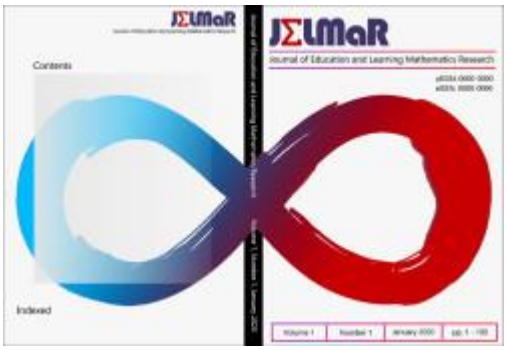

Journal of Education and Learning Mathematics Research (JELMaR)

Online ISSN : 2715-9787
Print ISSN : 2715-8535
Journal Homepage : http://jelmar.wisnuwardhana.ac.id/index.php/jelmar/index

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To cite this article: Wuryanie, M., Wibowo, T., Kurniasih, N., & Maryam, I. (2020). Intuition Characteristics of Student in Mathematical Problem Solving in Cognitive Style. *Journal of Education and Learning Mathematics Research (JELMaR)*, *1*(2), 31-42. https://doi.org/10.37303/jelmar.v1i2.25

To link this article : https://doi.org/10.37303/jelmar.v1i2.25

Publisher
Department of Mathematics Education,
Faculty of Teacher Training and Education,
Universitas Wisnuwardhana Malang

Journal of Education and Learning Mathematics Research (JELMaR)
Volume: 1, Number: 2, November 2020, pp. 31-42
p-ISSN: 2715-8535, e-ISSN: 2715-9787

Received: Maret 2020 *Revised: April, 2020* *Accepted: November 2020* *Published: November 2020*

Intuition Characteristics of Student in Mathematical Problem Solving in Cognitive Style

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Abstract: *This study aims to describe the student's intuition characteristics in solving mathematical problems in the cognitive style Field Dependent (FD) and Field Independent (FI). Source of data comes from students grade VIII taken with a purposive technique. Data collection techniques using tests, field notes, and interviews. The data validity inspection technique used triangulate technique. Data analysis techniques used data reduction, data display, and conclusion drawing. Based on the results of the study concluded that: students with a Field Dependent (FD) cognitive style used intuition with direct, self-evident, extrampolativeness, intrinsic certainly, coerciveness, and conclusive characteristics. While students with Field Independent (FI) cognitive style use intuition with direct, extrampolativeness, self-evident, intrinsic certainly, coerciveness, and conclusive characteristics. In addition, there are also characteristics that are not found in Field Dependent students, there are globality and one of the anticipatory intuition characteristics (trying hard to solve problems).*

Keywords: intuition characteristics, solving mathematical problems, cognitive style.

INTRODUCTION

Mathematics is a science that can not be separated from human life. Without the help of basic mathematical knowledge and processes, a person will experience many difficulties. *The five process standards are described through examples that demonstrate what each standard looks like and what the teacher's role is in achieving it: problem solving, reasoning & proof, communication, connections, and representation* (NCTM , 2019 , p.1) . This shows that mathematics learning activities are very closely related to mathematical problem solving. The problem solving process requires the right abilities, skills and strategies. As stated by Zevenbergen (in Ulya , 2015 , p. 2) that in solving problems it is necessary to have adequate understanding and knowledge, and to have various strategies that can be chosen when facing different problems. Some students when faced with mathematical problems will be able to solve them and feel confident with their logic and reasoning abilities, but only a few are successful in using their formal cognition.

Solving mathematical problems sometimes requires the presumption or claim of a statement without having to prove it. Someone may be able to resolve a problem with a routine procedure, but others by not routine. Students tend to use conscious mental processes in the form of analytic and logical thought processes when solving problems with routine procedures. Whereas other students tend to use mental activities differently from formal cognition in solving problems that do not use routine procedures (Hudoyo, 1990, p. 23).

Therefore there are different mental activities from formal cognition and algorithmic cognition in operating mathematical activities, including in solving mathematical problems. These different mental activities are called *intuitive cognition* .

Intuition can encourage students' creativity in choosing ideas and strategies to solve a problem (Hasanah , 2011 , p. 128) . This shows that intuition is very instrumental in solving mathematical problems. Intuition is seen as important by students because

intuition will help students in committing thoughts towards the desired problem solver. Therefore, if the students' intuition is not well developed, the problem solving process can be hampered. Intuition occurs when someone suddenly finds a solution in a mathematical problem. Conscious or unconscious, a person often uses intuition to solve mathematical problems . M hrough training and familiarization process, individuals can develop a new intuition so it is said that the intuition can be learned, acquired and developed. In other words one's intuition is obtained by experience, study, and pursue mathematics (Fischbein in Nurrakhmi, 2014, p. 209). This is shown from the results of Hafriani's research (2018, p. 46) namely in solving mathematical problems, students tend to use intuition. Some of the characteristics of intuitive thinking that they use include: *direct, self-evident, intrinsic certainty, perseverance* and *coerciveness, extrapolativeness* , global (*globality*) and implicit (*implicitness*).

There are several factors that affect students in solving mathematical problems, one of which is the cognitive style of students. Cognitive style is the way a person processes his understanding regarding what he sees, remembers, and thinks about. Cognitive style is distinctive in the way students learn, both with regard to how the reception and processing of information, attitudes toward information and practices related to the learning environment (Uno , 2012 , p. 185). Students' cognitive styles are needed in designing or modifying material, goals, and learning methods. So that student learning outcomes can be achieved optimally. There are several types of cognitive styles put forward by psychologists and education experts who can reflect the way someone analyzes in interacting with their environment, namely *Field Dependent* (FD) and *Field Independent* (FI). Someone with FD style is more accepting of a concept as a whole. They are difficult to analyze information into different parts. Whereas someone with a FI style shows more separate parts of an overall concept and is able to analyze the concept into its components.

Based on the observations of researchers at SMP Negeri 27 Purworejo , Central Java, it is shown that more than 50% of students have difficulty in solving mathematical problems. This can be seen from the results of grade VIII mathematics tests. While in teaching, the teacher has given guidance with sufficient understanding to students. One of the influencing factors is the lack of students' understanding of the material and the lack of intuition in solving mathematical problems. They only focused on the examples given by the teacher while learning. So they do not have the initiative or ideas to try to find their own solution if given a new problem. Another factor that affects the teacher is not yet fully aware of the cognitive style students have and also the way of thinking (cognitive style) of students varies with the concept of material learned in class. So students are only active in learning but in solving problems tend to be less interested in learning them. Considering the students' low understanding of material and their lack of intuition inmathematical problem solving, the study aims to describe the characteristics of intuition students in mathematical problem solving in cognitive style *Field Dependent* and *Field Independent* .

METHOD

This research method uses qualitative research with a phenomenological approach. Phenomenology is defined as subjective experience or phenomenological experience (Moleong, 2012, p. 14). The data collected in the form of words or images, so it does not emphasize numbers The subject taking technique in this study is purposive technique, where the subject has received material of geometry flat side and have difficulty in understanding teh material. The subjects studied were students of SMP Negeri 27 Purworejo grade VIII in the 2018/2019 school year. As for determining the subject, researchers determine students with the *Field Dependent* and *Field Independent* cognitive styles using the GEFT (*Group Embedded Figure Test*) *test* . This GEFT

test has tested its validity and reliability 0.82 (Witkin in Bostic, 1988, p.870) . Data collection techniques in this study used mathematical problem solving tests, field notes, and interviews. Mathematical problem solving tests are conducted to determine the students' intuition characteristics in solving mathematical problems. The following problem solving tests used in this study:

Question

1. The Adi's Aquarium is a beam that measures 10 dm × 8 dm × 6 dm filled with full water. If the water is poured into another aquarium in the form of a large prism whose base is 96 dm^2 and already filled with water as high as 5 dm. How many liters of water does a prism shaped aquarium now? (1 dm^3 = 1 liter).
2. In front of the factory there is a tank without a cover filled with water. The tank is shaped like a beam with a length of 8 m and 10 m. Suddenly a coconut with a volume of 80 dm^3 fell into the tank. So the volume becomes 400 dm^3. What was the volume of the tank before there was coconut? Then determine the width of the tank.

Figure 1. Mathematical Problem Solving Test

The indicators of intuition characteristics in mathematical problem solving can be seen in the following table below.

Table 1 Type of Intuition

Type of Intuition	Characteristics of Intuition	Indicator	Description
Affirmatory Intuition	*Direct*	Students can immediately understand the purpose of the problem	Coherent answers, read the question once knowing what is known and asked
	Self Evident Cognitions	Students can solve the solution without using empirical evidence	Statement that can be received directly (mention formula, properties of triangle shapes, triangle characteristics)
	Intrinsic Certainly	Students can show the formula or operation operations to calculate the shape of the flat side space that is asked without the need for proof	The use of formulas or arithmetic operations based on the problem presented
Type of Intuition	**Characteristics of Intuition**	**Indicator**	**Description**

	Coerciveness	Students can find solutions to problems by following a pattern of patterns that are known from the beginning	Using theories that have been done, or using experience that has been done in solving triangular problems. For example using the formula
	Extrampolativenes s	Students can guess the solution of the problem	Can write numbers on the same side of an isosceles triangle, if only one side is known
Anticipatory Intuition	It appears when trying hard to solve a problem	Students can find solutions to problems, but it takes a long time	Reading question more than once, knowing what is known and asked but should ber p ikir moment
	Using global ideas	Students can solve problems using other methods or different from general	Without using right formula, teorema, books and definitions can be using right global ideas
	Contrary to conjecture in general (*Globality*)	Students can guess the solution of the problem but differ in a way that is generally or contrary to his expectations (using *feeling*)	
Conclusive		Students can make intuitive global conclusions about the results of the elaboration of problem solving ideas.	Can draw conclusions from solving mathematical problems.

Then the interview was conducted with the aim of obtaining more in-depth information in describing the subject's answers. While field records are used to strengthen the data of student answers and written things that are heard, seen and experienced while doing research. Data analysis techniques using the Miles & Huberman model (in Sugiyono, 2013, p. 337), namely data reduction, data presentation, and drawing conclusions.

RESULTS AND DISCUSSION

Based on the results of research on the intuition characteristics in mathematical problems solving obtained as follows:

Students with *Field Dependent* (FD) cognitive style

Students involve intuition in solving mathematical problems with a variety of characteristics. This can be seen from the results of answers, field notes, and interviews with research subjects.

Problem Number 1

The results of students' answers and field notes can be seen in the picture below .

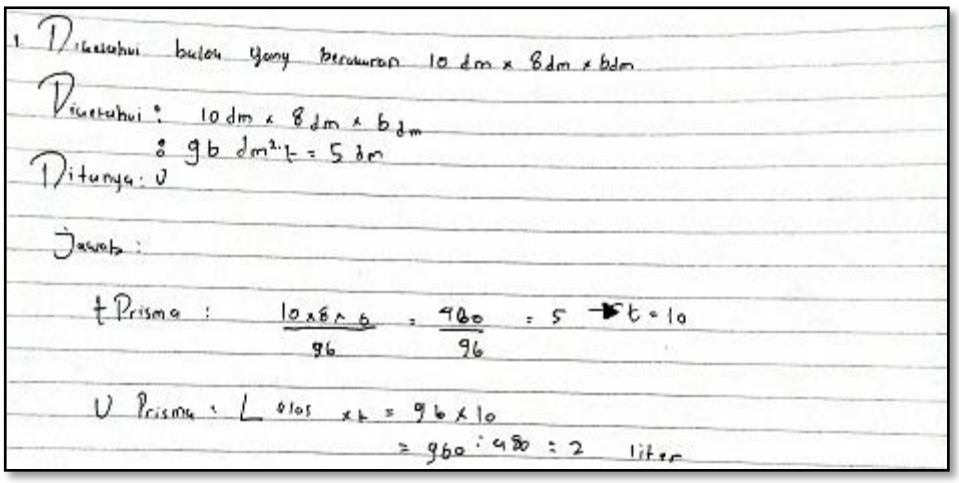


Figure 2. Results of FD Student

Problem Solving Number 1

–Student write their identity on the answer sheet

–Student read questions by playing ballpoint

–Then he writes what is known and what is asked

–Students write the answers starting with finding the height of the prism of the volume of the beam divided by the area of the prism base

–He calculates division by scribbling try 96 times 5 equals 480

–Then student looking for the volume with the usual calculation, the area of the base multiplied by height, then equal to the volume of the prism

–Student does not re-check , He did not write the conclusions of the answers

–Then he recalculated by writing 480 times 2, 960 crossed out.

Figure 3 . FD Student's Field Notes

The first thing students do is that students can determine what is known and what is asked directly when reading the problem and also can determine if the data contained in the problem can be used to find what is asked. This shows that at the stage of understanding the problem, students involve the characteristics of intuition, namely *direct* and *extrampolativeness* . Same with Usodo study (2012), where his research shows that students using intuition characteristics directly (*direct*). Later in this study, also found another intuition characteristics, namely the alleged (*extrampolativeness*) .

Students have a completion plan, which is to directly search for the height of the prism, then look for the final volume of the prism to a new height, indicating that students use their intuition. This can be seen from the results of interviews with students as follows:

P : "Is the information in the problem enough to find the answer to the problem?"
S : "Yes"
P : "Can you link the information in question to what was asked?"
S : "Yes, I can"
P : "How do you plan to solve the problem?"
S : "The height of the prism is 10 times 8 times 6 divided by 96 is 460 divided by 96 high school by 5. The volume of the prism of the base area times the height is 95 times 10 high school with 960 divided by 480 equals 2 liters."
P : "What formula did you use to solve the problem?"
S : "Formula ... calculation formula, beam volume and prism volume"

Characteristics intuition used in the settlement plan, which is *direct* , *self-evident* , and *extrampolativeness* . This is in line with Rukoyah's research (2018), which in his research shows that students use the characteristics of *direct* intuition , *self-evident* , and *extrapolativeness*.

Furthermore, in carrying out the plan, students involve the characteristics of intuition, namely *direct* . The results of interviews with students stated that he used calculation operations and formulas in carrying out the completion plan. This is consistent with the indicators in mathematical problem solving that students using the formula must have (*intrinsic certainty*) , and *coercivenes*. In the re-checking process there are students who do not use intuitive characteristics, while other students use *conclusive* intuitive characteristics , which can draw conclusions from the problem.

Problem Number 2

The results of answers and students' field notes can be seen in the picture below.

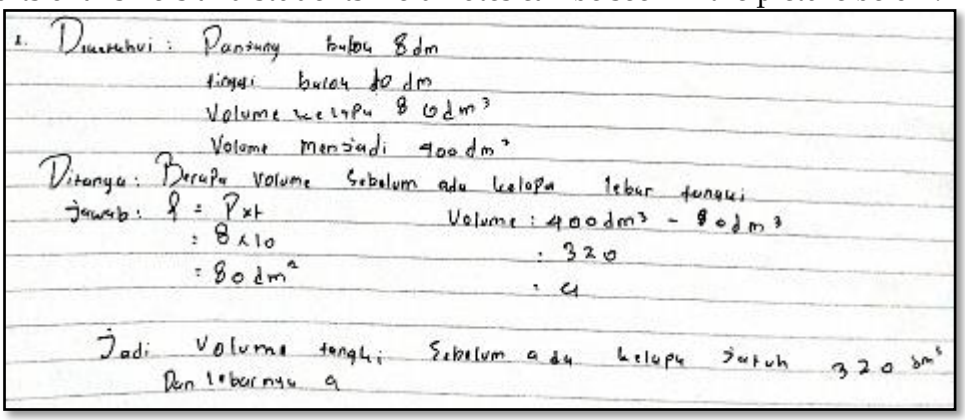
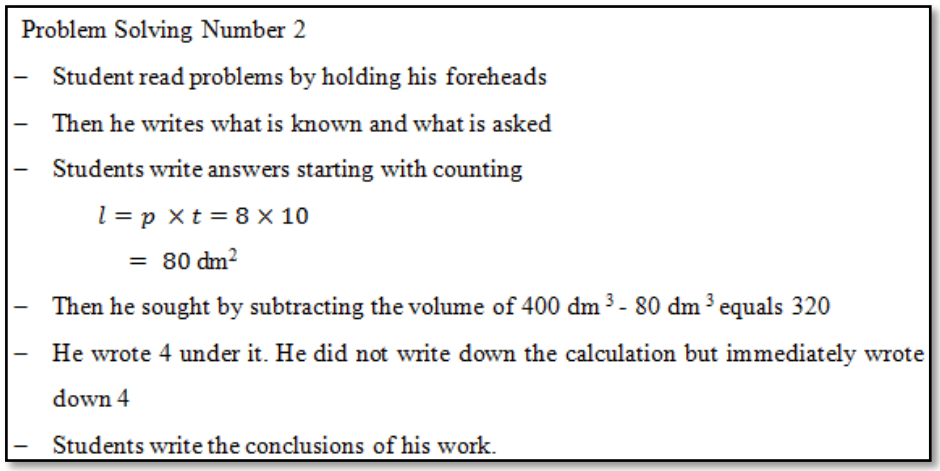


Figure 4. Result of FD Student



Problem Solving Number 2

- Student read problems by holding his foreheads
- Then he writes what is known and what is asked
- Students write answers starting with counting

$$l = p \times t = 8 \times 10$$
$$= 80 \text{ dm}^2$$

- Then he sought by subtracting the volume of 400 dm^3 - 80 dm^3 equals 320
- He wrote 4 under it. He did not write down the calculation but immediately wrote down 4
- Students write the conclusions of his work.

Figure 5. FD Student's Field Notes

From the results of the student's work , it can be seen that he did it correctly. This shows that he can understand directly when reading questions by writing down what is known and asked in his own language even though it is almost the same as what is in question. This is classified in the characteristics of intuition, namely *direct* . In the planning section for completion, students can relate the information that is asked and asked in the problem, can be seen in the following interview excerpt:

P : "Can you link the information in question to what was asked?"
S : "Yes, I can"
P : "How do you plan to solve the problem?"
S : "Looking for area .. area of beam , length times height"

P : "What formula did you use to solve the problem?"
S : "Formula ... formula ... beam volume formula"

Based on the interview footage, students use the characteristics of intuition in the settlement plan, namely direct and *extrampolativeness.* Because students use formulas in making problem solving plans. In addition, students also use the characteristics of intuition *self-evident* because he can state the formula that will be used in solving problems. This is in line with Rukoyah's research (2018), which in his research shows that students use the characteristics of *direct* intuition, *self-evident* , and *extrapolativeness*. Students can carry out the completion plan by doing calculations directly. From the answers of students who do calculations by writing formulas, using formulas in their work, this shows that they have knowledge in solving problem number 2. This shows that students use intuitive characteristics, namely *self-evident* and *coerciveness* .

Then he makes conclusions to answer questions about number 2. This shows that he uses the characteristics of intuition, namely *concuslive* . This can be seen also from the following interview with students:

P : "How do you check that the solution to your problem is correct?"
S : "Streaked"
P : "Have you checked all the results of your work?"
S : "Yes, I have"
P : "Can you draw conclusions from solving the problem you are working on?"
S : "Yes"
P : "What?"
S : "Jadi So the tank volume before there is coconut is 320 dm ^{3} and the width of the tank is 4."

Students with the *Field Independent* (FI) cognitive style

Students involve intuition in solving mathematical problems with a variety of characteristics. This can be seen from the results of answers, field notes, and interviews with research subjects.

Problem Number 1

The results of students' answers and field notes can be seen in the following figure .

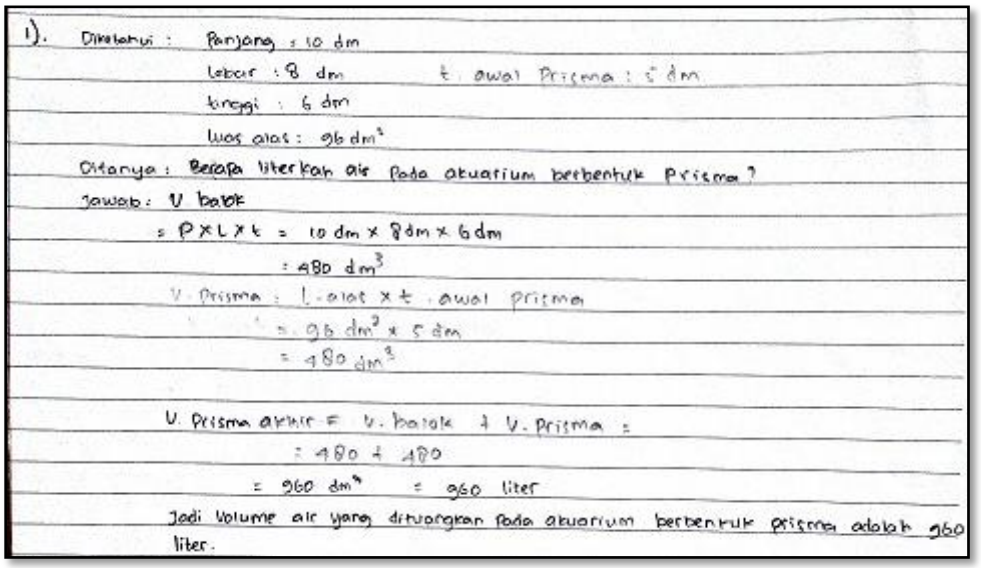
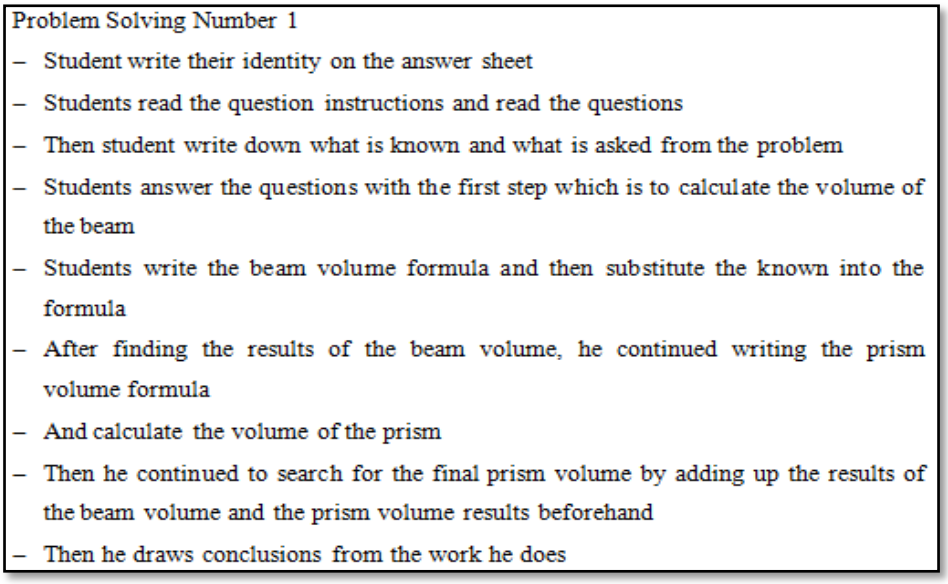

1). Diketahui : Panjang : 10 dm
Lebar : 8 dm t. awal Prisma : 5 dm
tinggi : 6 dm
luas alas : 96 dm²
Ditanya : Berapa literkah air pada akuarium berbentuk Prisma ?
Jawab : V balok
= P x L x t = 10 dm x 8 dm x 6 dm
= 480 dm³
V. Prisma : L. alas x t. awal prisma
= 96 dm² x 5 dm
= 480 dm³
V. Prisma akhir = V. balok + V. Prisma :
= 480 + 480
= 960 dm³ = 960 liter
Jadi Volume air yang dituangkan pada akuarium berbentuk prisma adalah 960 liter.

Figure 6. Results of FI Student


Problem Solving Number 1

- Student write their identity on the answer sheet
- Students read the question instructions and read the questions
- Then student write down what is known and what is asked from the problem
- Students answer the questions with the first step which is to calculate the volume of the beam
- Students write the beam volume formula and then substitute the known into the formula
- After finding the results of the beam volume, he continued writing the prism volume formula
- And calculate the volume of the prism
- Then he continued to search for the final prism volume by adding up the results of the beam volume and the prism volume results beforehand
- Then he draws conclusions from the work he does

Figure 7 . FI Student's Field Notes

The first thing students do is that students can determine what is known and what is asked directly when reading questions. Students can also determine if the data in the problem can be used to find what is asked. This shows that at the stage of understanding the problem, students involve the characteristics of intuition, namely *direct*, such as the results of Usodo (2012). In addition students also use the characteristics of intuition to guess (*extrampolativeness*) according to the stage of understanding the problem .

Then in the completion plan stage , FI students have a different plan from FD students by directly looking for the volume of beams and prism volumes first . Then he added the results of the calculation of the two volumes to find the volume in question. In this case s ISWA use intuition in the settlement plan, which is *direct* , *self-evident* , and *globality* (contrary to the allegations in general) . Students also use the intuitive characteristics of *extrampolativeness* in the planning stage of completion. This can be seen from the results of interviews with students, as follows:

P : "Is the information in the problem enough to find the answer to the problem?"
S : "Yes"
P : "Can you link the information in question to what was asked?"
S : "Yes, I can"

Furthermore, in the research of Usodo (2012) in the stage of implementing the plan, students did not use their intuitions. While in this study found the students used the characteristics of intuition, which is *direct* , *self-evident* , *intrinsic certaintly* , and *coercivenes* . This can be seen from the excerpt from the results of interviews with students, as follows:

P : "How do you carry out the plans that you make?"
S : "Eng ... Calculate the beam volume and calculate the prism volume. Then the volume of the final prism is the same as the beam volume plus the prism volume"
P : "Have you used the information in the problem to find the answer to that problem?"
S : "Yes, I have"
P : "Do you find it difficult to solve the problem?"
S : "No, I don't"
P : "Prove that every step you take is correct!"
S : "The beam volume is length times width times height. Equals 10 dm times 8 dm times 6 dm, equals 480 dm^3 . The volume of prism is wide base times high. Equals 96

dm^2 times 5 dm equals 480 dm^3. The final prism volume is left plus 480 dm^3 + 480 dm^3 equals 960 dm^3"

Based on these results, it shows that students use formulas, calculate operations directly, and use their own knowledge or experience. It is included in the characteristics of *direct* , proven by itself (*self-evident*) , proved to be intrinsic (*intrinsic certaintly*) , *coercivene* , and *globality*. Like the results of Rukoyah's research (2018) which shows that students use the characteristics of intuition *direct, self-evident, coerciveness, extrapolativeness, intrinsic certainty* in carrying out the plan of completion. Re-checking stage, students involve intuition, namely *conclusive* , where students can draw conclusions from the problem. This can be seen from the results of interviews with students, as follows:

P : "How do you check that the solution to your problem is correct?"
S : "In the Streaked"
P : "Have you checked all the results of your work?"
S : "Yes, I have"
P : "Can you draw conclusions from solving the problem you are working on?"
S : "So the volume of water poured into the prism is 960 liters"

Problem Number 2

The results of students' answers and field notes can be seen in the following figure.

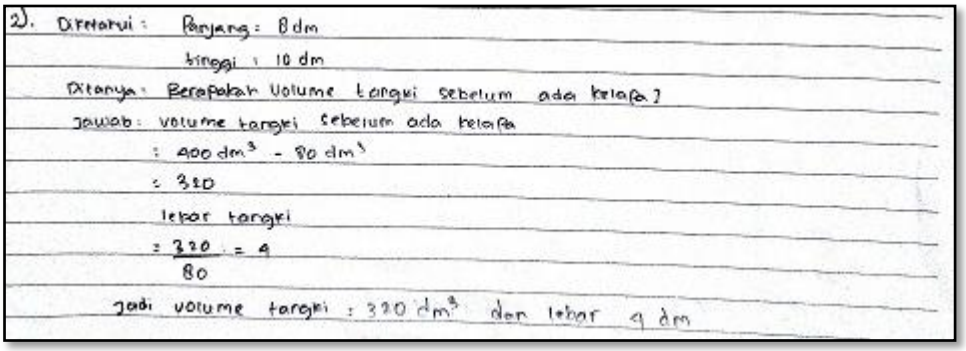


Figure 8. Results of FI Student

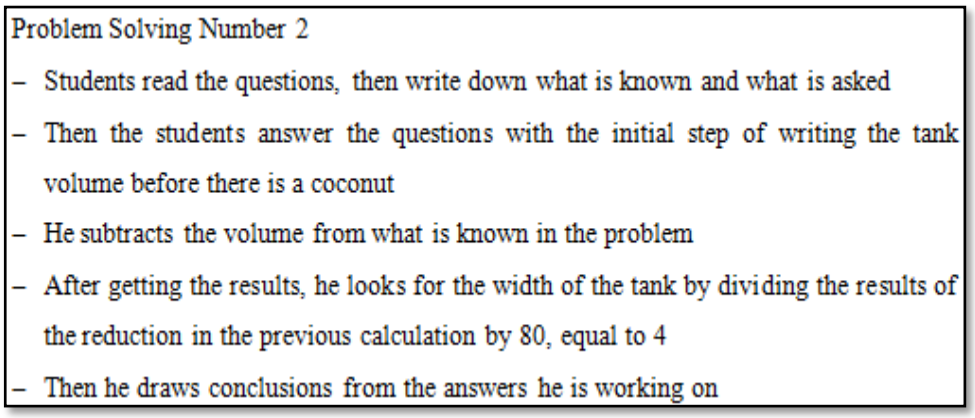


Figure 9. FI Student's Field Notes

Based on the pictures of problem solving test answers and students' field notes, it can be seen that students answer questions question number 2 correctly. From the results of these answers indicate that students can understand directly when reading questions by writing down what is known and asked in their own language. This can be seen in the results of interviews with students as follows::

P : "What do you know about the problem?"

S : "The beam length is 8 dm, the beam height is 10 dm"
P : "Anything else?"
S : "Volume ... head volume is 80 dm^3 and beam volume is 400 dm^3"
P : "What was asked about the problem?"
S : "What is the volume of the tank before there is a coconut and then determine the width of the
tank?"
P : "Is the information in the problem enough to find the answer to the problem?"
S : "Yes"

Based on the results of the interview, at the stage of understanding students' problems using *direct* intuitive and *extrampolativeness characteristics* . In the planning part of the settlement, S can link the information available and asked about in the problem. This is evident from the results of interviews with students, as follows:

P : "Can you link the information in question to what was asked?"
S : "Yes, I can"
P : "How do you plan to solve the problem?"
S : "Beam volume with reduced coconut volume. Then to find the width of the tank by the beam volume divided by length times height "
P : "What formula did you use to solve the problem?"
S : "Beam volume"

Based on the interview above, it can be seen that students can connect directly what is known to what is asked. The students plan the known volume to be reduced, then to find the width by the beam volume. This shows that it uses the characteristics of intuition *direct, self-evident,* and *intrinsic certainly* . This is consistent with research Rukoyah (2018) , where in the planning stages of completion research on student use intuition characteristic *direct, self-evident,* and the *intrinsic certainly* Then on stage to implement the settlement plan , students perform calculations directly, using the formula he had expected can solve the problem. This shows that it uses the characteristics of intuition, namely *intrinsic certainly.* From the answers of students who do calculations directly, this shows that he has the knowledge in solving questions number 2. He uses *coerciveness* so that he can find solutions to problem number 2.

Then students draw conclusions to answer question question number 2. Similarly, when an interview is conducted, students can draw conclusions from the questions. Following are excerpts from interviews with students for the re-checking stage .

P : "How do you check that the solution to your problem is correct?"
S : "Re-examine the answer"
P : "With scribbles or directly?"
S : "Right at work"
P : "Have you checked all the results of your work?"
S : "Yes, I have"
P : "Can you draw conclusions from solving the problem you are working on?"
S : "Yes, I can, so the tank volume is 320 dm^3 and the tank width is 4dm"

This shows that S uses intuitive characteristics, namely *concuslive* . In contrast to the results of the research of Usodo (2012) and Rukoyah (2018), for the re-checking stage. students do not involve intuition, whereas in this study students involve intuition with *conclusive* characteristics (drawing conclusions).

CONCLUSION

Based on the results of research and discussion it can be concluded that (1) Students with a *Field Dependent* (FD) cognitive style involve intuitive characteristics in understanding problems, namely *direct* and *extrampolativeness*. At the stage of planning the solution, it uses the characteristics of intuition, namely *direct, self-* evident , and *extrampolativeness* . Then in carrying out the plan, using the characteristics of intuition, namely *direct, self-evident, intrinsic certaintly* , and *coercivenes* (incline). In the re-checking stage, one subject does not involve intuition. While other subjects involve, namely *conclusive* (drawing conclusions) . (2) Students with the *Field Independent* (FI) cognitive style involve intuitive characteristics in understanding the problem, namely *direct* and *extrampolativeness*. At the stage of planning the solution, it uses the characteristics of intuition, namely *direct, self-* evident , and *extrampolativeness* . There are other characteristics raised in this stage, namely *globality* (contrary to general conjecture). Then in carrying out the plan, using the characteristics of intuition, namely *direct, self-evident, intrinsic certaintly* , and *coercivenes*. There are other characteristics raised in this stage, namely *anticipatory* and *globality* . In the re-checking stage, it involves intuition, which is *conclusive* (drawing conclusions).

Based on the results of the research and discussion above, it is suggested the following things: (1) It is better in learning mathematics, teachers are more training students by giving problem solvers to hone the initiative or intuition of students in dealing with various types of new questions. (2) For other researchers who are interested in looking for students' intuition characteristics at different reviews and at different levels. In addition, attitude is needed to be more careful in categorizing intuition characteristics in problem solving.

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