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# Misconceptions Analysis of Students' Reflective-Impulsive Cognitive Style on Function Material

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**ABSTRACT**

Students generally experience errors in two forms, namely conceptual and execution errors. Conceptual errors are related to students' lack of understanding, while execution errors occur when attempting to solve problems with incomplete procedures. This study aims to measure students' understanding of concepts after learning. The misconception analysis in this study used a four-tier diagnostic test. The results of this test provide five categories of student answers, namely understanding concept (understand), incomplete understanding (partial understanding), misconception, not understanding the concept (not understand), and cannot be coded (uncode). This research uses a mixed method. The data analysis phase is carried out by analyzing the data collected as Matching Familiar Figure Test (MFFT), four-tier diagnostic test data results, and in-depth interview data based on the results of the study concluded that in terms of students' reflective-impulsive cognitive style, impulsive students tend to experience higher misconceptions than reflective students.



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## 1. INTRODUCTION

Some studies assume mathematics is crucial in the 21st century [1]. Therefore, learning mathematics should help develop creative activities that involve imagination, intuition, and discovery by developing divergent, original thinking, curiosity, making predictions and guesses, and dabbling [2]–[4]. Also, the Ministry of Education [5] explained that the purpose of learning mathematics at elementary and secondary school levels is to understand mathematical concepts, explain the interrelationships between concepts, and apply concepts or algorithms flexibly, accurately, efficiently, and precisely in problem-solving. Therefore, understanding concepts in mathematics is very important to instil in students because this concept will be the foundation for shaping further knowledge, even when working on problems that arise in contexts outside mathematics [6].

However, the fact is that during the learning process, students are not always able to absorb the information provided by the teacher as a whole. Students find it difficult to understand various concepts, especially in mathematics, which contains many complex and abstract concepts [7], [8]. This is in line with Ruseffendi [9] that many students who, after learning mathematics, cannot understand even the simplest parts. Many concepts are misunderstood, so mathematics is a complex, complicated, and difficult science.

Error in understanding the concept is commonly known as a misconception. A misconception results from a lack of understanding of a case or an error in applying rules or mathematical generalization [10]–[12]. Students generally experience errors in two forms, namely conceptual errors and execution errors [13], [14]. Conceptual errors are related to students' lack of understanding, while execution errors occur when attempting to solve problems with incomplete procedures. Misunderstandings in mathematics can be a severe problem if they are not corrected immediately because one concept error can cause students to have continuous errors. Because the basic concepts in mathematics will continue to be used and related to other concepts [15].

One of the factors that cause misconceptions is coming from the teacher [16]–[18]. Usually, the quality of the teacher in conveying learning will affect student interest in learning mathematics and understanding concepts received by students [19]. Based on the research results by Yulianingsih & Sobandi [20], teacher teaching performance positively and significantly affects student learning achievement, both partially and simultaneously. However, in reality, many students often have difficulty solving problems even though the teacher's learning process is already good, indirectly affecting the mastery of students' mathematical concepts. This is consistent with the results of research Trends in International Mathematics and Science Study (TIMSS) in 2015, in which the mathematics mastery of Indonesian students was ranked low, at 45th place out of 50 countries surveyed [21].

Based on the results of a preliminary study conducted at one of the state high schools in Cirebon Regency, the low learning achievement is allegedly due to students experiencing misconceptions about the material being taught, so the knowledge they get is not perfect. Such conditions will be a problem that can hinder the continued absorption of students' knowledge. Also, the success of learning depends on the characteristics of the individual. Each student has a different cognitive style in compiling the information obtained [22]–[24]. Cognitive style is an individual characteristic in receiving, storing, or using information to respond to a task or various environmental conditions [25]. The difference in students' abilities can ultimately cause the possibility of different mistakes, not to mention the students' lack of confidence in their abilities, making it difficult for students to develop their potential in mathematics [26].

Of the various types of learning styles that exist, researchers are interested in reflective and impulsive cognitive styles. According to Arifin [27], the Reflective cognitive style is the cognitive style of students who tend to be slower in reacting to a given stimulus because it takes time to think about the stimulus it receives, while the impulsive cognitive style is the cognitive style of students who tend to react quickly to the stimulus they receive without deep reflection. Reflective and impulsive cognitive styles also influence

the students 'mathematical problem-solving efforts; this is seen in students' mastery of understanding concepts and solving problems.

If the cognitive style possessed by students is appropriate and supportive in understanding the material, it will undoubtedly reduce the risk of misunderstanding the concepts explained by the teacher in learning [28]. Therefore, there needs to be an effort to detect these misconceptions so the teacher can know students' incomplete understandings or even deviate from the proper rules. One way to diagnose occlusion is by a four-tier diagnostic test. The test is a four-level multiple-choice test, which is the development of a three-tier diagnostic test. In a three-tier diagnostic test, a question will measure students' knowledge about a concept, then provide answers, the reasons for the answers, and the confidence level. However, in a four-tier diagnostic test, the confidence level is provided twice: the confidence level in the answer and the level of confidence in the reason.

## 2. METHOD

The type of research used in this research is descriptive research with quantitative and qualitative approaches. The descriptive method gathers information about current (current) natural conditions. The results of this study are a description of the Percentage of students who experience misconceptions in the function material based on categories in the four-tier diagnostic test and a description of the comparison of students' misconceptions in terms of reflexive and impulsive cognitive styles.

This research was conducted at one of the state high schools in the Cirebon District with 36 research subjects from class X MIPA 4. Data were obtained by giving tests to students. The data analysis phase is carried out by analyzing the data collected in the form of the Matching Familiar Figure Test (MFFT) [29], data from four-tier diagnostic test results, and in-depth interview data that has been carried out.

## 3. RESULTS AND DISCUSSION

Analysis of students' misconceptions is done to measure the level of understanding of concepts possessed by students after conducting the learning process. The misconception analysis in this study used a four-tier diagnostic test. The results of this test provide five categories of student answers, namely understanding concept (understanding), incomplete understanding (partial understanding), misconception (misconception), not understanding the concept (not understanding), and cannot be coded (uncode).

In the experimental class, the instrument Matching Familiar Figure Test (MFFT) is used to determine the classification of students' cognitive styles based on the speed and accuracy of students in understanding something [30]–[32].

Table 1. Cognitive Style of MIPA 4

| Cognitive style | Total Students |
|---|---|
| Fast Accurate | 6 |
| Slow Innecurate | 8 |
| Reflection | 6 |
| Impulsive | 16 |

Based on the results of the MFFT instrument filling, out of the 36 students, 16 had impulsive cognitive styles, and 6 had reflective cognitive styles, as seen in Table 1 above.

Classification of students' conceptions is obtained by category from the results of the four-tier diagnostic test. The Percentage of students' choice of answers in doing the test can be grouped into five categories: understanding concept, incomplete understanding, misconception, not understanding, and cannot be coded (uncode). The classification of student conceptions can be seen in the following Figure 1:

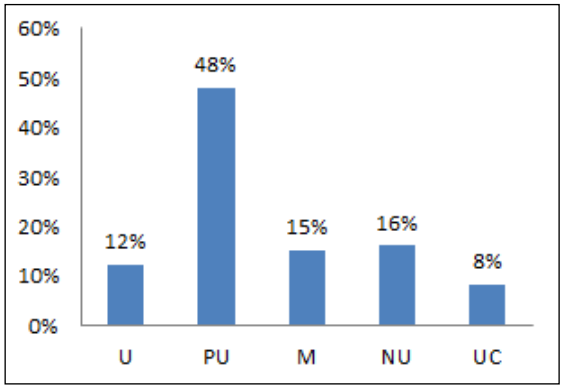



Figure 1. Classification of Student Conception Level

Based on Figure 1 above, the order of students' conception classification from highest to lowest is a partial understanding of the concept by 48%, not understanding by 16%, a misconception by 15%, understanding the concept (understanding) by 13%, and cannot be encoded (uncode) by 8%. It can be seen that the Percentage of students who do not understand the concept is more significant than students who experience misconceptions. This shows that the low student achievement is influenced by misconceptions and students' lack of understanding of the tested concepts.

Understanding students' concepts is crucial in learning, especially with the cognitive aspects of students [31], [32]. Therefore, the researcher will review students' conceptualization of the reflective-impulsive cognitive style. Students' misconceptions will be analyzed in solving mathematical problems in the material function through this cognitive style. The explanation of misconception analysis in terms of reflective-impulsive cognitive style will be discussed in more detail.

1. States the Concept of Relationships

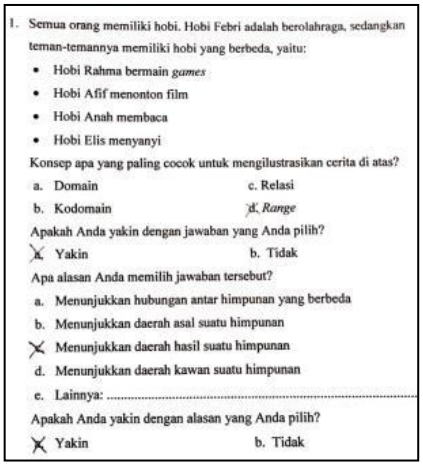
   In question number 1, students are asked to state the concept of the relationship based on the illustrated examples presented in the problem. The Percentage of students' conception level in question number 1 can be seen in the following Table 2:

Table 2. Percentage of Conception Level Problem 1

| Category | Percentage |
|---|---|
| Understand | 14% |
| Partial Understanding | 56% |
| Misconception | 8% |
| Not Understand | 11% |
| Uncode | 11% |

In question number 1, partial understanding is the highest Percentage of student categories. Students who answered the questions correctly in the first tier tended to be fewer than students who answered the reason correctly in the third tier, and the difference was quite significant, around 39%. This shows that most students have an incomplete understanding because they are less able to answer questions well but have the right reasons for the answers chosen and a high level of confidence.

The misconceptions experienced by students in question number 1 are relatively low, which is 8%. There is one reflective student and two impulsive students who experience misconceptions. In this case, impulsive students have higher misconceptions than reflective students. In this problem, reflective students choose answers with the choice of D-A-C-A. Students believe that the concept of range is the most appropriate to illustrate the examples presented in the problem. This example explains the result area of a set. The answers to students' misconceptions can be seen in Figure 2 below:


1. Semua orang memiliki hobi. Hobi Febri adalah berolahraga, sedangkan teman-temannya memiliki hobi yang berbeda, yaitu:
   - Hobi Rahma bermain *games*
   - Hobi Afif menonton film
   - Hobi Anah membaca
   - Hobi Elis menyanyi

   Konsep apa yang paling cocok untuk mengilustrasikan cerita di atas?
   a. Domain c. Relasi
   b. Kodomain d. *Range*

   Apakah Anda yakin dengan jawaban yang Anda pilih?
   a. Yakin b. Tidak

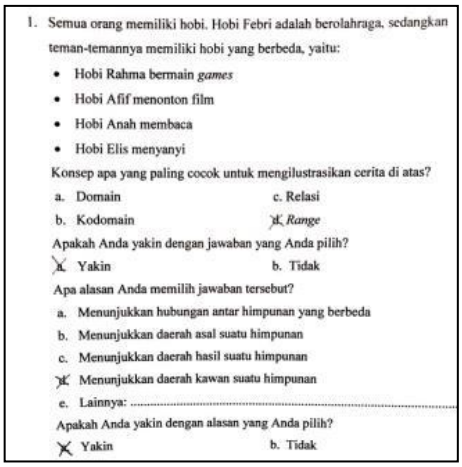
   Apa alasan Anda memilih jawaban tersebut?
   a. Menunjukkan hubungan antar himpunan yang berbeda
   b. Menunjukkan daerah asal suatu himpunan
   c. Menunjukkan daerah hasil suatu himpunan
   d. Menunjukkan daerah kawan suatu himpunan
   e. Lainnya: .....

   Apakah Anda yakin dengan alasan yang Anda pilih?
   a. Yakin b. Tidak

Figure 2. Answers to Reflective Student Misconceptions in Problem Number 1

Based on the interview results, it is known that students correctly answer the results area of the illustrations presented in the problem but are wrong in applying the concepts they should. From the interview results, it can be concluded that students do not fully understand the concepts of relations and range, so they build the wrong knowledge to answer these questions.

For impulsive students, the answer chosen for question number 1 is D-A-D-A. In this case, students choose range as an appropriate concept to illustrate examples of problems, but the reasons chosen do not support the answer in the first tier. The choice of answers and inappropriate reasons are thought to occur because the acquired knowledge is not perfect, so students combine their knowledge to be able to answer questions on the test. The answers to the students' impulsive misconceptions can be seen in Figure 3 below:


1. Semua orang memiliki hobi. Hobi Febri adalah berolahraga, sedangkan teman-temannya memiliki hobi yang berbeda, yaitu:
   - Hobi Rahma bermain *games*
   - Hobi Afif menonton film
   - Hobi Anah membaca
   - Hobi Elis menyanyi

   Konsep apa yang paling cocok untuk mengilustrasikan cerita di atas?
   a. Domain c. Relasi
   b. Kodomain X *Range*
   Apakah Anda yakin dengan jawaban yang Anda pilih?
   X Yakin b. Tidak
   Apa alasan Anda memilih jawaban tersebut?
   a. Menunjukkan hubungan antar himpunan yang berbeda
   b. Menunjukkan daerah asal suatu himpunan
   c. Menunjukkan daerah hasil suatu himpunan
   X Menunjukkan daerah kawan suatu himpunan
   e. Lainnya: .....
   Apakah Anda yakin dengan alasan yang Anda pilih?
   X Yakin b. Tidak

Figure 3. Answers to Impulsive Student Misconceptions in Problem Number 1

Based on the interview results, impulsive students choose the range as the correct answer but are wrong in interpreting the meaning of the range itself. In this case, students' understanding of the range concept is confused with the meaning of the codomain, which is a friend area. These results indicate that students are thought to have experienced misconceptions because they misunderstood the terms and meanings of the fundamental relations concepts.

The correct answer to question number 1 is C-A-A-A. In this illustration, two sets are presented, namely, the set of people and the set of hobbies, so the most appropriate concept to describe the relationship between the two sets is the relation.

2. States the Function Concept

In problem number 3, students are asked to state the concept of the function by mentioning the set which includes functions. The Percentage of students' conception level in question number 3 can be seen in the following Table 3:

Table 3. Percentage of Conception Level Problem 3

| Category | Percentage |
|---|---|
| Understand | 0% |
| Partial Understanding | 61% |
| Misconception | 17% |
| Not Understand | 11% |
| Uncode | 11% |

In question number 3, there is no categorization of students' understanding, while the highest percentage category of students is partial understanding. Students who answered the questions correctly in the first tier tended to be fewer than those who answered the reason correctly in the third tier, and the difference was quite significant at around 31%. This shows that most students have an incomplete understanding because they are less able to answer questions well but have the right reasons for the answers chosen and a high level of confidence. Misconceptions experienced by

students are equal to 17%. There is one reflective student and three impulsive students who experience misconceptions.

In reflective students who experience misconceptions, the answer chosen is D-A-A-A. In this problem, students are asked to name a set that is not a function, but students choose answers that are functions. The choice of answers from students experiencing misconceptions in question number 3 can be seen in Figure 4 below:

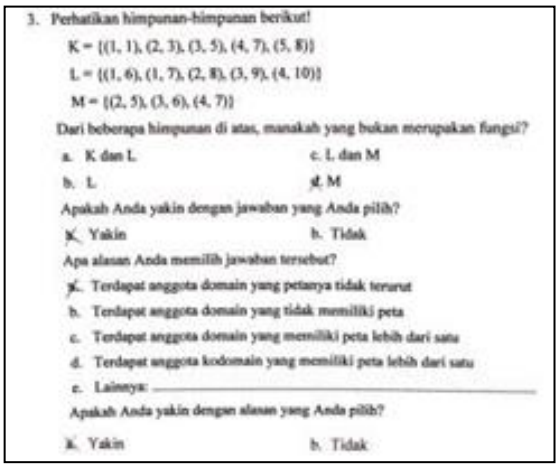

3. Perhatikan himpunan-himpunan berikut!
K = {(1, 1), (2, 3), (3, 5), (4, 7), (5, 8)}
L = {(1, 6), (1, 7), (2, 8), (3, 9), (4, 10)}
M = {(2, 5), (3, 6), (4, 7)}
Dari beberapa himpunan di atas, manakah yang bukan merupakan fungsi?
a. K dan L
c. L dan M
b. L
d. M
Apakah Anda yakin dengan jawaban yang Anda pilih?
a. Yakin
b. Tidak
Apa alasan Anda memilih jawaban tersebut?
a. Terdapat anggota domain yang petanya tidak terurut
b. Terdapat anggota domain yang tidak memiliki peta
c. Terdapat anggota domain yang memiliki peta lebih dari satu
d. Terdapat anggota kodomain yang memiliki peta lebih dari satu
e. Lainnya: _____
Apakah Anda yakin dengan alasan yang Anda pilih?
a. Yakin
b. Tidak

Figure 4. Answers to Reflective Students' Misconceptions in Problem Number 3

Based on these answers, reflective students assume that M is not a function. He chose it because there were domains whose maps were not ordered. If we see members on the set M, each member has a different pair, so it can be ascertained if M is a function.

Based on interviews, students believe in the answers but cannot explain where the answers they choose come from. In this case, students are also suspected of not understanding the concepts in the problem, so they do not have enough knowledge to choose the correct answer.

For impulsive students, the average answer chosen is A-A-A-A. In this problem, students are asked to mention the set that is not a function, but just like reflective students, impulsive students also choose answers that are functions. The choice of answers from students experiencing misconceptions in question number 3 can be seen in Figure 5 below:


3. Perhatikan himpunan-himpunan berikut!
K = {(1, 1), (2, 3), (3, 5), (4, 7), (5, 8)}
L = {(1, 6), (1, 7), (2, 8), (3, 9), (4, 10)}
M = {(2, 5), (3, 6), (4, 7)}
Dari beberapa himpunan di atas, manakah yang bukan merupakan fungsi?
a. K dan L c. L dan M
b. L d. M
Apakah Anda yakin dengan jawaban yang Anda pilih?
a. Yakin b. Tidak
Apa alasan Anda memilih jawaban tersebut?
a. Terdapat anggota domain yang petanya tidak terurut
b. Terdapat anggota domain yang tidak memiliki peta
c. Terdapat anggota domain yang memiliki peta lebih dari satu
d. Terdapat anggota kodomain yang memiliki peta lebih dari satu
e. Lainnya: .....
Apakah Anda yakin dengan alasan yang Anda pilih?
a. Yakin b. Tidak

Figure 5. Answers to Impulsive Student Misconceptions in Problem Number 3

The correct answer for question number 3 is B-A-C-A. A set that is not a function is an L set because there are domain members with more than one map. However, based on quotes from interviews conducted with impulsive students, in addition to the set L, impulsive students also believe that set K is not a function; it is based on the thought that domain members should not be paired with the same members in the codomain. From the answer, the misconception is suspected because students have wrong reasoning about the concept of function, so students draw their conclusions on their understanding.

3. Understanding and Determining the Types of a Function

In problem number 7, students are asked to state and determine the types of a function by honing arithmetic skills and how students interpret word problems whose contents are examples of linear functions in everyday life. In question number 7, the highest level of student conception is partial understanding, with a Percentage of 36%. Students who answered the questions correctly in the first tier tended to be more than students who answered the reason correctly in the third tier, and the difference was about 3%. Although the difference is relatively small, most students have an incomplete understanding because they can answer questions well but have inappropriate reasons for the answers they choose, which are accompanied by a high level of confidence. Misconceptions experienced by students are equal to 17%. There is one reflective student and two impulsive students who experience misconceptions.

The percentage level of the conception of students in problem number 7 can be seen in the following Table 4:

Table 4. Percentage Level Conception Problem Number 7

| Category | Percentage |
|---|---|
| Understand | 22% |
| Partial Understanding | 36% |
| Misconception | 17% |
| Not Understand | 17% |
| Uncode | 8% |

The average answer for students who experience reflective and impulsive misconceptions is C-A-C-A. The answer choices of reflective and impulsive students who experience misconceptions in problem number 7 can be seen in Figure 6 below:

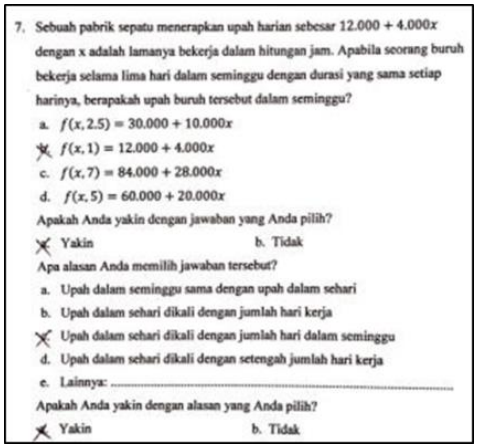

7. Sebuah pabrik sepatu menerapkan upah harian sebesar $12.000 + 4.000x$ dengan x adalah lamanya bekerja dalam hitungan jam. Apabila seorang buruh bekerja selama lima hari dalam seminggu dengan durasi yang sama setiap harinya, berapakah upah buruh tersebut dalam seminggu?
a. $f(x, 2.5) = 30.000 + 10.000x$
X $f(x, 1) = 12.000 + 4.000x$
c. $f(x, 7) = 84.000 + 28.000x$
d. $f(x, 5) = 60.000 + 20.000x$
Apakah Anda yakin dengan jawaban yang Anda pilih?
X Yakin b. Tidak
Apa alasan Anda memilih jawaban tersebut?
a. Upah dalam seminggu sama dengan upah dalam sehari
b. Upah dalam sehari dikali dengan jumlah hari kerja
X Upah dalam sehari dikali dengan jumlah hari dalam seminggu
d. Upah dalam sehari dikali dengan setengah jumlah hari kerja
e. Lainnya: .....
Apakah Anda yakin dengan alasan yang Anda pilih?
X Yakin b. Tidak

Figure 6. Answers to Students' Reflective and Impulsive Misconceptions in Problem Number 7

Based on Figure 6, it can be seen that students are wrong in interpreting the questions. In this problem, students are asked to look for labour costs with five work days a week. Based on these questions, students should multiply the function in the problem by the number of working days per worker, which is five.

However, some students experience misconceptions about this problem because they ignore the number of labour days but instead focus on the number of days a week. In this case, the students' numeracy skills are already good, but how students interpret questions about the story needs more attention.

Based on the results of reflective and impulsive student interviews, it is increasingly seen that students are indeed less able to interpret the questions well. Students are not careful in understanding the problem, so they are wrong in interpreting the purpose of the problem. In this problem, students experience a misunderstanding when interpreting the day of the week the worker uses for work. Even though the problem has been stated, each worker only works five days a week. So, the best answer is D-A-B-A.

4. Determine the Domain and Range of a Function

In problem number 10, students are asked to determine the domain of a function through a graph. The percentage level of the conception of students in problem number 10 can be seen in Table 5 below:

Table 5. Percentage Level Conception Problem Number 10

| Category | Percentage |
|---|---|
| Understand | 8% |
| Partial Understanding | 50% |
| Misconception | 28% |
| Not Understand | 8% |
| Uncode | 6% |

Based on Table 5, the highest conception level category in this problem is a partial understanding, with a Percentage of 50%, meaning that half of the sample class has incomplete knowledge about the concept domain of a function. Students who chose the answer correctly in the first tier were 50% with a 92% confidence level, while students who chose the reason correctly in the third tier were only 19% with a confidence level of 78%. In this case, some students in the sample class could determine the members of the domain presented in the graph but could not choose the reason correctly.

The Percentage of misconceptions in question number 10 is 28%. There is one reflective student and four impulsive students who experience misconceptions. In reflective students who experience misconceptions, the chosen answer is D-A-E-A. From the answer selection, it can be seen that students choose an open reason (option E) to express the reason for the answer in the first tier. The answer choices of reflective students experiencing misconceptions in problem number 10 can be seen in Figure 7 below:

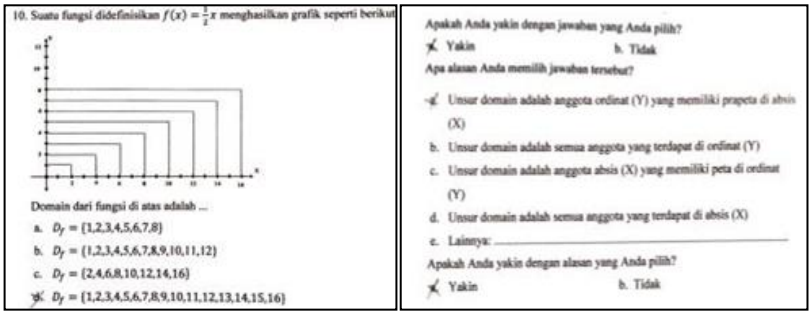



Figure 7. Answers to Reflective Student's Misconceptions in Problem Number 10

In Figure 7, students answer D in the first tier because they chose the domain by mentioning all members from 1 to 16 in the X coordinate. In the problem, it can be seen that the members in the X coordinate that have pairs are just even numbers, namely 2, 4, 6, 8, 10, 12, 14, and 16, but in this case, students choose all members, both even and odd. Then, for this reason, students choose to convey the results of their thinking on the open reason options available in the problem. Students reveal that the domain value is the original area.

In the student's statement, he has used the results of his thinking to answer the questions following the knowledge he obtained. However, the reason is not quite right; even from the answers in the first tier, it is suspected that students have misconceptions in domain terms. A domain is not the original area but is the area of origin.

From the interview results, it was obtained that reflective students mistakenly interpreted the domain. Students assume that the domain is all members of the X coordinate. If sifted through, odd members in the X coordinate do not have a partner, whereas if there are domain members who do not have a pair, it is not called a function. Therefore, the correct answer for the first tier is C.

Besides misconceptions in the first tier, students also experience misconceptions in the third tier. In this third tier, it is assumed that students experience misconceptions

about the terms of the domain meaning. Students think that the domain is the original area, even though the exact meaning of the domain is the area of origin.

In impulsive students who have misconceptions, some students choose A-A-A-A answers. The answers of reflective students experiencing misconceptions can be seen in Figure 8 below:

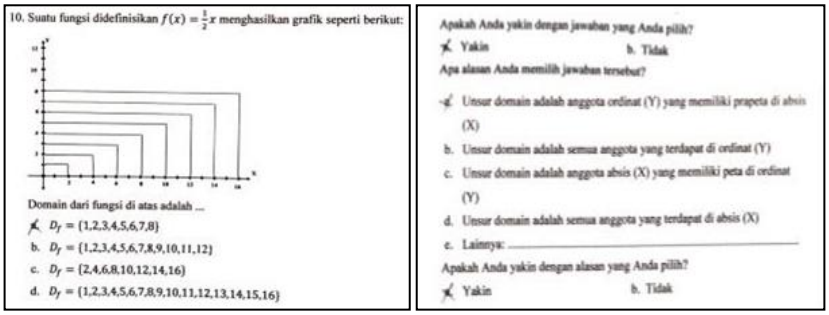



Figure 8. Answers to Impulsive Student's Misconceptions in Problem Number 10

In the first tier, the impulsive student chooses A (1,2,3,4,5,6,7,8) as the domain because the domain element is an ordinate member who has a pre-map in abscissa. The level of trust in the answers and reasons is sure, so students are suspected of having misconceptions.

Based on the correct concept, the domain in Cartesian coordinates occupies the abscissa, so the answers given by students can be ascertained wrong. This can be seen from the reasons chosen, which indicate that the answers intended by students in the first tier are in the ordinate area. The concept most suitable for describing students' answers is a range because option A indicates the range member of the intended function.

The interview results show that the misconceptions possessed by impulsive students in problem number 10 are due to incomplete student understanding. In this case, students understand the basic concepts of the domain but do not have enough knowledge to apply the concepts in graphics, so they build alternative concepts that are wrong.

The correct answer to question number 10 is C-A-C-A. The domain in the graph is even-numbered from 2 to 16 who are abscissa members. It is known that domain members are all abscissa members who have maps because domains that do not have maps are not called functions.

In this case, both reflective students and impulsive students, their misconceptions are caused by students' misconceptions and imperfect concepts owned by students in answering questions, thus creating alternative concepts that do not follow the valid scientific field.

5. Determine the Results of Algebra Operations on Functions

In question number 12, students are asked to determine the type of algebraic operation used in the problem. The emphasis in this problem is more on students' skills in calculating and formulating the types of operations of two functions. Even so, the

questions presented follow the indicators that have been set, so if a misconception occurs, it will be explored whether understanding students' concepts in performing algebraic operations or operating a problematic function. The percentage level of the conception of students in question number 12 can be seen in the following Table 6:

Table 6. Percentage Level Conception Problem Number 12

| Category | Percentage |
|---|---|
| Understand | 22% |
| Partial Understanding | 56% |
| Misconception | 0% |
| Not Understand | 17% |
| Uncode | 6% |

In question number 12, the highest conception level category is a partial understanding, with a percentage of 56%. Based on Table 6, more students answered correctly in the first tier than students who answered correctly in the third tier.

However, it should be noted that the questions in number 12 do not thoroughly test concepts but tend to test students' mathematical skills in counting and determining the algebraic operation of a function so that answers and reasons for students can ideally be selected in tandem. However, the facts on the ground show something else, leading to allegations that students tend to guess and guess when solving problem number 12.

The correct answer for question number 12 is A-A-B-A. The answer for the first tier is $f(x) \times g(x)$ because the results of the two functions result from the function's algebraic multiplication operations. In this problem, no students experience misconceptions, so the understanding of concepts possessed by reflective and impulsive students is considered the same. However, students' tendency to guess and guess answers must get special attention from both the teacher and the students themselves because it can lead to the interpretation that students do not understand the concept of basic algebraic operations.

In the four-tier diagnostic test, students are said not to understand the concept if they are wrong in answering questions to all available tiers or wrong in answering the first and third tiers and are not sure in setting the level of confidence in one or all second and third tiers. Students who do not understand the concept indicate that they cannot explain the concepts they have learned and are given responses that cannot be understood if told to explain the concepts they received. Such conditions indicate low student confidence in their answers to the problem, regardless of whether the answer is true or false.

Students with uncode categories do not choose answers to all tiers or one tier, and students who choose answers to multiple choices in all tiers or one-tier. Based on the study's results, the average total uncode category was 8%. This category occupies the lowest position of all detected conception levels. The items with the highest Category uncode are number 9, with a percentage of 14%. Uncode is a category of student understanding that cannot be coded. This means we cannot know the ability of students to understand the problem because the choice of answers cannot be detected. The existence of

this category uncode usually occurs because students do not understand the concept well, so students choose to leave the answers to the questions, but it can also be caused by students' inaccuracy in answering questions so that they skip answers or even choose more than one answer in the available tier.

Misconception students' average total obtained from the total number of questions is 15%. This shows that more students experience misconceptions than students who understand concepts and are smaller than students who do not understand concepts, even though the differences between the three are insignificant. The problem with the highest misconception is in problem number 9, with subconcepts understanding and determining the types of functions, and number 11, with subconcepts determining the domain and range of a function. The magnitude of the second misconception is 42%. Also, there are 3 of 7 sub-concepts that have an average of misconceptions exceeding the total average, namely sub-concepts about understanding and determining the types of functions with an average percentage of 19%, determine the domain and range of a function with an average Percentage of 35%, and understand the inverse of a function with an average percentage of 19%.

In terms of students' reflective-impulsive cognitive style, impulsive students tend to experience higher misconceptions than reflective students. Reflective students have an average total misconception of 2%, and impulsive students have an average total of 7%, while the remaining misconceptions are owned by students with other cognitive styles (fast, accurate, and slow innocent). The highest misconception experienced by students based on reflective-impulsive cognitive style lies in problem number 9, with a reflective student percentage of 8% and an impulsive student percentage of 22%.

From the existing questions, students' misconceptions occur in almost all items with varying magnitude. The sub-concept sequence in the function material with the highest misconceptions is the lowest in sequence, namely:

1. Determine the domain and range of a function (35%) with the Percentage of reflective and impulsive student misconceptions, 3% and 14%, respectively.
2. Understanding and determining the types of functions (19%) with the Percentage of reflective and impulsive students' misconceptions are 4% and 9%, respectively.
3. Understanding the inverse of a function (19%) with the Percentage of students' reflective and impulsive misconceptions are 2% and 8%, respectively.
4. Stating the concept of function (13%) with the Percentage of students' reflective and impulsive misconceptions, respectively are 2% and 6%.
5. Stating the concept of relation (4%) with the Percentage of students' reflective and impulsive misconceptions are 1% and 3%, respectively.

Students are detected to experience misconceptions when they answer the questions and reasons that are wrong in the first and third tiers and have a level of confidence in the second and fourth tiers. In this case, students feel confident in the answers they set, even though the choice is not the correct answer. Misconceptions experienced by students on each item are not too high, but misconceptions are students' mistakes in understanding concepts that should be, even if their knowledge is not addressed, will cause students not to

understand the concept so that the existence of this misconception should be minimized as little as possible.

Most of the causes of this misconception occur due to students 'preconceptions and constructs and the students' mistakes in understanding the concepts being learned. They also, based on the results of interviews, obtained error detection. Students suspected of having misconceptions from the results of the four-tier diagnostic test did not understand the concepts in the questions presented. This means that misconceptions can also be caused by factors of guessing and guessing by setting a high level of confidence in the answers and reasons. Therefore, it is necessary to have an assimilation and accommodation process in the learning process in class to correct the concepts they received before so that the misconception can be corrected.

## 4. CONCLUSION

The research results concluded that in terms of students' reflective-impulsive cognitive style, impulsive students tend to experience higher misconceptions than reflective students. Reflective students have an average total misconception of 2%, and impulsive students have an average total of 7%, while the remaining misconceptions are owned by students with other cognitive styles (fast, accurate, and slow innocent). The highest misconception experienced by students based on reflective-impulsive cognitive style lies in problem number 9, with the Percentage of reflective students at 8% and the Percentage of impulsive students at 22%.

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