problems. Students' inability to solve problems on the circle material can indicate that students do not understand the concept or even experience misconceptions.

According to Natalia T, Subanji & Sulandra (2016), misconception can be defined as a student's interpretation of a particular concept that is inaccurate or inconsistent with the generally accepted understanding. This is in line with the opinion of Zulvita, Halim, & Elisa (2017) who explain that misconception is a concept that is not in accordance with the concept recognized by experts. Meanwhile, Husna (2019) defines misconception as a wrong understanding of concepts in students' knowledge that occurs repeatedly due to students' lack of understanding of certain concepts. From these opinions, it can be concluded that mathematical misconceptions are mathematical conceptual errors made by students due to students' lack of understanding of certain concepts which results in students often being less accurate in interpreting or interpreting a concept.

Misconceptions in mathematics learning can be in the form of students' misunderstanding of prerequisite concepts at the beginning of learning which results in students having difficulty understanding subsequent mathematical concepts, as well as difficulty in connecting one mathematical concept to another. This is in accordance with the opinion of Mursidah (2019) who said that misconceptions in mathematics learning are conceptual errors that have been understood by students that are contrary to the concepts agreed upon by mathematics experts.

Misconceptions in students that are not handled seriously can continue and can affect student learning outcomes. To minimize or reduce ongoing misconceptions that result in decreased learning outcomes in students, a process of identifying student misconceptions is needed using diagnostic tests. One of the diagnostic test instruments that has been developed is a multiple-choice diagnostic test with multi-tiers or several levels, including a five-tier diagnostic test (Five-Tier Diagnostic Test). This five-tier diagnostic test is a diagnostic test that is the result of the development of a four-tier diagnostic test instrument by adding a fifth tier in the form of the level of student confidence in the relationship between the answers at the first level and the reasons at the third level (Setiawan, 2020). The Five-Tier Diagnostic Test was chosen because the use of the Five-Tier Diagnostic Test in identifying student misconceptions is considered to provide more accurate and more in-depth results. So that it can minimize errors in grouping students who do not understand the concept with students who experience mathematical misconceptions.

The results of previous research conducted by Setiawan (2020) showed that the Five Tier Diagnostic Test instrument is feasible to use and can reveal students' misconceptions more accurately. In addition, Anam, Widodo, Sopandi, & Wu (2019) also revealed that the advantages of using the Five-Tier Diagnostic instrument can provide more explanations regarding the level of knowledge and understanding of students, minimize the level of errors and deficiencies when diagnosing misconceptions in students, and provide information on how students express their opinions or conceptual thoughts. Other studies conducted by Afanti, Fadillah, & Hartono (2020);

Safira (2020); Murniasih, Ferdiani, & Agustina (2018); Putri, Nurhilaliati, & Kurniawati (2017) on students' misconceptions in solving circle problems, most of the researchers conducted research on circle problems that are routinely taught by teachers, and in using methods to identify student misconceptions, the researchers used including Certainty of Response Index (CRI), Three-Tier Diagnostic, Four-Tier Diagnostics Test (FTD-Test), and the use of other methods such as observation, interviews, and questionnaires.

Based on the explanation above, this study is different from previous studies, namely it is more focused on analyzing students' mathematical misconceptions using the Five-Tier Diagnostic Test in solving Higher Order Thinking Skill (HOTS) type questions, identifying types of students' mathematical misconceptions, namely classification misconceptions, correlational misconceptions and theoretical misconceptions in solving HOTS type questions on circle material, and knowing the factors that cause students' mathematical misconceptions so that teachers can anticipate so that students' mathematical misconceptions do not occur.

2. METHOD

This type of research uses a descriptive qualitative research method. Descriptive research is research with the aim of describing something as it is (Sudaryono, 2016). Descriptive research is intended to create a description of the facts and characteristics of a particular population or area systematically, factually and accurately (Wagiran, 2019). This research was conducted at SMP Negeri 1 Gunung Jati. The data collection technique in this study used test and interview instruments. The test used was a five-tier diagnostic test (Five-Tier Diagnostic Test). According to Putra, Hamidah, & Nahadi (2020), the Five-Tier Diagnostic Test consists of the first level in the form of regular multiple choice questions used to determine students' cognitive abilities. The second level contains questions about confidence in the answers given by students. The third level contains questions to find out students' reasons related to the answers at the first level. The fourth level contains the level of students' confidence in the reasons given. Then, at the fifth level, questions are used to determine whether there is a relationship between the answers and the reasons chosen by students to communicate the results they have obtained.

The test instrument consists of 5 questions of the Higher Order Thinking Skill (HOTS) type which are equipped with five levels in each question, given to 39 students of class VIII F of SMP Negeri 1 Gunung Jati after being validated by experts from mathematics lecturers and mathematics teachers who showed its validity, both in terms of construction/content and language. In addition, the questions have also been tested on students to see the validity, reliability, level of difficulty and discriminatory power of the questions, all of which have met the specified criteria, so that the test instrument can be used to measure students' misconceptions.

The data analysis technique used in this study uses the opinion of Miles and Huberman consisting of three stages, namely data reduction, data display, and concluding drawing/verification. (Sugiyono, 2015). First, grouping students' test results into categories of understanding the concept, not understanding the concept, and misconceptions. Second, calculating each category in the Five-Tier Diagnostic questions using the following formula:

$$P = \frac{f}{N} \times 100\%$$

Note:

P : Percentage of students from each category

f : Number of students from each category

N : The total number of students who are research subjects

Furthermore, the calculation results for each category of students are presented in the form of tables and diagrams. Third, analyze and group students who experience misconceptions into three types of misconceptions based on the types of misconceptions expressed by Ainiyah and Sugiyono (2016). From each type of misconception, there are several indicators, including those that can be seen in Table 1 below.

Table 1. Types of Misconceptions

SN	Types of Misconceptions	Indicator
1	Classificational Misconceptions	a. Errors in determining classification in solving problems. b. Errors in interpreting the mathematical sentences in the problem into the form of a mathematical model. c. Errors in writing down the steps to solve the problem.
2	Correlational Misconceptions	a. Use of incorrect formulas or formulas in solving problems. b. Errors in connecting one concept with another concept.
3	Theoretical Misconceptions	a. Mistakes in understanding the definition of a concept. b. Errors in stating reasons for answering questions. c. Errors in writing the formula to be used. d. Errors in converting the units requested in the problem.

Based on Table 1 above, it can be seen that classification misconceptions occur when students make mistakes in interpreting mathematical sentences which results in students also making mistakes in writing down the steps to solve problems. Correlational misconceptions occur when students make mistakes in connecting mathematical concepts. Meanwhile, theoretical misconceptions occur because students make mistakes in defining a concept, or in using the formula that will be used in solving problems.

3. RESULT AND DISCUSSION

The data from this research were obtained based on the results of a misconception analysis carried out to determine the level of understanding of the concepts possessed by students after receiving learning.

3.1. Level of Understanding of The Concept

Analysis of student misconceptions in this study used the Five-Tier Diagnostics Test with multiple choice questions on circle material. Based on the results of the Five-Tier Diagnostics test and a combination of students' answers and reasons for their answers with their level of confidence, the ability of class VIII F students at SMP Negeri 1 Gunung Jati in solving HOTS type questions on circle material can be grouped into the categories of understanding the concept, not understanding the concept, and experiencing mathematical misconceptions. The research data can be seen in Table 2 below.

Table 2. Results of Analysis of Students' Mathematical Ability Categories

Question Indicator	No	Percentage of Students (%)		
		PK	TPK	M
Analyze the relationship between central angles and circumferential angles facing the same arc.	1	38.462	15.385	46.154
Relate the relationship between central angle, arc length and area of a circle.	2	33.333	25.641	41.026
Examine the relationship between the length of an arc, the circumference of a circle, and the central angle of a circle.	3	38.462	17.949	43.590

Compare the areas of two circles.	4	35.897	25.641	38.462
Plan, create, or design a circle concept to find a solution to a problem.	5	33.333	30.769	35.897
Average Percentage		35.897	23.077	41,026

Note:

PK: Understand the concept, TPK: Don't understand the concept, M: Misconceptions

Based on Table 2, it can be shown that students' mathematical ability in solving HOTS-type problems on circle material with the misconception category is still dominant with a percentage of 41.026%. This percentage is much larger than other categories. In contrast to the research of Udma, S.A.S., Heryandi, Y., & Muchyidin, A. (2024), that most students do not understand the concept and only about one-fifth of students understand the concept. Although the difference in percentage between students who understand the concept, misconceptions and do not understand the concept is relatively small, it greatly influences the success of student learning in working on questions.

To find out more clearly the grouping of students' mathematical abilities based on the overall Five-Tier Diagnostic test results, it can be presented briefly in the form of a graph of the average percentage of students' understanding of concepts in Figure 1.

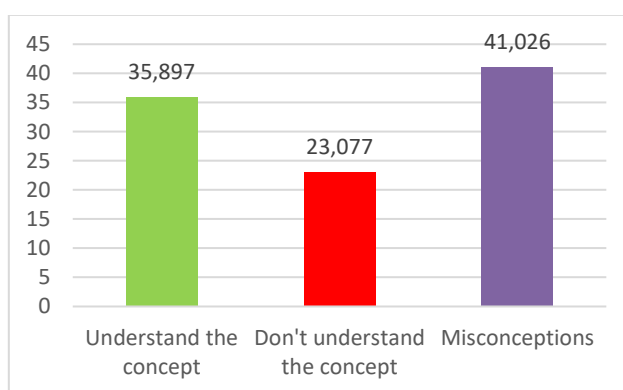


Figure 1. Graph of Percentage of Student Concept Understanding

Based on Figure 1, it can be seen that the test results using Five-Tier Diagnostic show that 41.026% of the total number of students experienced mathematical misconceptions, 35.897% understood the concept, and the remaining 23.077% did not understand the concept.

3.2. Types of Student Misconception

Misconceptions categories based on data from students' understanding of concepts above can be mapped and regrouped into several types of misconceptions that are often encountered by students, including classificational misconceptions, correlational misconceptions and theoretical misconceptions. The percentage grouping for each type of student misconception in each question item can be seen in Table 3.

Table 1. Types of Student Misconception

No.	Types of Misconception (%)			Total Percentage (%)
	Correlational	Classificational	Theoretical	
1	5.128	23.077	17.949	46.154
2	0.000	23.077	17.949	41.026
3	10.256	17.949	15.385	43.590
4	17.949	12.821	7.692	38.462
5	12.821	12.821	10.256	35.897
Mean	9.231	17.949	13.846	41.026

Table 3 shows that misconceptions occur in all indicators of circle questions with an average misconception of 41.026%. With the highest percentage of misconceptions occurring in number 1 at 46.154% in the indicator examining the relationship between arc length, circumference of a circle, and the central angle of a circle. Conversely, the misconception with the lowest percentage occurs in number 5 at 35.897% in the indicator planning a solution to determine the number of wheel rotations needed to cover the same distance as another wheel using a comparison of the circumferences of two circles. This is in line with the results of the research analysis (Khoerunnisa, 2020) which shows that many students experience mathematical misconceptions out of 15 students, all students experience mathematical misconceptions with different causes and types of misconceptions.

Based on the data from the interview conversations, the answers given by students were often the same, and not a few answers or opinions were given differently. From the interview results, it can be seen that the role of teachers, learning media, and students' personal selves have a great influence on the process of understanding concepts. Some students who were used as interview sources admitted to having difficulty translating questions, operating calculations, and applying formulas in solving problems. However, in the initial question, students admitted to being very sure of all the answers given during the test, but some were unsure of their answers. This can be used as a reference to diagnose the causes of student misconceptions.

In question number 1, students are asked to analyze the relationship between three angles of the circumference facing the same arc with the central angle of the circle. Based on Table 3, the highest percentage of student misconceptions in question number 1 is the type of classification misconception. Classification misconceptions usually occur because students make mistakes in interpreting the question. Thus, students make mistakes in solving the next stage. This is in line with the opinion of the same types of misconceptions also expressed by Ainiyah and Sugiyono (2016) who stated that one indicator of classification misconception is students' mistakes in interpreting mathematical sentences in the question into mathematical forms. Thus, it is not uncommon for the results of the student's solution to be wrong. In addition, the types of misconceptions found in question number 1 are theoretical misconceptions and correlational misconceptions. An example of a student's answer who experienced classification misconceptions in question number 1 can be seen in Figure 2.

1.1 Diketahui sebuah lingkaran dengan titik pusat O, memiliki lima buah titik yang terletak pada keliling lingkaran. Dari kelima titik tersebut jika ditarik beberapa garis lurus akan terbentuk 4 buah juring lingkaran seperti pada gambar berikut ini.

Langkah-langkah Pengerjaan:
 $\angle AOE = 90^\circ$
 $\angle AOE = \dots$
 $\frac{1}{3} \times 90^\circ$
 $= 30^\circ$

Jika tiga buah sudut juring dijumlahkan menjadi $\angle ABE + \angle ACE + \angle ADE = 90^\circ$, maka besar $\angle AOE$ adalah...

a. 90°
b. 60°
c. 45°
d. 30°

1.2 Seberapa yakin Anda dengan jawaban tersebut?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☒ 4

Sangat Tidak Yakin Sangat Yakin

1.3 Apa alasan dari jawaban Anda pada pertanyaan sebelumnya?

a. Menggunakan konsep hubungan sudut pusat dan sudut keliling yang menghadap busur yang sama sehingga besar sudut pusat = $2 \times$ sudut keliling.
b. Menggunakan konsep hubungan sudut keliling yang menghadap busur yang sama memiliki besar yang sama.
c. Menggunakan konsep sudut keliling yang menghadap diameter besarnya 90° .
d. Menggunakan konsep hubungan sudut pusat dan sudut keliling yang menghadap busur yang sama, maka besarnya sama.
e.

1.4 Seberapa yakin Anda dengan kebenaran alasan tersebut?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☒ 4

Sangat Tidak Yakin Sangat Yakin

1.5 Apakah Anda yakin terdapat hubungan sebab-akibat (konsekuensi) antara jawaban dan alasan jawaban Anda?

☒ Ya
☐ Tidak

Figure 2. Classification Misconception Answer Number 1 Student F5

Based on Figure 2, it can be seen that students with research code F5 chose answer d, with the steps for solving as shown in the figure. The answer at the first level of student F5 in the figure is wrong. At the first level, student F5 made a mistake in interpreting the problem, namely interpreting that the sum of the three angles known in the problem which should be the angle around the circle was interpreted as the angle at the center of the circle, which resulted in the student's solution process experiencing errors by considering $\angle AOE$ as the angle around the circle, and The magnitude is found using the formula circumferential angle = $\frac{1}{3}$ of the central angle of the circle. However, F5 students can explain the reasons at the third level correctly, namely using the concept of the relationship between the central angle and the circumferential angle facing the same arc so that the central angle = $2 \times$ the circumferential angle, with the level of confidence given by F5 being very

high, and assuming that the answers and reasons have a correlation. So, based on the results of student F5's answers and the interpretation of the answers in the misconception table, student F5 is included in the misconception group, with the type of classificational misconception.

In question number 2, students are asked to relate the relationship between arc length, area and circumference of a circle to find out the area of a sector of a circle. Based on Table 3, the highest percentage of student misconceptions in question number 2 is the classification misconception type. In addition, the type of misconception found in question number 2 is the theoretical misconception type, correlational misconceptions were not found in question number 2. An example of a student's answer who experienced classification misconceptions can be seen in Figure 3.

2.1 Sebuah lingkaran dengan pusat lingkaran berada di O memiliki jari-jari sepanjang 10 cm, serta memiliki titik P dan titik Q yang terletak pada keliling lingkaran. Jika diketahui panjang busur PQ = 12 cm. Hitunglah luas juring POQ. a. 20cm² b. 30cm² c. 60cm² d. 120cm²	Langkah-langkah Penyelesaian: $= \frac{L}{360^\circ} \cdot 360^\circ$ $= \frac{12}{360} \cdot 360^\circ$ $= \frac{12}{360} \cdot 360^\circ = 12$ $= 30$ $= 30 \text{ cm}^2$
2.2 Seberapa yakin Anda dengan jawaban tersebut? Sangat Tidak Yakin: ☐ 0 ☐ 1 ☒ 2 ☐ 3 ☐ 4 ☐ 5 Sangat Yakin	
2.3 Apa alasan dari jawaban Anda pada pertanyaan sebelumnya? a. Luas juring dapat diketahui dengan menggunakan konsep hubungan sudut pusat dan sudut keliling. b. Luas juring dapat diketahui dengan menggunakan konsep hubungan keliling, panjang busur, dan luas juring lingkaran. c. Luas juring dapat diketahui dengan menggunakan konsep hubungan luas juring dan sudut pusat. d. Luas juring dapat diketahui dengan menggunakan konsep hubungan panjang busur dan luas juring lingkaran. e.	
2.4 Seberapa yakin Anda dengan kebenaran alasan tersebut? Sangat Tidak Yakin: ☐ 0 ☐ 1 ☒ 2 ☐ 3 ☐ 4 ☐ 5 Sangat Yakin	
2.5 Apakah Anda yakin terdapat hubungan sebab-akibat (korelasi) antara jawaban dan alasan jawaban Anda? ☒ Ya ☐ Tidak	

Figure 3. Classification Misconception Answer Number 2 Student F10

F10 students experienced errors in interpreting mathematical sentences into mathematical models. In the solution steps, students wrote that to find the area of the circle, the formula for area of the circle can be used $= \frac{\alpha}{360^\circ} \times \text{circumference of the circle}$, but in the next step, students made a mistake by interpreting that the number 12 in the problem was the size of the angle α . This is clearly wrong, because the number 12 in the problem is the arc length of PQ. Because there was a misinterpretation, the solution result was wrong because the answer at the third level was also wrong. The error made by student F10, in accordance with the type of classificatory misconception expressed by Fitriani, Mardiyana and Pramesti (2017), namely an error in determining the elements in the question. However, the level of confidence given by student F10 is quite high. Based on the results of student F10's answers and the interpretation of the answers in the table of misconceptions, student F10 is included in the misconception group, with the type of classificatory misconception.

In question number 3, students are asked to examine the relationship between the central angle and the circumference of a circle to find the length of an arc on a circle. Based on Table 3, the highest percentage of student misconceptions in question number 3 is the classification misconception type. In addition, other types of misconceptions found in question number 3 are theoretical misconceptions and correlational misconceptions. An example of a student's answer who experienced classification misconceptions in question number 3 can be seen in Figure 4.

Based on Figure 5, it can be seen that students with research code F35, based on the misconception indicator, student F35 experiences correlational misconception because student F35 makes mistakes in connecting concepts with formulas used in solving problems, this is in accordance with the opinion of Aini & Wiryanto (2020) which states that the indicator of student misconception with the correlational misconception type is that students cannot understand the relationship between the concepts they write. In the steps of student completion, it can be seen that the final result obtained by student F35 is correct. However, the reason for the answer at the third level given by student F35 is wrong, with a relatively high level of confidence and assumes that there is a correlation between the answer and the reason. Based on the results of student F35's answers and the interpretation of the answers in the misconception table, student F35 is included in the misconception group, with the correlational misconception type.

In question number 5, students are asked to plan a solution to determine the number of wheel revolutions needed to cover the same distance as another wheel using the ratio of the circumferences of two circles. Based on Table 3, the highest percentage of student misconceptions in question number 5 are classificational misconceptions and correlational misconceptions. Apart from that, another type of misconception found in question number 5 is the type of theoretical misconception.

5.1 Roda sepeda Lisa berdiameter 56 cm, sedangkan roda sepeda Dini berdiameter 49 cm. Jika Lisa bersepeda, rodanya berputar sebanyak 140 kali, berapa kali roda sepeda Dini harus berputar untuk menempuh jarak yang sama dengan Lisa? a. 140 kali b. 150 kali c. 160 kali d. 170 kali		Langkah-langkah Pengerjaan: $n \text{ Lisa} \times k \text{ Lisa} = n \text{ Dini} \times k \text{ Dini}$ $n \text{ Dini} = \frac{n \text{ Lisa} \times k \text{ Lisa}}{k \text{ Dini}}$ $n \text{ Dini} = \frac{56 \times 140}{49}$ $= 160$
5.2 Seberapa yakin Anda dengan jawaban tersebut? ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☒ 4 ☐ 5 Sangat Tidak Yakin Sangat Yakin		
5.3 Apa alasan dari jawaban Anda pada pertanyaan sebelumnya? a. Menggunakan konsep perbandingan senilai antara diameter roda sepeda Lisa dan diameter roda sepeda Dini. ☒ Menggunakan konsep perbandingan berbalik nilai antara keliling roda sepeda Lisa dan keliling roda sepeda Dini. c. Menggunakan konsep perbandingan senilai antara keliling roda sepeda Lisa dan keliling roda sepeda Dini. d. Menggunakan konsep perbandingan berbalik nilai antara luas roda sepeda Lisa dan luas roda sepeda Dini. e.		
5.4 Seberapa yakin Anda dengan kebenaran alasan tersebut? ☐ 0 ☐ 1 ☐ 2 ☒ 3 ☐ 4 ☐ 5 Sangat Tidak Yakin Sangat Yakin		
5.5 Apakah Anda yakin terdapat hubungan sebab-akibat (korelasi) antara jawaban dan alasan jawaban Anda? a. Ya ☒ Tidak		

Figure 6. Classification Misconception Answer Number 5 Student F24

Based on Figure 6, it can be seen that students with research code F24, based on the misconception indicator, experience classification misconceptions because F24 students make mistakes in interpreting mathematical sentences into mathematical model forms, according to Ainiyah and Sugiyono (2016) one of the indicators of classification misconceptions is students' mistakes in interpreting mathematical sentences in questions into mathematical forms. In the steps of solving, F24 students interpret that the diameter known in the question is the circumference of the circle of each of the Lisa and Dini wheels. However, even though there is a misinterpretation, the solution result is correct. with the reason that the answer at the third level is wrong. However, the level of confidence given by F24 students is quite high, but doubtful about the correlation between the answer and the reason given. Based on the results of F24 students' answers and the interpretation of the answers in the F24 student misconception table, it is included in the misconception group, with the type of classification misconception.

In summary, the types of students' mathematical misconceptions in solving HOTS-type problems on the topic of circles can be seen in Table 4.

Table 4. Types of Misconceptions Based on Question Indicators

Question Indicators	Mathematical Misconceptions	Types of Misconceptions
1	Interpret the angle of the circumference of a circle as the central angle of the circle, by assuming $\angle AOE$ as the angle of the circumference of the circle, and finding its size using the formula for the angle of the circumference = $1/3$ of the central angle.	Classification
2	Interpret the number 12 which is the arc length of PQ as the size of angle α in calculating the area of a sector of a circle.	Classification
3	In the solution steps, students wrote that 14 is the central angle of the garden, even though it is the radius of the circle.	Classification
4	Students have a high level of confidence in the answers and reasons given, and conclude that they are interrelated or correlated.	Correlation
5	Interpret the known diameter in the problem as the circumference of each wheel.	Classification

Based on the results of the analytical presentation on each question item and the results of interviews, it can be seen that students experience more classificational misconceptions with the misconception indicator being errors in interpreting questions into mathematical form.

3.3. Factors Causing Misconceptions In Students

Based on the interview results, students admitted that they often had difficulty interpreting questions. Apart from that, other obstacles encountered by students are due to limited knowledge or references because students only learn based on the explanations given by the teacher and only use one book as a reference, students also do not repeat learning, and are only used to the questions routinely given by the teacher. Apart from that, teachers' learning methods that still use the lecture method also often make students feel confused because they are left behind with the material explained by the teacher. The factors causing misconceptions found during research are in accordance with the opinion expressed by Zulifah (2018), who believes that student misconceptions are influenced by the students themselves, teachers, textbooks and teaching methods. Meanwhile, Suparno (2013) also revealed that the biggest factors that can cause student misconceptions can originate from the students themselves, such as preconceptions, wrong intuition, and the student's stage of cognitive development.

There is also data from interviews conducted with 5 students who experienced many misconceptions. Based on data from interview conversations, the answers given by students are often the same, and quite a few of the answers or opinions given are different. Of the total of 18 questions asked, there were several answers that could be considered as factors causing students' misconceptions. From the interview results, it can be seen that the role of the teacher, learning media, and students' personal selves have a big influence on the process of understanding concepts. Some students who were used as interviewees admitted that they had difficulty translating questions, operating calculations, and applying formulas in solving problems. However, in the initial question, students admitted that they were very confident with all the answers given during the test, but some felt doubtful about the answers. This can be used as a reference for diagnosing the causes of student misconceptions.

4. CONCLUSION

The results of the study showed that the level of students' ability in solving HOTS-type questions on the circle material with the category of understanding the concept was 35.897%, not understanding the concept was 23.077%, and misconceptions were 41.026%. This percentage is much larger than other categories. Although the difference in percentage between students who

understand the concept, misconceptions and do not understand the concept is relatively small, it greatly influences the success of student learning in working on questions. The types of misconceptions experienced by students were correlational misconceptions with an average of 9.231%, classification misconceptions were 17.949%, and theoretical misconceptions were 13.846%. Based on the results of the analytical presentation on each question item and the results of interviews, it can be seen that students experience more classificational misconceptions with the misconception indicator being errors in interpreting questions into mathematical form. Students experienced more classification misconceptions with indicators of misconceptions in the form of errors in interpreting questions into mathematical forms. This is because students only learn based on the explanation given by the teacher and only use one book as a reference for their knowledge, students also do not repeat learning, and are only accustomed to questions that are routinely given by the teacher.

REFERENCES

- Afanti, A. M., Fadillah, S., & Hartono. (2020). Analisis miskonsepsi siswa dalam menyelesaikan soal pada materi lingkaran menggunakan certainty of response index (CRI) di kelas VIII smp negeri 9 pontianak. *Jurnal Prodi Pendidikan Matematika (JPMM)*, Vol. 2, No. 1, 39-50. <https://jurnal.mipatek.upgripnk.ac.id/index.php/JPPM/article/view/61>
- Aini, S. N., & Wiryanto. (2020). Analisis miskonsepsi matematika siswa pada materi operasi hitung pecahan desimal kelas V di sekolah dasar. *JPGSD*, Vol. 08, No. 02, 341-351. <https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/34265>
- Ainiyah, L. A., & Sugiyono. (2016). Identifikasi miskonsepsi siswa dalam materi geometri pada pembelajaran matematika siswa kelas VIII SMP Negeri 1 Punggulan. *Jurnal Pendidikan Matematika*, Vol. 5, No. 1, 1-10. <https://journal.student.uny.ac.id/index.php/jpm/article/view/681/2444>
- Anam, R. S., Widodo, A., Sopandi, W., & Wu, H.-K. (2019). Developing a five tier diagnostic test to identify students' misconceptions in science: an example of the heat transfer concepts. *Elementary Education Online*, 18 (3), 1014-1029. <https://doi.org/10.17051/ilkonline.2019.609690>
- Ernawati, & Sutiarto, S. (2020). Analisis kesulitan menyelesaikan soal matematika kategori higher order thinking skills menurut tahapan polya. *Jurnal Penelitian Pembelajaran Matematika*, Vol. 13, No. 2, 178-195. https://repository.lppm.unila.ac.id/24891/1/2020_S4_Untirta_Anggota.pdf
- Fitriani, D. A., Mardiyana, & Pramesti, G. (2017). Analisis miskonsepsi siswa pada pembelajaran matematika materi pokok ruang dimensi tiga ditinjau dari kecerdasan visual-spasial siswa kelas X SMA Negeri 1 Klaten. *Jurnal Pendidikan Matematika dan Matematika*, Vol. 1, No. 6, 27-34.
- Hanipah, I. R., & Purnomo, Y. W. (2018). Student mistakes to solve higher order thinking based problem in the quadrilateral topic. *The Journal of Innovation in Elementary Education*, Vol. 3, No. 2, 73-80. <https://journal.uhamka.ac.id/index.php/jipd/article/view/8651>
- Husna, N. (2019). Miskonsepsi siswa dalam materi persamaan linear satu variabel pada siswa SMP Negeri 2 Sebawi. *Educatio*, Vol. 14, No. 2, 68-81. <https://doi.org/10.29408/edc.v14i2.1593>
- Murniasih, T. R., Ferdiani, R. D., & Agustina, R. (2018). Identifikasi miskonsepsi siswa SMP pada materi lingkaran dengan menggunakan three tier test. *Jurnal Ilmu Edukasi dan Sosial*, Vol. 9, No. 2, 174-180.
- Mursidah, R. (2019). *Identifikasi miskonsepsi peserta didik dalam menyelesaikan soal aritmetika sosial ditinjau dari kemampuan awal matematis*. Skripsi, Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi, Tadris Matematika, Jambi.
- Natalia T, Karolin; Subanji; Sulandra, I Made. (2016). Miskonsepsi pada penyelesaian soal aljabar siswa kelas VIII berdasarkan proses berpikir manson. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, Vol. 1, No. 10, 1917-1925. <https://media.neliti.com/media/publications/210139-miskonsepsi-pada-penyelesaian-soal-aljab.pdf>

- Putra, A. S., Hamidah, I., & Nahadi. (2020). The development of five-tier diagnostic test to identify misconceptions and causes of students' misconceptions in waves and optics material. *Journal of Physics: Conference Series*, 1-10. DOI 10.1088/1742-6596/1521/2/022020
- Putri, B. K., Nurhilaliati, & Kurniawati, K. R. (2017). Identifikasi miskonsepsi siswa pada pembelajaran matematika di SMKN 1 Praya Tengah. *Paedagogia*, Vol. 8, No. 2, 24-31. <https://doi.org/10.31764/paedagogia.v8i2.63>
- Khoerunnisa, Runi. (2020). *Analisis Miskonsepsi Matematika Siswa pada Materi Bangun Ruang di Kelas V SD Negeri Ciputat*. S1 thesis, Universitas Pendidikan Indonesia. <http://repository.upi.edu/id/eprint/52334>
- Safira, P. R. (2020). *Analisis miskonsepsi siswa smp dalam menyelesaikan soal matematika tipe HOTS dengan menggunakan four-tier diagnostic test*. Skripsi, Universitas Muhammadiyah Malang, Pendidikan Matematika, Malang.
- Setiawan, D. (2020). *Pengembangan asesmen diagnostik miskonsepsi fluida berformat five-tier untuk mengungkap profil pemahaman konsep siswa*. Tesis, Universitas Negeri Semarang, Pendidikan Fisika, Semarang. <http://lib.unnes.ac.id/id/eprint/35248>
- Sudaryono. (2016). *Metode penelitian pendidikan*. Jakarta: PT Kharisma Putra Utama.
- Sugiyono. (2015). *Metode penelitian kuantitatif, kualitatif dan R&D*. Bandung: Alfabeta.
- Suparno, P. (2013). *Miskonsepsi dan perubahan konsep dalam pendidikan fisika*. Jakarta: PT. Grasindo.
- Wagiran. (2019). *Metodologi penelitian pendidikan: teori dan implementasi*. Yogyakarta: Deepublish Publisher.
- Zulifah, H. A. (2018). *Identifikasi miskonsepsi pada materi lingkaran kelas VIII MTs sabilul ulum tahun ajaran 2017/2018 dengan menggunakan uji tes diagnostik pilihan ganda tiga tingkat*. Skripsi, Universitas Islam Negeri Walisongo, Fakultas Sains dan Teknologi, Semarang. <https://eprints.walisongo.ac.id/id/eprint/9381>
- Zulvita, R., Halim, A., & Elisa. (2017). Identifikasi dan remediasi miskonsepsi konsep hukum newton dengan menggunakan metode eksperimen di MAN Darusalam. *Jurnal Ilmiah Mahasiswa (JIM) Pendidikan Fisika*, Vol. 2, No. 1, 128-134. <https://jim.usk.ac.id/pendidikan-fisika/article/view/2213>
- Udma, S.A.S., Heryandi, Y., & Muchyidin, A. (2024). Miskonsepsi Siswa dalam Menyelesaikan Soal Numerasi Ditinjau dari Gaya Kognitif. *ALGORITMA Journal of Mathematics Education*, 6 (2), 95-110. DOI: <https://doi.org/10.15408/ajme.v6i2.42778>