Description of Junior High School Students' Mathematical Understanding According to Skemp Theory in terms of Rational Personality Types

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ABSTRACT

Mathematical understanding is one of the supporting factors for students' success in mathematics. Skemp divides understanding into two types, namely instrumental understanding and relational understanding. This research purpose was to describe the mathematical understanding of seventh grade D students in solving set problems based on Skemp's theory of understanding in terms of rational personality types. The type of research used was descriptive qualitative. This research was conducted at Junior High School. Selection of subjects using a purposive sampling technique. The subjects in this study were two students with rational personality types. Data were obtained using a mathematical understanding test and interviews. The study's results showed that students with rational personality types tend to have a relational understanding because they can explain reasons or interpret problem-solving procedures according to the set concept correctly. In addition, students are able to understand the purpose of the given set of problems, can apply ideas according to the logic of thinking in solving problems, can write problem solving procedures coherently according to Skemp's theory even though they tend to be brief, can solve mathematical understanding problems accompanied by appropriate answer arguments, can change mathematical sentences in the given problem in the form of words, images, or certain mathematical symbols. Furthermore, this type can achieve all of the indicators of instrumental understanding and can fulfill the six indicators of relational understanding, except for the ability to correlate several set concepts. Based on these results, it is expected that rational personality type students can determine detailed planning in solving problems, and improve understanding of mathematical concepts such as being more careful in the use of solution strategies so that students are accustomed to applying various solution strategies.

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A. INTRODUCTION

Mathematical understanding is a basic ability that is very necessary for learning mathematics. Mathematical understanding is one of the supporting factors for students' success in mathematics (Arifin et al., 2021). Mathematical understanding is the ability of students to know, observe, and understand the meaning and connotation of mathematical knowledge Yang et al. (2021), then connect several concepts, and apply logical steps in solving a problem (Negara, 2015). Mathematical understanding is the ability of students to build or connect new

knowledge with previous knowledge NCTM, (2000) to describe mathematical problems using different ways and to determine differences (Jbeili, 2012). Their experiences have shaped the mathematical understanding possessed by students in various contexts (MacDonald, 2022). Mathematical understanding is an important and valuable basic part Yang et al. (2021) of the process of learning mathematics because students do not just memorize material Mayasari et al. (2022) but are taught to deepen their understanding, develop their way of thinking and make decisions (Surya et al., 2017). Therefore, mathematical understanding is a very important ability and must be mastered by students because it refers to students' understanding of mathematical concepts and can train students' abilities to relate one concept to another (Dini et al., 2018; Yeh et al., 2019).

To determine students' mathematical understanding, in-depth analysis of students' understanding in solving mathematical problems is required. Analyzing the problem solving steps taken by students can provide information about students' understanding. The mathematical understanding implemented is based on Skemp's theory of understanding. Skemp's understanding theory is a theory of mathematical understanding that teachers can use to distinguish students who understand and don't understand a concept (Annisa et al., 2019). There are two understandings according to Skemp (1976;1978) namely first, instrumental understanding is the ability to correctly apply mathematical rules or procedures in solving problems without knowing the reasons for their use and having an understanding limited to memorizing facts (Ibrahim, 2015) without a deeper understanding of a concept. The second understanding, according to Skemp, namely relational understanding, is the ability to apply mathematical rules or procedures Makonye & Fakude (2016) correctly in solving problems and knowing the reasons for their use so that they can connect various mathematical concepts.

The instrumental understanding indicators implemented to analyze students' mathematical understanding based on Skemp's theory, include: students' ability to recall the concepts learned, the ability to identify a concept, the ability to choose appropriate concepts or strategies to solve problems, and the ability to represent a concept in the form of pictures or writing (Baiti et al., 2020). Then, the relational understanding indicators implemented to analyze students' mathematical understanding based on Skemp's theory, include: students' ability to classify objects based on needs that can form a concept, applying the concept algorithmically, providing an example of a concept, repeating the concepts learned, provide representative mathematical concepts, correlate some mathematical concepts, and the ability to develop the necessary and sufficient requirements for certain concepts (Skemp, 1978; Annisa et al., 2019; Kuncorowati et al., 2017; Nurhana & Abdullah, 2021; Baiti et al., 2020).

The results of observations and interviews with one of the mathematics teachers of class VII D MTs Darul Aman Mataram on Tuesday, 16 March 2022, showed that students had difficulty understanding one of the mathematics materials, namely the sets. The teacher explains that students need help understanding the properties of set operations, have difficulty changing story problems into sentences or mathematical symbols, associate several set concepts, perform calculation procedures, and illustrate information known to the problem in Venn diagrams. These difficulties were found by the teacher after correcting students work on assignments and daily tests. In addition, the teacher explained that these difficulties occur because students think math is difficult, students have difficulty thinking of appropriate

formulas to answer problems, so they are lazy to practice solving math problems independently which results in difficulties in understanding and answering the given math problems. The results of research support this by Komariyah et al. (2018), which states that class VII students still have difficulty understanding set material, such as using symbols, making Venn diagrams, and solving problems. In addition, the difficulties experienced by students related to mathematical understanding, according to research by Limardani et al. (2015), showed that 45.5% of students had difficulty making mathematical models; 3.0% had difficulty giving other examples, and 63.6% had difficulty writing the necessary and sufficient conditions for a concept. Based on some of the research, it is indicated that the difficulties experienced by students are due to a lack of student understanding of mathematical concepts which can hinder the further learning process and have an impact on students' ability to solve problems.

One factor that influences mathematical understanding is the different personalities that each individual has (Putra et al., 2019). Students' understanding of mathematics cannot be separated from behavioral differences (Rahman et al., 2018). Students have different ways of understanding mathematical concepts, one of the things that causes these differences is personality types (Fahira, 2021). Therefore, personality differences are indicated to have a direct effect on students' mathematical understanding (Embarak et al., 2019). Keirsey (1998) classifies personality into four types: guardian, rational, idealist, *and* artisan (Güngör et al., 2014). A rational type has smart characteristics, always sees things from many sides, is full of confidence, is too complicated for others to understand, ignores certain details, enjoys solving problems based on logic, and is rich in images such as making pictures, likes abstract types of questions and this type tends to ignore material that is considered unimportant (Keirsey, 1998; Keirsey & Bates, 1984).

Some research on analyzing students' understanding in solving math problems was previously carried out (Asih & Imami, 2021); Tianingrum & Sopiany, 2017; Mulyani et al., 2018). However, the research on analyzing students' mathematical understanding according to Skemp's theory in solving mathematical problems by paying attention to the personality side of students, especially the rational personality type, has not yet been conducted before. Based on the description, the issue of understanding students with rational personality types in solving mathematical problems based on the theory of instrumental and relational understanding according to Skemp is very interesting to researchers, so that researchers further examine the mathematical understanding of students according to Skemp's theory, and the special characteristics that appear from rational personality type students in solving mathematical problems, especially in set material. It is expected that the results of this research can be used as a basis by teachers in providing appropriate assistance to rational types of students who are still experiencing difficulties in mathematical understanding in solving a problem.

B. METHODS

This type of research is descriptive qualitative. This research was conducted at MTs Darul Aman Mataram in the even semester. Subject selection using purposive sampling technique. The research subjects were determined based on the results of the Keirsey personality test which had previously gone through a validation process. Based on the results of the personality

test, seven male students with a rational personality type were obtained. Then, the researcher chose two of the seven male students of class VII D, namely R-11 and R-22 with several considerations. These considerations, include: 1) students have learned the set material; 2) students have good learning achievement and understanding; 3) students' communication skills are good; and 4) students were selected and determined based on recommendations from the mathematics teacher of class VII D. Then, students were given a mathematical understanding test on set material consisting of 4 questions according to Skemp's indicators (see Table 1) which were designed by the researcher and had previously gone through a validation process. The form of the mathematical understanding test questions is shown in Table 1.

Table 1. Sets Test

Question
1. Please check whether the following statements are "true" or "false". If correct, explain your answer! If the statement is false, then give reasons! a. The collection of intelligent people is not a set. b. The collection of natural numbers is not a set.
2. Please take a look at some of the following object groups! a. Large group of students.　　　　　　　　c. The collection of even numbers between 4 and 16. b. The collection of animals that live in the sea.　d. Collection of tall trees. Please check which is a set and not a set!
3. A well-known bank has opened a job vacancy for the Teller position. 65 applicants must take written tests and interviews to be accepted as employees. It turned out that 37 people passed the interview test, 53 people passed the written test, and 11 people did not take the test. Determine the number of applicants who pass the interview and written tests!
4. Given the set, S is the set of whole numbers less than 17. If A is the set of even numbers between 1 and 15, B is the natural numbers between 2 and 13, and C is the odd numbers between 3 and 14. Determine:　a. $A \cup (B-C)$　　　b. $(A \cup B)^c$

Data collection methods in this research used tests and interviews. There are two tests carried out in this study, namely a personality test to determine the personality type of students, and a description test to collect data on students' understanding in solving set problems. The results of interviews used as data are statements about things that students, students' understanding in solving problems, difficulties experienced by students in solving problems, and the causes of student difficulties. Before the test, the content validation test of the items was carried out, including: material, sentence construction, and language. Validation of test instruments was carried out by expert validators, namely 3 mathematics education lecturers. Data validity in this research was carried out using method triangulation techniques.

This research was conducted in three stages in obtaining data. The first stage is giving Keirsey personality type questionnaire, the second stage is giving mathematical understanding test, and the third stage is interview. Data analysis techniques used in this research are reduction or data compaction, data presentation, and conclusion (Miles & Huberman, 1994).

C. RESULT AND DISCUSSION

The results of the work of subjects R-11 and R-22 in solving set problems, along with the results of analysis and interviews, are as follows.

1. R-11 Subject with Rational Personality Type

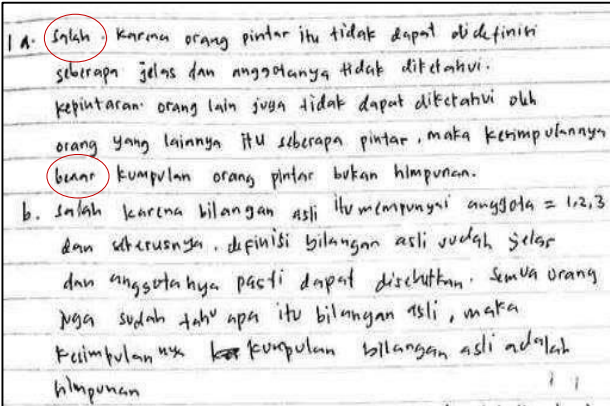a. Indicator Point 1 Classifying Objects that Can Form a Concept, as shown in Figure 1.

<div style="display:flex; gap:2em;">
<div>
Answer in Indonesian Language
</div>
<div>
Answer in English Language
</div>
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Figure 1. R-11 Work Results at Number 1

Based on Figure 1, subject R-11 can answer the questions in sufficient detail, accompanied by appropriate arguments in according to the set concept shown in 01 and 02, starting from defining, then identifying known objects, then classifying objects according to the definition of the set such as the statement in the question can be clearly defined and its members can be determined with certainty or not. However, R-11 still wrote the initial answer 1a incorrectly, as shown in the red circle, which are not aligned. The researcher conducted interviews with R-11 about problems number 1 and the results showed that R-11 can explain his argument correctly because it follows the concept of a set, such as an object can be clearly defined, and its members can be known or not. R-11 believes the answer is correct and can classify known objects into the concept of sets and not sets. In addition, R-11 revealed that he forgot to re-check the wrong answers at work. Based on the results of further interviews, students forgot to recheck the results of their work because the time needed to answer the remaining questions was small, spending more time thinking about the right answer, so that students were not focused and rushed answer questions.

b. Indicator Point 2 Applying the Concept Algorithmically, as shown in Figure 2.

Based on Figure 2, subject R-11 can identify things that are known correctly. Therefore, subject R-11 can write the sequential settlement procedure, first answering the set difference operation, then answering the union operation of sets. The researcher conducted interviews with R-11 about problems 4a and the results showed that R-11 reveals that the solution to the problem is carried out sequentially, starting from the operation inside the brackets first, then the operation outside the brackets. According to R-11, the solution is in such a way according to the applicable rules. In addition, subject R-11 did not appear to have any difficulties because he was able to explain the reasons for using the settlement procedure correctly and according to his understanding. This

shows that R-11 did not experience difficulties and could write the problem solving steps appropriately, sequentially, and systematically containing the set concepts that had been learned.
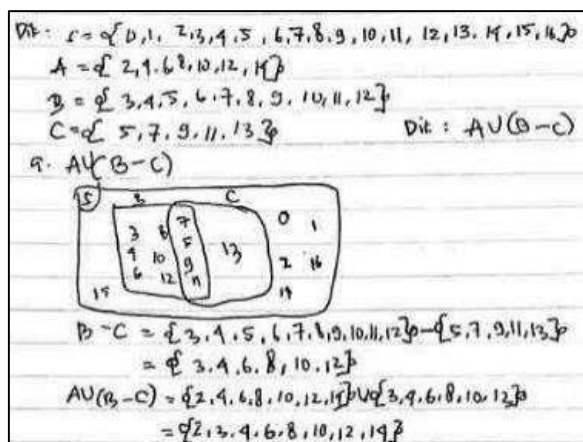

Figure 2. R-11 Work Results at Number 4a

c. Indicator Point 3 Provides an Example of a Concept, as shown in Figure 3.
    Based on Figure 3, subject R-11 can correctly determine examples of objects that belong to sets and not sets. This is because R-11 writes answer in sufficient detail accompanied by explanations or arguments related to the definition of sets. However, R-11 lacked detailed explanations of the answers to points a and d, such as not providing an argument on why the collection of large students and tall trees is said to have no clear definition.

Answer in Indonesian Language	Answer in English Language
	2. *a, d does not belong to a set, because the collection of big-bodied students and tall trees is not well defined. The set of big-bodied students and the set of tall trees are also unknown elements. *b, c is a set, because the definition is obvious and certain. The set of even numbers between 4 and 16 can be known and the set of animals that live in the sea can be known. The even numbers between 4 and 16 are 6, 8, 10, 12, and 14, while the animals in the sea are crabs, jellyfish, octopus, and others.

Figure 3. R-11 Work Results at Number 2

The researcher conducted interviews with R-11 about problems number 2 and the results showed that subject R-11 can explain the reasons for using the appropriate settlement procedure because it fits the definition of a set. R-11 had no difficulty answering the questions because he already understood the concept of sets and could cite other examples besides in the questions. In addition, R-11 admitted that the answers for points a and d were lacking in detail because he felt the answers were clear enough, and according to R-11, the most important thing was that the results could answer the questions.

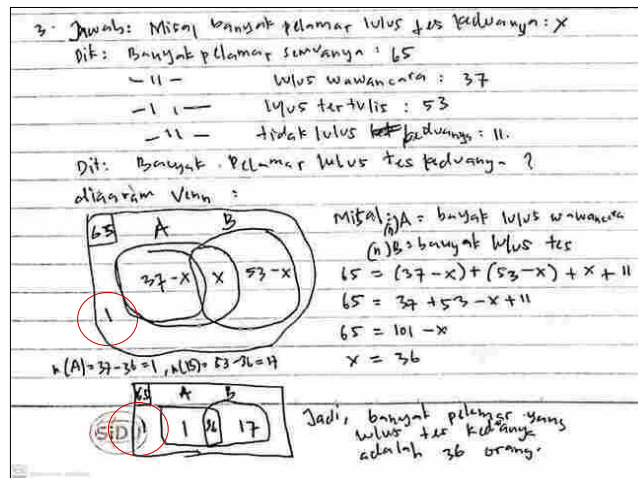d. Indicator Point 4 Repeating Learned Concepts, as shown in Figure 4.

Figure 4. R-11 Work Results at Number 3

Based on Figure 4, subject R-11 can answer the questions correctly, model the problem using a Venn diagram and perform the correct calculations. However, R-11 cannot use a formula containing set symbols and mistakenly writes the members of the set on the Venn diagram shown in the red circle. The researcher conducted interviews with R-11 about problems number 3 and the results showed that R-11 subject was able to explain the reasons for using problem-solving procedures, even though he had a little difficulty in choosing the right strategy at the beginning of answering the questions. In addition, R-11 explained that he had not been able to use a formula containing set symbols because he forgot and did not remember the formula, and R-11 realized that he had mistakenly written down the members of the set regarding the many applicants who passed both tests on the Venn diagram because he forgot to re-check the answer. Student R-11 forgot to recheck the results of his work because he was in a hurry to do the problem because there was little time left. Nevertheless, based on the results of the explanation and the results of R-11's work that are in accordance with what is known, it can be indicated that R-11 has understood the concept of the set well.

e. Indicator Point 5 Provides Mathematical Concepts, as shown in Figure 5.
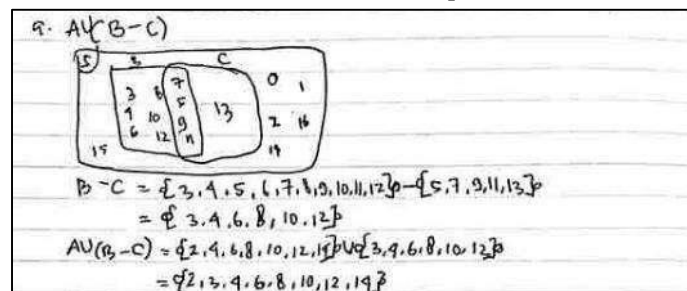
Figure 5. R-11 Work Results at Number 4a

Based on Figure 5, subject R-11 can provide the concept of sets to solve problem 4a, namely present a Venn diagram image as a representation of the set difference operation.

The researcher conducted interviews with R-11 about problems 4a and the results showed that R-11 could explain the results of his work correctly, along with the reasons for using a Venn diagram to represent the set difference operations to make it easier to answer questions. R-11 can mention other set concepts that can be used to solve problems 4a, but R-11 preferred to apply a problem-solving strategy using the set concept which he found easy to understand and easy to apply.

f. Indicator Point 6 Correlating Multiple Mathematical Concepts, as shown in Figure 6.
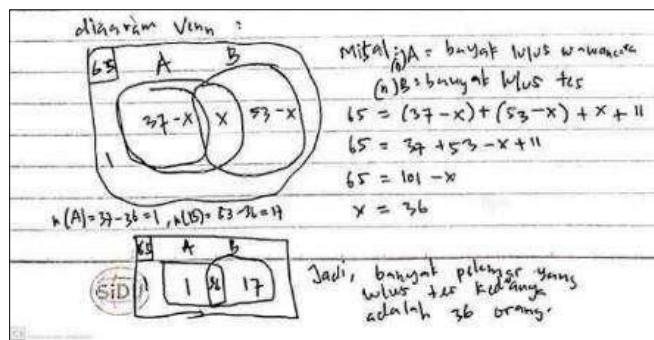
Figure 6. R-11 Work Results at Number 3

Based on Figure 6, subject R-11 has not been able to correlate the strategies used in solving the problem because only implemented separated strategy. R-11 illustrates only represents problem by the Venn diagram, accompanied the calculation procedure correctly. The researcher conducted interviews with R-11 about problems number 3 and the results showed that R-11 revealed that he forgot the formula that could be used to solve the problem, so R-11 used other ways or problem-solving strategies, even though R-11 knew and could mention and explain the meaning of set concepts related to problem number 3. Subject R-11 also explained that he can only apply Venn diagrams and perform simple calculations because he's easy to apply, and these strategies can answer questions. In this case, R-11 has not been able to develop a known strategy so that it can be correlated between one strategy and another.

g. Indicator Point 7 Developing Necessary Requirements and Adequate Requirements of a Concept, as shown in Figure 7.
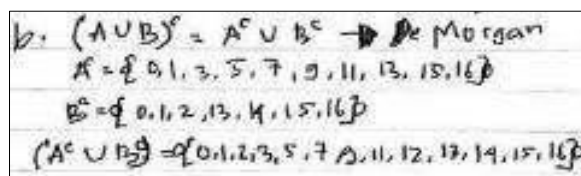

Figure 7. R-11 Work Results at Number 4b

Based on Figure 7, subject R-11 can answer question correctly. Moreover, R-11 can identify the name of the operation in the problem, which is one of the characteristics of De Morgan, and can describe the form of the complete operation as a necessary condition

and can determine the result of the intersection of two sets as a sufficient condition for solving problem 4b. However, R-11 wrote down the completion procedure briefly, shown on the final step.

The researcher conducted interviews with R-11 about problems 4b and the results showed that R-11 could explain the reasons for using the procedure according to his understanding. R-11 shortens the writing of the settlement procedure because the results are important and sufficient to answer the questions. During the interview process, R-11 also looked confident and said the answers written were correct.

The results of the mathematical understanding analysis show that R-11 has fulfilled the six indicators of relational understanding except for the ability to correlate several set concepts. In addition, R-11 has fulfilled all indicators of instrumental understanding. This is shown when R-11 can mention the concepts of sets concerning the given problem and its definition, the characteristics of objects that are said to be sets and not sets, and know the operational form of De Morgan's properties. Furthermore, in the second indicator, R-11, you can choose a known and considered easy strategy, such as making a Venn diagram and carrying out the correct calculation procedure using certain symbols. R-11 can also identify a known concept, namely determining the name and complete form of the operation on a question related to one of De Morgan's properties, and then writing down the necessary information by listing the complement members in the set. This relates to the third indicator. Then, R-11 can present a problem-solving strategy by making a picture of a venn diagram accompanied by the correct manufacturing conditions and providing a description of the picture using certain symbols and representing things that are known in the form of words to state an object in the problem. Other findings found by the researcher were that R-11 students forgot the formula that could be used to solve the problem so that they used other ways or problem-solving strategies in answering the problem, and R-11 often did not recheck their work because they used more time given to think about the answer in the right way and rushed to answer the question. Nevertheless, student R-11 has understood the concept of set well.

2. R-22 Subject with Rational Personality Type
a. Indicator Point 1 Classifying Objects that Can Form a Concept, as shown in Figure 8.

Answer in Indonesian Language	Answer in English Language
	1a) True. A collection of smart people is not a set because people's opinions vary, the definition is not obvious, and the elements are unknown. 1b) False. The set of natural numbers is a set because the definition is obvious and the natural numbers are: 1, 2, 3, 4, ... So, the set of natural numbers is a set, its elements can be determined.

Figure 8. R-22 Work Results at Number 1

Based on Figure 8, subject R-22 can understand the purpose of the question so that he can write the answers correctly and sufficiently detailed, accompanied by an explanation according to the set concept. In addition, R-22 can classify objects in questions such as

identifying known objects, whether he can be clearly defined, and whether his members can be named.

The researcher conducted interviews with R-22 about problems number 1 and the results showed that R-22 can explain the reasons for using the answers that are written correctly because he is following the set concept, and can explain the definition of the set according to what is known correctly. Subject R-22 felt confident that the answers written were correct. In this case, R-22 can classify objects in questions based on their characteristics which can form the concept of a set and not a set.

b. Indicator Point 2 Applying Concepts Algorithmically, as shown in Figure 9.

Answer in Indonesian Language   Answer in English Language

Figure 9. R-22 Work Results at Number 4a

Based on Figure 9, subject R-22 can solve the questions correctly. Subject R-22 was able to wrote down the sequential settlement procedure shown in the green square, namely starting from carrying out the set difference operation and continuing to carrying out the union operation of sets.

The researcher conducted interviews with R-22 and the results showed that R-22 could provide an explanation regarding the information provided, including information that was known and asked in the questions. R-22 also explained that there is a sequence of solving procedures for answering question, namely first doing the operations in brackets because R-22 thinks that solving questions marked with parentheses is usually like that and R-22 had no difficulty explaining the reasons for using the settlement procedure.

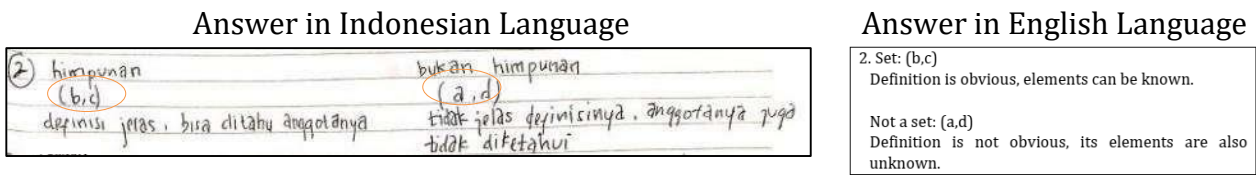c. Indicator Point 3 Providing an Example of a Concept, as shown in Figure 10

Answer in Indonesian Language	Answer in English Language

Figure 10. R-22 Work Results at Number 2

Based on Figure 10, subject R-22 can determine examples of sets and non-sets accompanied by correct reasons even though not specific. R-22 writes down the solution to the problem briefly, namely only writing points a, b, c, and d, followed by a makeshift explanation. Subject R-22 also did not write statement sentences for each point a, b, c, d, such as the name of the collection of objects and only wrote things that were considered important to answer the questions shown in the orange circle.

The researcher conducted interviews with R-22 and the results showed that R-22 deliberately did not write his answer in detail because he felt that his answer was enough to answer the question, so he could finish the other problems on time. In addition, R-22 explained that if he wrote sentences for each point a, b, c, and d, the answer would be long. In addition, R-22 had no difficulty in answering question number 2 because he could explain the reason for using the answer correctly according to the concept of set.

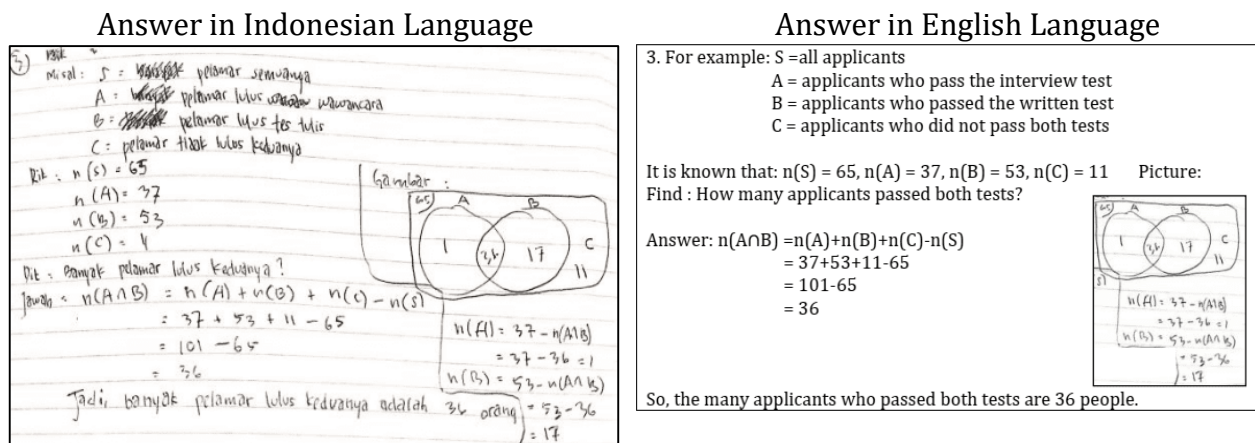d. Indicator Point 4 Repeating Learned Concepts, as shown in Figure 11.

Answer in Indonesian Language	Answer in English Language

Figure 11. R-22 Work Results at Number 3

Based on Figure 11, subject R-22 can answer the questions correctly. Subject R-22 can create a solution model based on the situation in the problem using a formula containing a set of symbols. Subject R-22 can identify known information in the form of mathematical symbols and questions in the problem using words.

The researcher conducted interviews with R-22 and the results showed that R-22 could explain the reason for using the written solution strategy because it was easy to use and could answer the questions. Where to find the desired answer, R-22 revealed that the information known in the problem could be substituted into the formula. In addition, R-

22 can mention concepts related to problem number 3, can explain the meaning of the drawings made orally, and is sure that the written solution procedure is correct.

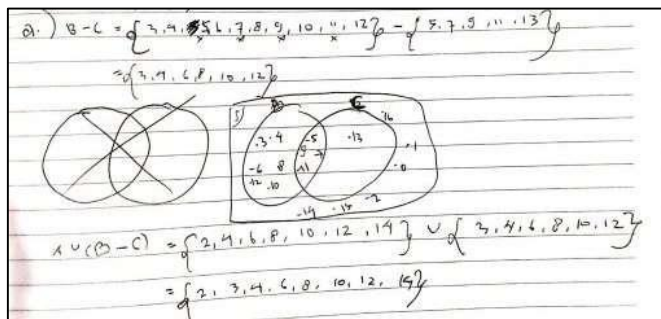e. Indicator Point 5 Provides Mathematical Concepts, as shown in Figure 12.

Figure 12. R-22 Work Results at Number 4a

Based on Figure 12, subject R-22 can answer questions by presenting a picture as an illustration of the problem. Subject R-22 draws a Venn diagram to illustrate the set difference operation with the correct manufacturing conditions. The researcher conducted interviews with R-22 and the results showed that R-22 can explain the reasons for applying the Venn diagram in problem solving to check the results of operating the set difference are the same or not. In this case, subject R-22 can answer the questions correctly and explain the provisions for making a Venn diagram correctly, even though it only presents one concept as a problem representation.

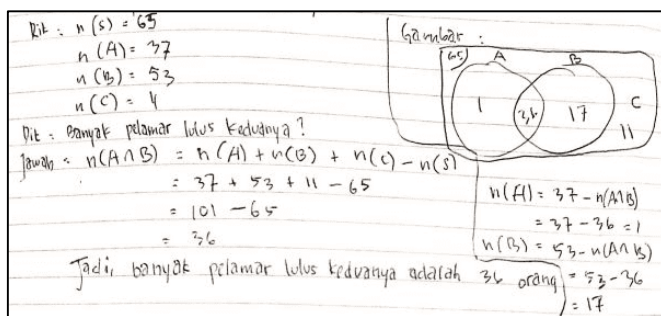f. Indicator Point 6 Correlating Several Mathematical Concepts, as shown in Figure 13.

Figure 13. R-22 Work Results at Number 3

Based on Figure 13, subject R-22 can represent information on the problem through words and symbols with a coherent solving procedure. However, R-22 has not been able to establish the settlement strategy relationship. Subject R-22 only applies separate solving strategies, namely using one formula and making a Venn diagram. The researcher conducted interviews with R-22 and the results showed that R-22 could mention the concept of sets related to question number 3, such as the concept of union and complement, along with their definitions. However, R-22 explains that he cannot apply the concept because he does not remember the math symbols and he didn't know

the relationship between the strategy used because he answered the questions according to what he understood.

g. Indicator Point 7 Developing Required Requirements and Adequate Requirements of a Concept, as shown in Figure 14.

Figure 14. R-22 Work Results at Number 4b

Based on Figure 14, subject R-22 can solve question 4b correctly. Subject R-22 could identify and describe the complete form of operation in the problem indicated shown in the green square, which is a necessary condition for solving the problem, even though R-22 did not identify the operation's name. Subject R-22 can also operate the set difference operation shown in the purple square, which is a sufficient condition for problem-solving.

The researcher conducted interviews with R-22 and the results showed that R-22 did not identify the operation's name in the problem because R-22 didn't think of writing the operation's name and thought that the form of the operation was clear, including de Morgan's characteristics. In addition, R-22 can also mention two forms of operations from De Morgan's properties in full, can explain the information that is known and needed to answer the questions. R-22 can also explain his answer with arguments, and is sure that the answer is correct.

The results of the mathematical understanding analysis show that R-22 has fulfilled the six indicators of relational understanding except for the ability to correlate several set concepts the same as subject R-11. R-22 also meets all indicators of instrumental understanding. It was shown that subject R-22 could recall the concepts learned, apply problem-solving strategies with the help of Venn diagrams, and apply and explain the meaning of the set difference and union of sets. Subject R-22 can also identify a concept by choosing an appropriate strategy, such as applying formulas that can be used and illustrating answers using Venn diagrams.

This study's results indicate that some results are appropriate and not in accordance with previous studies. Rational-type subjects in research can solve problems coherently. Subjects can illustrate answers or represent problems using appropriate models Wulan & Astuti (2022); Wulansari & Walid (2021) in the form of pictures, writing, and mathematical symbols related to the concept of sets. This follows the opinion expressed by Pambudi et al. (2021) that rational-type students can interpret a problem in a mathematical form. Furthermore, subjects with rational personality types already know and can apply ideas according to their logical thinking in solving a problem, able to clearly explain the reasons for using the solution procedure according to the set concept,

so researchers conclude that rational-type subjects are more inclined towards relational understanding. This is directly proportional to research by Fitriana et al. (2018), showing that rational personality types can provide logical reasons that support their problem-solving strategy. In addition, it is in line with Skemp's theory that someone with a relational understanding can use mathematical rules or procedures accompanied by explaining the reasons for their use. This is directly proportional to the results of research by Hasanah & Putra (2017) that rational types tend to quickly understand questions Ratnaningsih (2021); Putra et al. (2019) and can express the information they get orally and in writing. In accordance with research by Akrom et al. (2021) that this type can carry out calculation procedures based on certain rules or formulas.

This study also shows that rational-type students tend to write short answers. Rational type students write practical problem solving according to their logical thinking. This is different from research by Ahmadah (2020) that rational-type students like to write complete explanations in solving math problems. In addition, the results of this study indicate that rational-type subjects have not been able to implement solving strategies that can be correlated with one another, such as applying several formulas containing set symbols. This type of subject only implements a separate solution strategy in accordance with research by Komariyah et al. (2018) that the rational type has difficulty providing an overview of other methods that can be used in solving problems because their understanding of the material is still lacking in depth. This is in contrast to research by Fitria (2016) that rational types excel in making settlement strategies. This is consistent with the characteristics of the rational personality type, which likes explanations based on logic Akrom et al. (2021), is smart, ignores certain details, is full of confidence, and always solves problems in a coherent and intact manner (Keirsey & Bates, 1984; Keirsey, 1998).

D. CONCLUSION AND SUGGESTIONS

Based on the results of the research and discussion, it is concluded that students with rational personality types can think mathematically, which is associated with understanding indicators according to Skemp, and tend to have relational understanding because they can explain the reasons for using problem-solving procedures according to the set concept correctly. In addition, students are able to understand the purpose of the given set of problems, can apply ideas according to the logic of thinking in solving problems, can write problem solving procedures coherently according to Skemp's theory even though they tend to be brief, can solve mathematical understanding problems accompanied by appropriate answer arguments, can change mathematical sentences in the given problem in the form of words, images, or certain mathematical symbols. Furthermore, rational type students are able to achieve all indicators of instrumental understanding and six indicators of relational understanding have been achieved except for the ability to correlate several set concepts.

Based on the research that has been done, suggestions that can be given by researchers in developing mathematical understanding based on personality type, namely rational personality type students can be given direction to determine detailed planning in solving problems, and further improve understanding of mathematical concepts, for example, careful

use of solving strategies that support students' mathematical understanding. It is intended that students are accustomed to applying various solution strategies so that they do not stick to just one concept in problem solving.

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