

# Analysis of Metacognitive Skills in Solving Mathematical Problems Reviewed from Students' Learning Style

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**Abstract** This study aims to analyze: (1) the level of metacognitive skills in mathematical problem solving in terms of student learning styles; (2) metacognition difficulties experienced by students in solving mathematical problems in terms of student learning styles. This research is a descriptive qualitative research. The subjects of this study were 34 students of MTs Negeri 1 Labuhanbatu Selatan, then the interview subject was raised based on Honey & Mumford's learning style namely theory, pragmatics, reflector, and activist learning styles. Based on the results of the study it was found that: (1) There were 13 people (38,23%) students with reflector learning styles, students with reflector learning styles at the level of metacognition ability strategic use had high and moderate problem solving abilities. At the level of metacognition ability aware use has moderate solving abilities. At the level of metacognition ability tacit use has low problem solving abilities; There are 8 people (23.52%) students with pragmatic learning styles, students with pragmatic learning styles at the level of reflective and strategic use metacognition ability have high problem solving abilities. At the level of metacognition ability aware use have moderate problem solving abilities. At the level of metacognition ability tacit use students have low problem solving abilities; There are 10 students (29,41%) with theorist learning style, students with theorist learning style at the level of metacognition ability aware use have moderate problem solving abilities. At the level of metacognition ability tacit use has low problem solving abilities; and there are 3 students (8,82%) with activist learning styles, students with strategic use metacognition ability levels have high problem solving abilities, and the level of metacognition ability aware uses have medium problem solving abilities. (2) Metacognition difficulties experienced by students with pragmatic learning styles, reflectors, and theorists in mathematical problem solving are: a) Difficulty of facts, namely representing mathematical symbols to design mathematical models of the given problem; b) Concept difficulties, namely difficulties in applying the method of substitution, elimination, mixed methods, and determinant methods to solve problems; c) The difficulty of principle, namely the difficulty in applying mathematical formulas and rules as well as the difficulty in connecting the concepts given to solve problems and d) Difficulty of procedures, namely difficulty in presenting steps to solve problems in an orderly and correct manner, inaccuracy in presenting problem solving, as well as difficulties in devising problem solving strategies effectively and efficiently.

**Keywords:** *metacognition ability, mathematical problem solving, honey & mumford learning style*

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## 1. Introduction

Mathematics is important to be taught by students because mathematics is always used in students' daily lives. Students are expected to be able to use mathematics and mathematical mindset in everyday life, and also the ability to apply mathematics [1]. The purpose of learning mathematics is to be able to understand concepts, practice mathematical reasoning, solve problems, communicate ideas in the form of symbols, tables, diagrams or other, and develop students' attitudes in appreciating the usefulness of mathematics in everyday life. At present, problem solving is a focus in learning mathematics. Problem solving ability is the ability or strategic

competence shown by students in understanding, choosing approaches and coping strategies as well as a complete model to find solutions to a problem [2]. Problem solving is a part of the mathematics curriculum that is very important to be applied in solving a problem that is not routinely needed in everyday life [3]. Problem solving is an important part of learning mathematics and is very helpful when students face problems and see problems to be solved [4]. Therefore solving problems has an important role in learning mathematics and even becomes the center or focus in learning mathematics.

In relation to problem solving, there are 3 aspects that contribute to mathematical problem solving according to Charles and Lester, namely: (1) cognitive aspects, including conceptual knowledge, understanding and strategies to apply that knowledge; (2) affective aspects,

which are aspects that affect students' tendency to solve problems; and (3) aspects of metacognition, including the ability to regulate one's own thinking. Metacognition from an educational perspective refers to one's knowledge and monitoring and control of one's cognitive activities that require certain metacognitive skills such as planning and evaluation [5]. According [6] states that metacognition knowledge is knowledge about cognition, generally the same as awareness and knowledge about one's self cognition. It can be concluded that metacognition is a person's thoughts about what he understands, what is known and what is remembered including awareness and control over the process of cognition that is done.

Metacognition in problem solving is an important thing that needs to get the attention of educators, especially to help students to develop their ability to solve problems. Therefore, metacognition has its own role in the process of learning mathematics, especially in problem solving. Where students will be aware of their thought processes and evaluate themselves related to the results of their thought processes. So that it is possible to minimize student mistakes in solving or solving problems.

The fact that the researcher found when giving mathematical problem solving problems with the question of metacognition ability to students of class VIII Shiddiq, MTs Negeri 1 Labuhanbatu Selatan, actually showed that students had difficulty in solving problems in the form of problem solving and connecting them in daily life. Based on students' answers seen errors in the process of students' answers in doing cognitive exercise which results in errors in problem solving. Where the low metacognition ability of students, the impact on problem solving by students will be less good. Therefore the ability of metacognition in mathematics needs to be trained and familiarized with students as early as possible. This ability is needed by students as a provision in solving mathematical problems and problems found in everyday life.

Several studies that support that not all students can use their metacognitive skills well in solving mathematical problems, including research in [7] shows that the results of PGSD student problem solving in terms of Introverted and extroverted learning styles, the level of metacognition of students with extroverted learning styles are in the category of strategic use and aware use, where the use of his thoughts both before and after or even during the process takes less into consideration the continuation and improvement of his thought results, so there are some mathematical problems that are not exactly the result of his calculations. The low ability of metacognition can also be seen from the results of [8] research which shows that at each level of metacognition in solving story problems, high-ability students who have high metacognitive skills can pass through the stages of metacognition properly according to the indicators. But for low ability students have a low level of completeness of metacognition activities as well. Low ability students in passing through the stages of metacognitive behavior is still lacking, because there are several indicators that are not met by it. Like the analysis and inspection stages. Based on the results of these studies indicate that not all students can use their metacognitive abilities well, identify any metacognitive difficulties experienced by students in solving problems.

One that influences students' metacognitive skills in solving mathematical problems is the learning style. According [9] argues that various studies have shown that many students have difficulties in learning mathematics and are weak in achievement in the field of mathematics such as students' metacognitive abilities in problem solving. There are many factors and variables that influence, among others, learning styles, mathematics anxiety, lack of self-confidence, teacher trust, environment, lack of parental attention, and gender.

Each student has a different learning style and each learning style also has different characteristics. Therefore the teacher must also analyze the learning styles of each student so that the information obtained by the teacher can help the teacher understand the differences in each student so that meaningful learning occurs in the school environment (in the classroom). If a child captures information / material according to his own learning style, then there will be no difficult lessons. Barbara Prashning in [10] states that information absorption depends on how people work on it. Thus, it can be said that the characteristics of learning styles possessed by students is one of the influential capital in learning, processing, and communication.

An individual learns based on two ways, first through the learning process, and the second through experience [11]. According research of [12] shows that learning styles can be used to improve metacognitive abilities. Of 118 grade 4 students who were diagnosed with learning styles, test results were obtained which showed an increase in scores / grades. Some metacognition-related research in terms of learning styles have been carried out at several levels of education, namely [13] studies conducted at junior high school level, and research of [14] at high school level, and at the university level. High was shown in the research of Rawa (2017). All of these studies focus on VAK learning styles (Visual, Auditory, and Kinesthetic) and on the dimensions of introverted personality. However, in this study the researchers focused on learning styles according to Peter Honey and Alan Mumford. That is because the learning styles are grouped based on the way students learn and the way it affects learning [15].

Honey and Mumford in [16] describe four learning styles based on experience as follows: (1) having experience (Activist); (2) reviewing experience (Reflector); (3) inference from experience (Theorist); and (4) planning the next step (Pragmatist). Aljebri (2015) explained that the learning style is able to influence students' abilities in solving mathematical problems, and there is a relationship between these learning styles with every step in solving Polya's mathematical problems.

The teacher as a facilitator in learning should understand the characteristics of students. Through a good understanding of student characteristics, a teacher can determine the right model, strategy, and learning method. The selection of models, strategies, and appropriate learning methods can help teachers to invite students to learn so that the objectives of the learning process can be achieved. [17] state that knowing learning styles is important because knowing students' learning styles can help optimize the amount of knowledge gained at a time. Based on some of the descriptions above, this study was conducted in class VII Tabligh MTs Negeri 1 Labuhanbatu to analyze the

ability of Metacognition in Mathematical Problem Solving in terms of Student Learning Styles.

## 2. Methods of Research

This type of research is a qualitative descriptive study. This research is a type of research that aims to describe the students' metacognitive skills in mathematical problem solving in terms of student learning styles. The subjects in this study involved VII grade students of MTs Negeri 1 Labuhanbatu Selatan with 34 students. Appointment of subjects subject to interviews based on the glasses of student learning styles are grouped into four categories, namely 1) Theorists; 2) Pragmatic; 3) Reflector; and 4) Activist. The object in this study is the ability of metacognition in problem solving and student learning styles. The object in this study can be seen from the results of the metacognition ability test in problem solving namely through student answer sheets, student learning styles can be seen from the questionnaire of student learning styles, student activities and student achievement on each indicator of metacognitive skills in mathematical problem solving seen through sheets observation of student activities and through interviews, namely tape-recorder transcripts of students.

Analysis of the data used in this research is qualitative data analysis. Qualitative analysis is used to analyze the level of metacognition ability of students in mathematical problem solving, student learning style questionnaire data and analysis of student answer sheets in mathematical problem solving seen from the learning style. The steps for analyzing Miles and Huberman's data are shown in the following scheme [18]:

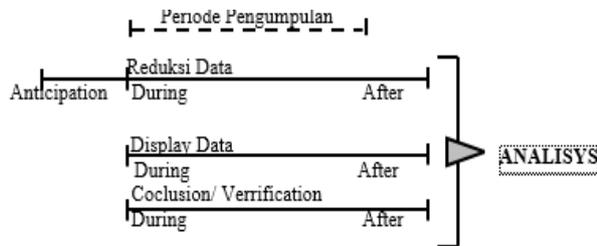


Figure 1. Data Analysis Process

### 2.1. Analysis of Student Metacognition Ability in Mathematical Problem Solving

Determination of the minimum standard of students' mathematical problem solving abilities based on the [19] Minimum Completeness Criteria (KKM)  $\geq 65$ . based on this view the results of tests of students' mathematical problem solving abilities can be presented in the following criteria intervals:

Table 1. Level of Mathematical Problem Solving

Level of Mathematical Problem Solving	Criteria
$0 \leq SKPMM < 65$	Low
$65 \leq SKPMM < 80$	Medium
$80 \leq SKPMM < 100$	High

Note: SKPMM = Mathematical Problem Solving Score.

To determine the criteria and analyze the students' mathematical metacognitive skills test data descriptively, and presented in the following criteria intervals:

Table 2. Interpretation of Student Metacognition Levels

No	Range of Stage	Level
1	3,41-4,00	Reflective Use
2	2,67-3,40	Strategic Use
3	1,33-2,66	Aware Use
4	0,00-1,32	Tacit Use

Information:

- Reflective Use: is a criterion for students' answers to the use of reflective thinking.
- Strategic Use: is a criterion for students' answers with the use of strategic thinking
- Aware Use: is a criterion for students' answers to the use of thinking with low awareness
- Tacit Use: is a criterion for students' answers to the use of thinking without awareness

## 3. Research Results

### 3.1. Descriptions of Learning Style Grouping

Based on the results of the Honey & Mumford learning style questionnaire that was conducted by 34 students of class VII Tabligh MTs Negeri 1 Labuhanbatu Selatan, the learning style results are shown in the Table 1 below:

Table 3. Questionnaire Learning Style Class VII Tabligh Students

Learning Style	Number of Students	Percentage
Activist	3 People	0 %
Reflector	13 People	44,11 %
Theorist	10 People	32,35 %
Pragmatic	8 People	23,52 %

Based on the table found that students classified into pragmatic learning styles amounted to 8 people (23.52%), with theorist learning styles totaling 11 people (35.35%), with reflector learning styles totaling 15 people (44.11%), and with activist learning styles amounted to 2 people (5,88%). Figure 2 presents the grouping of learning styles in class VII Tabligh MTs Negeri 1 Labuhanbatu Selatan.

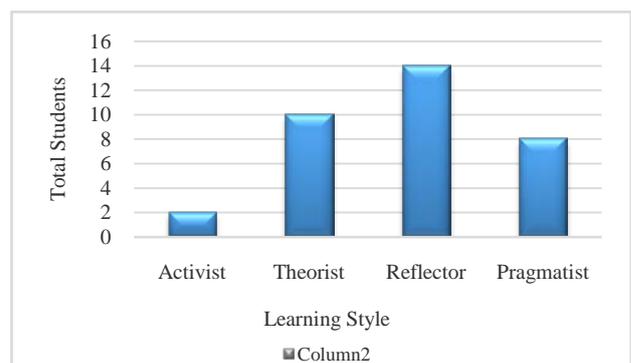


Figure 2. Grouping Diagrams Learning Style Class VII Tabligh MTs Negeri 1 Labuhanbatu Selatan

Based on Figure 2 and the Table 3, the class is dominant with a reflector learning style in which the learning situation, he likes to reflect on the experience and observe it from various points of view and they collect data, both directly and from others, and prefer to think through it thoroughly before come to any conclusion. (Honey & Mumford, 1992). This is in accordance with the characteristics of problem-based learning that is in groups, students can play a direct role in learning in improving the ability of metacognition in solving students' mathematical problems.

### 3.2. Levels of Student Mathematical Problem Solving

Based on the results of a student's mathematical problem solving test of 34 students, it is obtained the level of mathematical problem solving of students spread over three levels, can be presented as follows:

Table 4. level of mathematical problem solving ability

No	Interval Score	Number of Students	Percentage	Category
1	$0 \leq SKPMM < 65$	14 People	41,17 %	Low
2	$65 \leq SKPMM < 80$	15 People	44,11 %	Medium
3	$80 \leq SKPMM \leq 100$	5 People	14,70 %	High

In order to clarify, the level of mathematical problem solving of students in presented in the following diagram form:

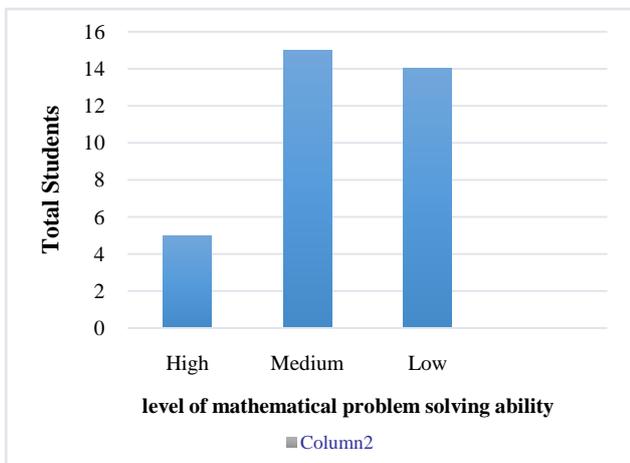


Figure 3. Diagram Level of Mathematical Problem Solving of Class VII Students of Tabligh MTs Negeri 1 Labuhanbatu Selatan

Based on Figure 3 and the Table 4 shows that out of 34 students, the highest proportion of students with moderate abilities has the highest mathematical problem solving rate, followed by low ability students, and high ability students.

### 3.3. Level of Metacognitins Ability

The students' metacognitive skills in solving mathematical problems are obtained by looking at the results of the metacognitive skills given. Based on the test results obtained levels of students' metacognitive skills, as presented in the following Table 5:

Table 5. Student Metacognition Ability Level

No	Metacognition Level	Number of Students	Percentage
1	Reflective Use	1	2,94 %
2	Strategic Use	13	38,23 %
3	Aware Use	12	35,29 %
4	Tacit Use	8	23,53 %

These results can be presented in diagram form in Figure 4 as follows:

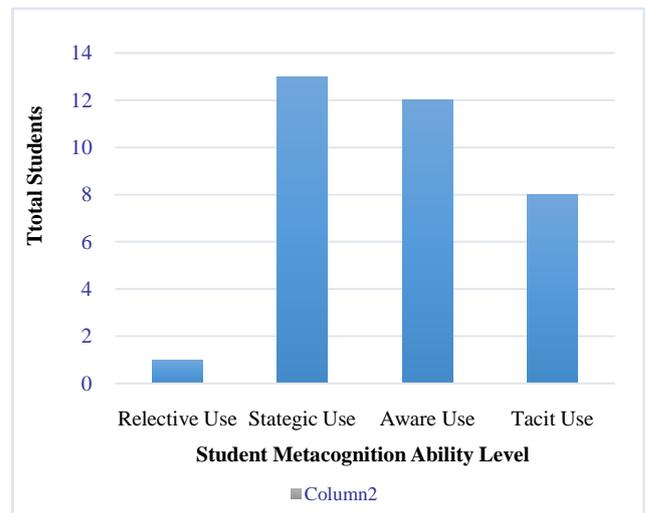


Figure 4. Student Metacognition Ability Chart

Based on Figure 4, level of metacognition ability of students in class VII Tabligh MTs Negeri 1 Labuhanbatu Selatan were more dominantly aware use and strategic use. This can be seen when solving mathematical problems, students with a level of metacognition aware use realize that he must use one step problem solving by giving an explanation why he chose to use these steps. Students with strategic use metacognitive skills, in this case are able to select specific strategies or skills to solve problems.

### 3.4. Description of the Level of Metacognition Ability in Mathematical Problem Solving Students in Terms of Learning Style

To see the level of ability metacognitive skills in solving students' mathematical problems in terms of learning styles is done by first classifying student test results according to their learning styles, then each learning style will be seen its level by looking at the total score of the results of problem solving tests in student mathematics.

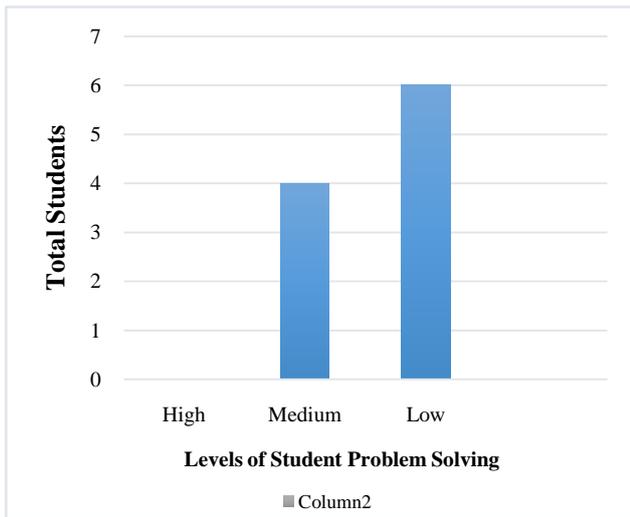
#### 3.4.1. Description of Metacognition Ability Levels in Mathematical Problem Solving Students with Theory of Learning Style

Based on the results of the grouping of students' learning styles, the VII grade students of Tabligh MTs Negeri 1 Labuhanbatu Selatan with a theorist learning style consisted of 10 students. Based on the results of tests given to students, the obtained level of students' mathematical problem solving abilities with theorist learning style is as in the following Table 6.

**Table 6. Levels of Mathematical Problem Solving Students with Theorist of Learning Style**

No	Score Interval	Number of Students	Percentage	Category
1	$0 \leq SKPMM < 65$	6 People	60 %	Low
2	$65 \leq SKPMM < 80$	4 People	40 %	Medium
3	$80 \leq SKPMM \leq 100$	-	0 %	High

The level of mathematical problem solving of students with theorist learning style spread over two levels that can be presented in the form of the following diagram:



**Figure 5.** Diagram Level of Mathematical Problem Solving Students with Theorist Learning Style

Of the 11 students with the theorist learning style, it turns out that the level of mathematical problem solving of students with low ability has the highest proportion, followed by students with medium ability, whereas for high ability students there are no students belonging to this level.

For the results of the students' metacognitive skills test with theorist learning style, the level of students' metacognitive skills is obtained as presented in the following table:

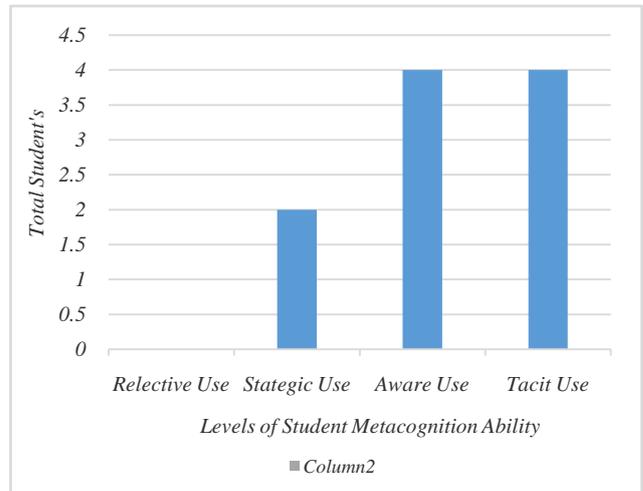
**Table 7. Levels of Metacognition Ability of Students with Theory of Learning**

No	Metacognition Level	Number of Students	Percentage
1	Reflective Use	0	0 %
2	Strategic Use	2	20 %
3	Aware Use	4	40 %
4	Tacit Use	4	40 %

More details can be observed in Figure 5 diagram of the level of metacognitive skills in solving students' mathematical problems with the Theorist learning style.

Based on Table 7, it was found that the level of students' metacognition ability in solving mathematical problems with dominant theorist learning style was at the level of metacognition aware use. In other words students with theorist learning styles are not in the high category and with the level of metacognition reflective use. This is due to individuals with this theorist learning style who prefer

to read in line with the opinions of Honey & Mumford (1992). Students with this learning style like to understand theory before doing an action, and tend to read books and make decisions based on theory. So it does not maximize the time in learning to hone the ability of metacognition in solving mathematical problems.



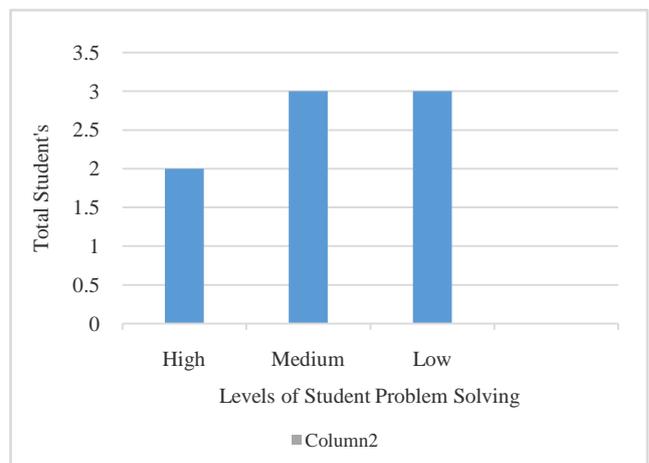
**Figure 6.** Diagram of The Level of Metacognition Ability in Mathematical Problem Solving of Students with Theorist Learning Style

**3.4.2. Description of Metacognition Ability Levels in Mathematical Problem Solving Students with Pragmatic Learning Styles**

Based on the results of the grouping of student learning styles, the VII grade students of Tabligh MTs Negeri 1 Labuhanbatu Selatan with Pragmatic learning styles consist of 8 students. Based on student test results, the level of mathematical problem-solving ability of students with pragmatic learning styles is obtained as in Table 8 the following.

**Table 8. Levels of Mathematical Problem Solving Students**

No	Score Interval	Number of Students	Percentage	Category
1	$0 \leq SKPMM < 65$	3 People	37,5 %	Low
2	$65 \leq SKPMM < 80$	3 People	37,5 %	Medium
3	$80 \leq SKPMM \leq 100$	2 People	25 %	High



**Figure 7.** Diagram of Mathematical Problem Solving Level of Students with Pragmatic Learning Styles

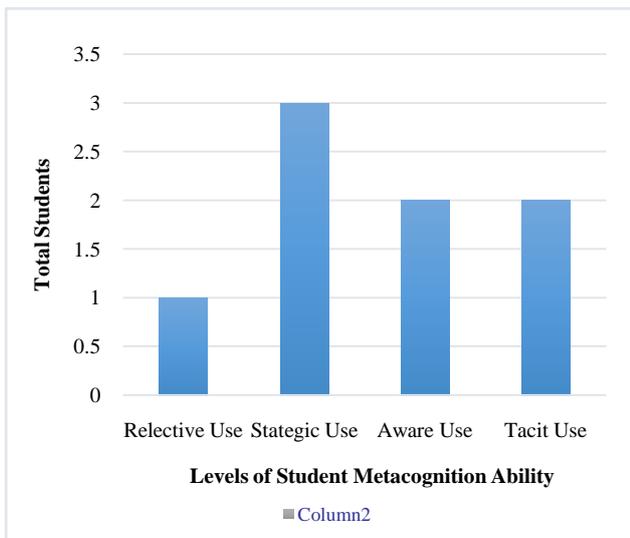
Based on the results of students' mathematical problem solving tests that have been grouped into each of their learning styles, obtained as many as 8 students belonging to pragmatic learning styles and obtained levels of mathematical problem solving students who are spread into three levels. The diagram is presented in Figure 7 as follows:

Of the 8 students, it turns out that the level of mathematical problem solving of students with moderate and low ability pragmatic learning styles has the same proportion as high ability students. Based on the results of metacognitive skills tests of students with pragmatic learning styles, the level of students' metacognitive skills is obtained as presented in the following table:

**Table 9. Levels of Mathematical Metacognition Ability of Students with Pragmatic Learning Styles**

No	Metacognition Level	Number of Students	Percentage
1	Reflective Use	1	12,5 %
2	Strategic Use	3	37,5 %
3	Aware Use	2	25 %
4	Tacit Use	2	25 %

More details can be observed in Figure 8 diagram of the level of metacognition ability in mathematical problem solving of students with pragmatic learning styles.



**Figure 8.** Diagram of The Level of Metacognition Ability in Mathematical Problem Solving of Students with Pragmatic Learning Styles

Based on Table 9 it was found that the level of metacognitive ability in solving mathematical problems of students with dominant pragmatic learning styles is at the level of metacognition strategic use. In the pragmatic learning style there are students with high ability categories and there are students with reflective use metacognition characteristics. This is because "in a learning situation, it is best to find practical uses of ideas and theories. He is able to solve problems and make decisions effectively" (Honey & Mumford, 1992). So that by optimizing the learning style during learning can improve the students' metacognition ability in solving mathematical problems.

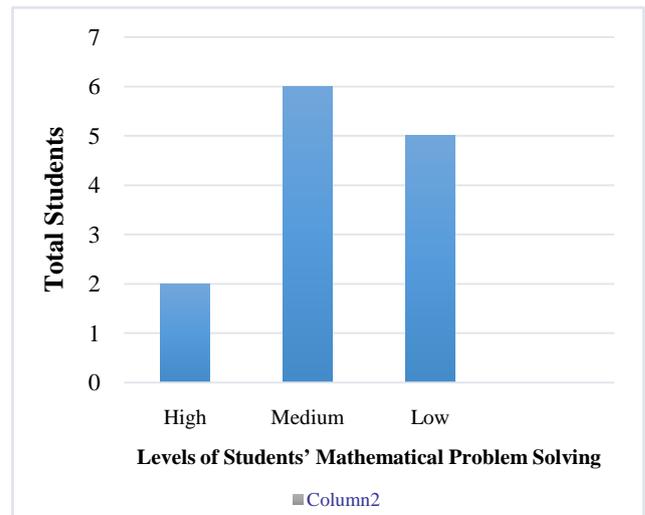
**3.4.3. Description of Metacognition Ability Levels in Mathematical Problem Solving Students with Reflector Learning Styles**

Based on the results of the grouping of student learning styles, the VII grade students of Tabligh MTs Negeri 1 Labuhanbatu Selatan with a theorist learning style consisted of 13 students. Based on the test results of metacognitive skills in solving students' mathematical problems, the level of metacognitive skills obtained in solving mathematical problems of students with Reflector learning styles as in the following Table 10.

**Table 10. Levels of Students' Mathematical Problem Solving**

No	Score Interval	Number of Students	Percentage	Category
1	$80 \leq SKPMM \leq 100$	2 People	15,38 %	High
2	$65 \leq SKPMM < 80$	6 People	46,15 %	Medium
3	$0 \leq SKPMM < 65$	5 People	38,46 %	Low

Based on the results of students' mathematical problem solving tests that have been grouped into each of their learning styles. Then obtained as many as 13 students belonging to the reflector learning style and obtained the level of mathematical problem solving of students spread over three levels. The following diagram is presented as follows:



**Figure 9.** Level Diagram of Mathematical Problem Solving Students with Reflector Learning Styles

Based on Figure 9 it was seen that out of 13 medium-ability students had the highest proportion, followed by low-ability students, and high-ability students. For the results of the students' metacognition ability tests with the reflector learning style the level of students' metacognitive skills is obtained, as presented in the following table:

**Table 11. Levels of Mathematical Metacognition Ability of Students with Reflector Learning Styles**

No	Metacognition Level	Number of Students	Percentage
1	Reflective Use	-	0 %
2	Strategic Use	6 People	46,15 %
3	Aware Use	5 People	38,46 %
4	Tacit Use	2 People	15,38 %

To see more details can be observed in Figure 10 diagram of the level of metacognitive skills in solving mathematical problems of students with reflector learning styles.

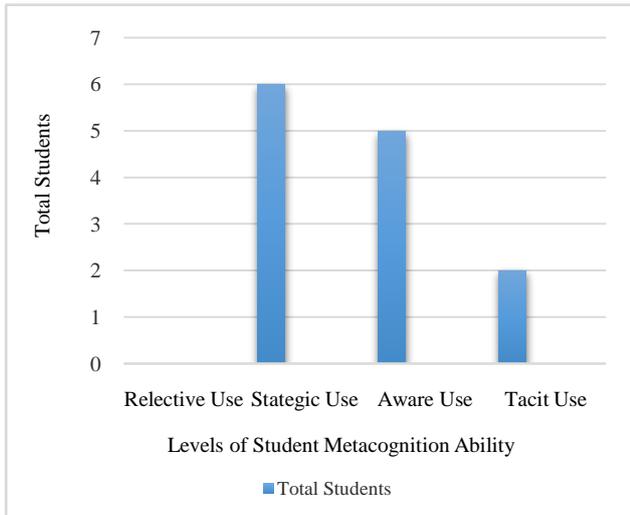


Figure 10. Diagram of the Level of Metacognition Ability in Mathematical Problem Solving of Students with Reflector Learning Styles

Based on Table 11, it was found that the level of metacognition ability in solving mathematical problems of students with the reflector learning style is more dominant and has a characteristic level of metacognition strategic use with moderate level of problem solving ability. In this Reflector learning style there are students in the high category and there are no students with characteristics of the reflective use metacognition level, this is due "in learning situations, he prefers to work in groups and receive personal feedback" (Honey & Mumford, 1992) . This is in line with problem-based learning that learns in groups so that students can play a direct role in learning so as to improve the ability of metacognition in mathematical problem solving.

**3.4.4. Description of Metacognition Ability Levels in Mathematical Problem Solving Students with Activist Learning Styles**

Based on the results of the grouping of students' learning styles, students of class VII Tabligh MTs Negeri 1 Labuhanbatu Selatan with a activist learning style consisted of 3 students. Based on the results of tests given to students, the obtained level of students' mathematical problem solving abilities with activist learning style is as in Table 12, the following.

Table 12. Levels of Mathematical Problem Solving Students with Activist Learning Styles

No	Score Interval	Number of Students	Percentage	Category
1	$0 \leq SKPMM < 65$	-	0 %	Low
2	$65 \leq SKPMM < 80$	2 Orang	66,67 %	Medium
3	$80 \leq SKPMM \leq 100$	1 Orang	33,33 %	High

The level of mathematical problem solving of students with activist learning styles spread over two levels, can be presented in the form of the following diagram:

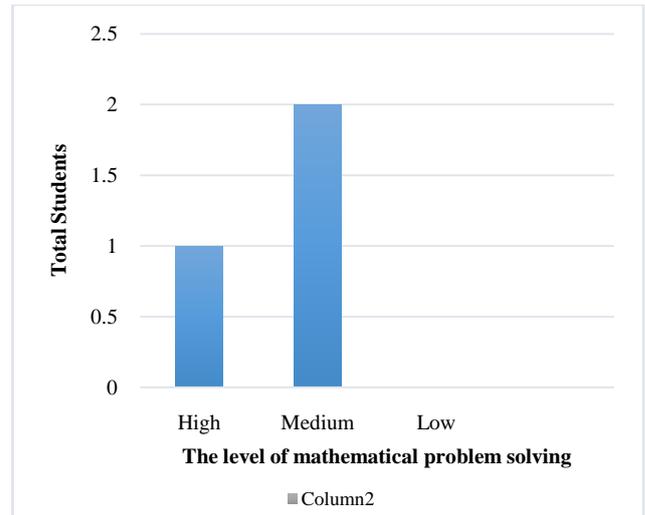


Figure 11. Level Diagram of Mathematical Problem Solving Students with Activist Learning Styles

Based on the 3 students with the activist learning style, it turns out the level of mathematical problem solving of students with the activist learning style is at medium problem solving ability. For the test results of students' metacognitive skills with activist learning styles the level of metacognitive skills of students is obtained, as presented in the following table:

Table 13. Levels of Metacognition Ability of Students with Theory of Learning

No	Tingkat Metakognisi	Jumlah Siswa	Presentase
1	Reflective Use	0	0 %
2	Strategic Use	2	66,67 %
3	Aware Use	1	33,33 %
4	Tacit Use	0	0 %

To see more details can be observed in Figure 12. diagram of the level of metacognitive skills in solving mathematical problems of students with activist learning styles.

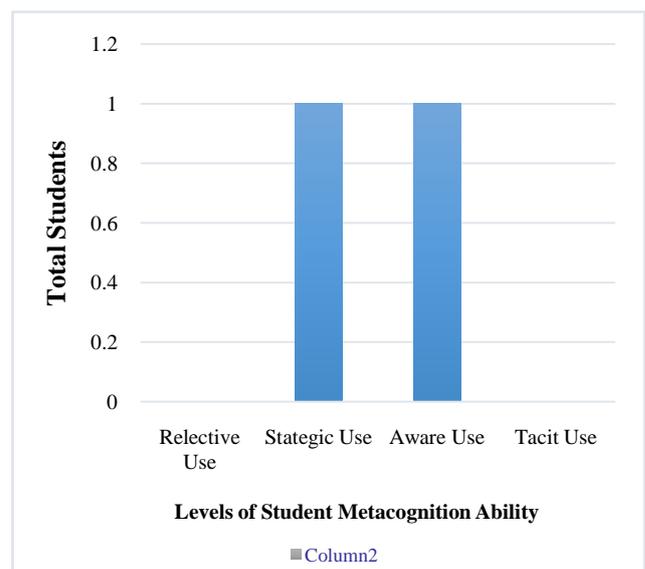


Figure 12. Level Chart of Metacognition Ability in Mathematical Problem Solving Students with Activist Learning Styles

Based on Table 13, it was found that the level of metacognition ability in solving students' mathematical problems with activist learning styles, was at the level of metacognition strategic use and aware use, and was at medium and high problem solving abilities. This is because students with activist learning styles involve themselves fully in new experiences. They are open-minded, not skeptical, and tend to be enthusiastic about something new. Their philosophy is "I'll try something once". They tend to act first and consider the consequences afterwards. They tend to develop new challenges but are bored with long-term application (Honey & Mumford, 1992). So they tend to problem solving or problem solving activities.

### 3.5. Difficulties in Mathematical Metacognition of Students

The mathematical metacognitive difficulties experienced by students during the learning process carried out using the problem-based learning model are as follows:

Table 14. Difficulties in Mathematical Metacognition of Students

No	Difficulties experienced by students	Indicator	Total students
1	Fact	<ul style="list-style-type: none"> <li>Students cannot interpret mathematical symbols or symbols in problem solving.</li> <li>Students are not able to understand the use of mathematical symbols in problem solving.</li> <li>Students cannot represent mathematical symbols to design mathematical models of a given problem.</li> </ul>	9 People
2	Concept	<ul style="list-style-type: none"> <li>Students are not able to write concepts in their own language</li> <li>Students are not able to give examples and not examples and their reasons.</li> <li>Students are not able to apply concepts in problem solving..</li> </ul>	11 People
3	Principle	<ul style="list-style-type: none"> <li>Students are not able to present steps in problem solving in an orderly and correct way.</li> <li>Students are not careful in presenting problem solving</li> <li>Students are not able to devise problem solving strategies effectively and efficiently.</li> </ul>	13 People
4	Procedure	<ul style="list-style-type: none"> <li>Students are not able to use mathematical formulas and rules in solving problems.</li> <li>Students do not connect the concepts given to solve problems.</li> </ul>	21 People

From this table, 9 students (26.47%) experienced metacognitive difficulties in understanding mathematical facts. As many as 11 people (32.35%) experienced difficulty in concept, 13 people (38, 23%) experienced difficulties in principle, and 21 people (61.76%) had difficulty understanding the procedure.

### 3.6. Difficulty of Students' Mathematical Metacognition Judging from the Learning Style

The following will describe each of the students' difficulties in solving the problem of metacognitive skills in solving each mathematical problem in a learning style to facilitate the selection of each subject to be interviewed.

#### 3.6.1. Analysis of Student Metacognition Difficulties in Mathematical Problem Solving Students with Pragmatic Learning Styles

Highly capable students with reflector learning styles are students with the S-24 code. It is expected that the subject can represent in providing good and correct information about the difficulties of metacognitive skills. Figure 13 the following is the result of a written test solving mathematical problems coded students S-24. Figure 13, will be analyzed to find metacognitive difficulties in solving students' mathematical problems.

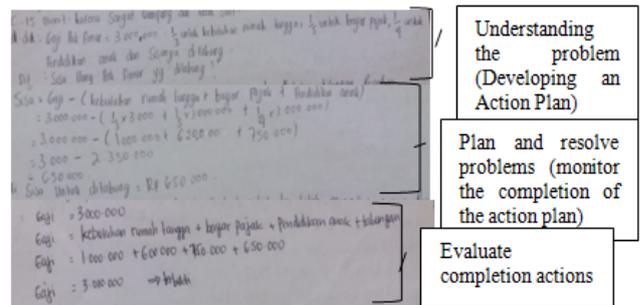


Figure 13. Answers to Problem Solving of High Capable Students with Pragmatic Learning Styles

Based on student answer sheets, it can be seen that, at the stage of understanding the problem students can write correctly what is known and what is asked. So students also fulfill the stage of developing a completion plan on metacognitive skills. At the strategic planning stage, students write plans to solve problems so that at the problem solving stage students do not experience errors. Based on this students can be said to be able to monitor the completion of metacognitive skills. In the stage of evaluating the completion action, students can check the answers correctly, by entering the results into the initial equation whether the answers obtained are correct. To see students' difficulties and metacognitive skills, interviews were conducted on the subjects, while the interview excerpts were as follows:

At the stage of developing the completion plan, students are required to recognize and understand facts in mathematics, which are able to interpret mathematical symbols. From the interviews above, it appears that students have no difficulty in understanding mathematical facts. Where students can interpret and understand the use of mathematical symbols in representing mathematical problems. This can be seen from students who are able to represent problems into known and asked or mathematical models that are made exactly and when given a problem "if for example a = 3, b = 5, and

$c = 2$ , determine the results of  $b-c$  ( $a + b$ ) = "Students are able to represent these symbols into mathematical models correctly.

At the stage of monitoring problem resolution students have no difficulty in understanding concepts, This can be seen from students who are able to provide definitions of fractions with their own language, and provide examples of fractions with the right reasons and students are able to apply the concept of fractions in solving problems. The subject is said to understand the principle, which is seen when the subject is able to use rules and formulas or the properties of fractions in solving problems.

At the stage of evaluating completion actions students have no difficulty in mathematical procedures. This can be seen from the steps of problem solving that are done by students in a timely and correct manner, and in solving these problems students have done the calculation correctly. Based on the results of interviews with highly capable students with pragmatic learning styles, it appears that the subject has understood what he wrote by demonstrating his ability to provide opinions supporting his thoughts. The subject is also aware of the capabilities he has. The subject shows that the problem solving is based on the awareness of his own thinking and has a way to convince what he made so it does not appear that the subject has difficulty in answering the questions metacognition given to him. To re-examine the subject is able to check by entering the results obtained into the initial equation.

Based on triangulation of data obtained from the description of student answer sheets and also the results of interviews on subjects with high category problem solving scores in the pragmatic learning style group, the characteristics of mindfulness of thinking are as follows: 1) The subject is able to understand and be aware of the abilities he has; 2) The subject also generally knows what he is doing; 3) The subject is able to provide convincing explanations for what he has done; 4) The subject understands information from the problem and determines the strategies and concepts to solve the problem; and 5) The subject is able to evaluate the truth or error of the solution used. Based on these characteristics, the S-24 subject with high problem solving scores in the pragmatic learning style group, is at the level of reflective use metacognitive skills. This is because the characteristics that emerge through students' thinking meet indicators at the level of reflective use metacognitive skills. This shows the subject uses reflective and conscious thinking in selecting strategies or skills to solve the given problem.

### 3.6.2. Analysis of Student Metacognition Difficulties in Mathematical Problem Solving Students with Theorist Learning Styles

For low-ability students with theorist learning styles, students with S-14 codes. It is expected that the subject can represent in providing good and correct information about the difficulties of metacognitive skills. Figure 14 is the result of a written test solving students' mathematical problems coded S-14 and analyzed to find metacognitive difficulties in solving students' mathematical problems:

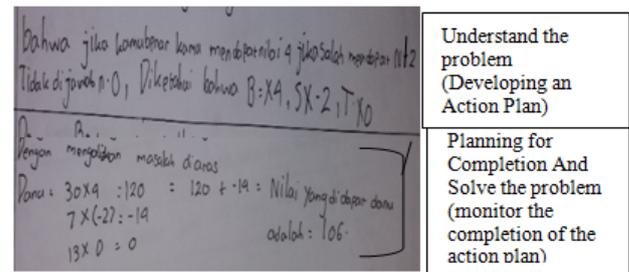


Figure 14. Answers to Problem Solving Students with Theorist Learning Styles

Based on the written test results, it can be seen that in the stage of understanding the problem, students write the known but not the asked questions. students are able at the stage of planning and solving student problems. at the stage of evaluating students have not been able, it can be seen from students who do not re-check the results of the answers, causing errors in the answers. To see students 'difficulties and students' metacognitive skills, interviews were conducted on the subjects, while the interview excerpts were as follows:

At the stage of developing a completion plan students are required to recognize and understand facts in mathematics, which are able to interpret mathematical symbols. From the interview above, it can be seen that students do not experience the difficulty of facts, where students can interpret and use appropriate symbols in representing mathematical problems. This can be seen from students being able to represent problems into the known but not right when writing what is asked, and the mathematical models made by students are also correct.

At the stage of regulating or monitoring the resolution of problems. Based on the interview passage, it can be said that at this stage students have no difficulty in understanding concepts. This can be seen from the students' answers when asked to give examples of integers and fractions. The subject also appeared to have no difficulty in understanding mathematical principles, where it was seen from students being able to use mathematical formulas and rules in solving problems, being able to connect the concepts given to solve problems and students were also careful in calculations in solving problems .

At the stage of evaluating problem solving actions. Based on the interview passage can be seen that at this stage students have no difficulty in mathematical procedures. Where it can be seen from the steps of problem solving done by students in a series of ways and correctly, and in solving these problems students have done the calculations correctly.

From the results of interviews with medium-capacity students with theorist learning styles, it appears that the subject has understood what he wrote by showing his ability to provide opinions supporting his thoughts. Where the subject is also aware of the capabilities he has. The subject showed that the solution to the problem he was working on was not based on the awareness of his own thinking and it was difficult to convince what he had made so that it seemed that the subject had difficulty answering the metacognitive questions given to him.

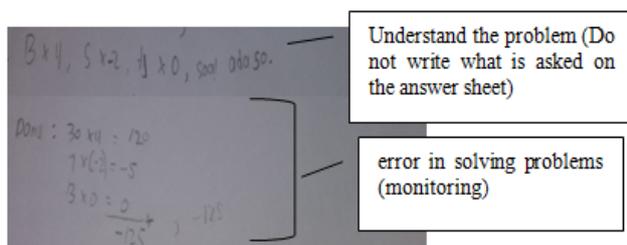
Based on the triangulation of data obtained from the description of student answer sheets and also the results of

interviews on subjects with medium category problem solving scores in the theorist learning style groups, the characteristics of mindfulness of thinking are as follows: 1) The subject is less aware of the abilities he has; 2) The subject also generally knows what he is doing; 3) The subject in general is difficult to give opinions that support his thinking; 4) The subject face difficulty in understanding the facts in problem solving.

Based on these characteristics, the subjects with high problem solving scores in the pragmatic learning style group, are at the level of metacognition ability for strategic use. This is because the characteristics that arise through students' thinking meet indicators at the level of strategic use metacognitive skills. And students are aware in selecting strategies or skills to solve the given problem.

### 3.6.3. Analysis of Student Metacognition Difficulties in Mathematical Problem Solving Students with Reflector Learning Styles

For low-ability students with theorist learning styles, students with S-33 codes. It is expected that the subject can represent in providing good and correct information about the difficulties of metacognitive skills. Figure 15 is the result of a written test solving mathematical problems coded students S-33 and will be analyzed to find metacognitive difficulties in solving students' mathematical problems.



**Figure 15.** Answers to Problem Solving Students with Reflector Learning Styles

Based on the student's answer sheet, it can be seen that, at the stage of understanding the problem students can write down what is known but cannot write what is asked, so students also do not fulfill the stage of developing a completion plan on metacognitive skills. At the stage of planning a strategy, students do not write a plan for solving problems, which causes students to experience errors at the problem solving stage. Based on this the students are not able to monitor the completion of the metacognition ability. At the stage of evaluating the completion action students are not able to check the answers by entering the results into the initial equation that causes unconsciousness in the calculation. The following are the results of interview Subject S-33 for difficulties and metacognitive skills:

The results of interviews in developing a completion plan stage with the subjects shows that at this stage students are not able to understand the facts in mathematics, this is seen from students who are not able to represent the problem completely known and asked or mathematical models made correctly.

The results of interviews at the monitoring stage completion with subjects related to awareness of thinking (metachogical) through the questions raised at the stage of

developing the completion plan are almost in accordance with the written answers. At this stage students have difficulty in understanding the concept. It is seen from students who are unable to solve the problem of integer multiplication operations. Students also have difficulty in understanding the principle, it is seen from students mistakenly adding positive integers with negative integers. And students are not able to connect the concepts given to solve problems and be careful in calculations.

Based on the results of interviews in evaluation stage of completion with subjects related to awareness of thinking (metakognition) through the questions raised at the stage after carrying out the action to solve the problem is almost in accordance with the written answers. At this stage students have difficulty in mathematical procedures. Where it can be seen from the steps of problem solving done by students in a series and not right, and in solving these problems students have made calculations incorrectly.

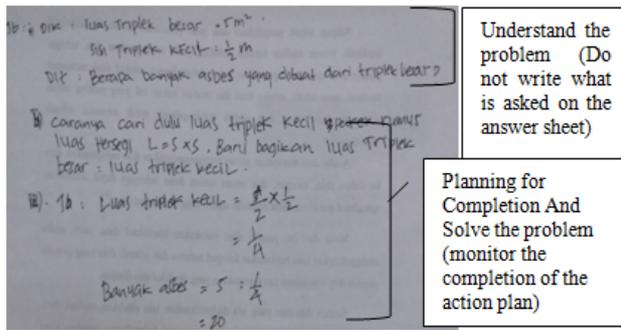
From the results of interviews with low-ability students with reflector learning styles, it appears that the subject lacks understanding of what he wrote and there are weaknesses in providing explanations supporting his thinking. Where the subject is also less aware of the capabilities they have. The subject cannot show that the solution to the problem he is doing is based on an awareness of his own thinking and has a way of convincing what he has made. So it appears that the subject has difficulty in answering the questions metacognition given to him.

Based on triangulation of data obtained from the description of student answer sheets and also the results of interviews on subjects with low-scores category problem solving in the reflector learning style group, the characteristics of mindfulness of thinking are as follows: 1) The subject is less aware of the abilities he has; 2) Subjects in general have weaknesses in giving opinions that support their thinking; 3) The subject does not understand the information contained in the problem; 4) Subjects are less aware of their weaknesses when solving problems; and 5) Subjects have difficulty understanding facts, concepts, principles, and procedures.

Based on these characteristics, the subjects with low problem solving scores in the pragmatic learning style group, are at the level of tacit use metacognitive skills. This is because the characteristics that arise through students' thinking meet indicators at the level of metacognitive skills of tacit use. In this case the student does not realize that he must use a method or problem solving step by giving reasons for the step he chose.

### 3.6.4. Analysis of Student Metacognition Difficulties in Mathematical Problem Solving Students with Activist Learning Styles

Students with activist learning styles are students with S-29 codes. It is expected that the subject can represent in providing good and correct information about the difficulties of metacognitive skills. Figure 16. The following is the result of a written test solving students' mathematical problems coded S-29 will be analyzed to find metacognitive difficulties in solving students' mathematical problems.



**Figure 16.** Answers to Problem Solving Students with Activist Learning Styles

Based on the student's answer sheet, it can be seen that, at the stage of understanding the problem students can write correctly what is known and what is asked. So students also meet the stage of developing a completion plan on metacognitive skills. At the stage of planning a strategy, students write plans to solve problems so that at the stage of solving problems students do not experience mistakes. Based on this the students can be said to be able to monitor the completion of the metacognition ability. At the stage of evaluating the completion action students are not able to check the answers by entering the results into the initial equation.

The results of interviews with subjects 29 related to awareness of thinking (metacognitive) through the questions raised are almost in accordance with the written answers. Students with high solving abilities have a good awareness in the metacognition stages to develop a completion plan. At developing a completion Plan stage students must recognize and understand facts in mathematics. Based on the above interview, it can be seen that students do not experience the difficulty of facts, where students can interpret and use appropriate symbols in representing mathematical problems. This can be seen from students being able to represent problems into known and asked questions or the mathematical models made by students are appropriate.

At the Monitoring Stage Completion Stage stage of regulating or monitoring the resolution of problems. Based on the interview passage, it can be said that at this stage students have no difficulty in understanding concepts. Where students are able to understand the concept it can be seen from students' answers when asked to provide examples of integers and fractions. In other aspects students are also able to apply concepts in problem solving, where when the subject answers correctly examples of integers and fractions with the right reasons and is able to solve the problem "a = 3, b = 5, and c = 2, determine the results from b - c (a + b) = "correctly and collapsing. The subject also appeared to have no difficulty in understanding mathematical principles, where it was seen from students being able to use mathematical formulas and rules in solving problems, being able to connect the concepts given to solve problems and students were also careful in calculations in solving problems .

At the evaluation stage of completion stage of evaluating problem solving actions. Where at this stage students have no difficulty in mathematical procedures. Where it can be seen from the steps of problem solving

done by students in a series of ways and correctly, and in solving these problems students have done the calculations correctly. But when checking back, students are less able to check again by entering the results of the answer into the initial problem to be tested for truth.

Based on the results of interviews with highly capable students with reflector learning styles, it appears that the subject has understood what he wrote by demonstrating his ability to provide opinions supporting his thoughts. Where the subject is also aware of the capabilities he has. The subject shows that the problem solving is based on the awareness of his own thinking and has a way to convince what he made so it does not appear that the subject has difficulty in answering the questions metacognition given to him.

Based on the triangulation of data obtained from the description of student answer sheets and also the results of interviews on subjects with high problem solving scores in the activist learning style group, the characteristics of thinking awareness are as follows: 1) The subject is aware of the abilities he has; 2) The subject also generally knows what he is doing or he is doing, 3) The subject can provide opinions that support his thinking; 4) The subject is able to provide convincing explanations of what he has done or done; and 5) Subjects have no difficulty in understanding facts, concepts, principles, and procedures in solving problems.

Based on these characteristics, the subject of the activist learning style group is at the level of strategic use metacognitive skills. This is because the characteristics that arise through students' thinking meet indicators at the level of strategic use metacognitive skills. And show students are aware in selecting strategies or skills to solve the given problem.

## 4. Discussion

This study focuses the analysis on students 'metacognitive skills in solving students' mathematical problems in terms of student learning styles. The mathematical problem is an intellectual one, because to be able to solve it requires involving one's intellectual abilities. Mathematical problems given to students in school, intended to train students to develop their intellectual abilities in understanding, planning to do and obtain solutions to any problems they face. In solving mathematical problems, students' metacognitive abilities also play a role so students can think of mathematical ideas in solving problems. As [20] state that the ability of metacognition also plays a role in problem solving, so students can think of mathematical ideas in solving mathematical problems. Metacognition is also a process in which a person thinks about thinking to develop strategies to solve problems. According [21] states that metacognition is thinking about thinking. Metacognition is the ability where the object of thinking is the thought process that occurs in oneself. In this case, the ability of metacognition involves one's knowledge and awareness of one's own cognitive activity or anything related to cognitive activity.

Based on the results of the study, it was obtained that 34 students of Tabligh VII class, there were 3 students

who had Activist learning styles, 13 people had reflector learning styles, 10 people had theorist learning styles, and 8 people had reflector learning styles. This means that the existence of reflector learning styles is the most compared to other learning styles, then the second position is theorist learning style, the third position is the pragmatic learning style, and the last is the active learning style. This is supported by [22] research results "The results of the analysis of the honey mumfrod learning style percentage, it is said that the dominant learning style is the Reflector Learning Style 44.4%, then followed by Pragmatic 37.8%, Theory 13.3% and finally the learning style Activist 4.4%". In other words that the reflector learning style is more dominant, while the second position is the pragmatic learning style.

This is also supported by the results of [23] research that based on the learning style questionnaire given to students of class XI MIA 1 of SMAN 8 Surabaya, 16 students were chosen with dominant learning styles including 1 student activist learning style, 10 students learning style reflector, 3 students pragmatic learning style, and 2 children theorizing learning style ". These results indicate that the dominant learning style is Reflector, followed by Pragmatics, Theorists and activists.

As explained by Aljebri (2015) that "the tendency of students with reflector learning styles implies that they prefer to observe and think about events that occur. They avoid direct involvement and prefer to see what happens from the other side. Spend time learning to see the experience from various perspectives, collect data and draw the most appropriate conclusions. [24] states that "people with reflector learning styles have a great opportunity to obtain and understand enormous information and combine it in the right way".

#### **4.1. Students' Metacognition Ability Level in Mathematical Problem Solving in Terms of Learning Style**

##### **4.1.1. The Level of Students' Metacognitive Skills in Solving Students' Mathematical Problems with Activist Learning Styles**

Students with high levels of problem solving in the activist learning style category are at the Strategic Use metacognition level of 33,33%, meaning that students have good awareness in several stages of metacognitive skills, ie students are able to write things that are known and things that are asked correctly and right. Students are also able to represent problems into mathematical models, students are also able to choose and implement appropriate and correct strategies to solve problems, and do calculations correctly and be able to deduce solutions according to the initial problem. Students with problem solving levels are at the level of metacognitive skills Strategic Use and aware use, meaning that 1 student has a good awareness in several stages of metacognitive skills, ie students are able to write things that are known and things that are asked correctly and correctly. Students are also able to represent problems into mathematical models, students are also able to choose and implement appropriate and correct strategies to solve problems, and do calculations correctly and be able to deduce solutions

according to the initial problem. A student with a level of metacognition skills aware use shows that students lack the awareness of thinking in mathematical problem solving activities.

Students with dominant activist learning styles are at the level of strategic use metacognitive skills, which means having a type of thinking related to the individual's arrangement in the process of thinking consciously by using specific strategies that can improve the accuracy of his thinking. Where in this study students are aware and able to select specific strategies or skills to solve problems. Students with activist learning styles are known to mingle with new experiences and find happiness through being guided by experiences. They prefer to process problems through brainstorming. They also tend to engage in challenges using new experiences, and they face boredom when it comes to procedures. Their motto is, "I will try to try". Students with this learning style tend to Problem Solving activities (Aljebri, 2015).

##### **4.1.2. The Level of Students' Metacognitive Skills in Solving Students' Mathematical Problems with Reflector Learning Styles**

Students with high problem solving levels in the reflector learning style category are at the Strategic Use metacognition level of 15,38%, meaning that students have good awareness in several stages of metacognitive skills, ie students are able to write things that are known and things that are asked correctly and right. Students are also able to represent problems into mathematical models, students are also able to choose and implement appropriate and correct strategies to solve problems, and do calculations correctly and be able to deduce solutions according to the initial problem. Students with problem solving levels are at the level of Strategic Use metacognitive skills at 15,38% and 30,77%, meaning students have good awareness in several stages of metacognitive skills, namely students are able to write things that are known and things that are asked correctly and correctly. Students are also able to represent problems into mathematical models, students are also able to choose and implement appropriate and correct strategies to solve problems, and do calculations correctly and be able to deduce solutions according to the initial problem. Students with reflector learning styles with low problem solving levels at Aware Use metacognition ability level of 23,07 % and tacit use sebesar 15,38%. it means as many as 6 students lack of awareness in mathematical problem solving. While 1 student has no awareness in solving mathematical problems.

Students with dominant reflector learning styles are at the level of Strategic Use metacognitive skills, which means students with reflector learning styles have a type of thinking that is related to individual regulation in their thought processes consciously by using specific strategies that can improve the accuracy of their thinking. Where in this study students with reflector learning styles are aware and are able to select specific strategies or skills to solve problems. This is reinforced by Aljebri (2015) that people with reflector learning styles, prefer to stand behind experience, gather information, and pay great attention to detailed information before issuing generalizations and conclusions. They tend not to jump to conclusions or

make decisions until they have the necessary evidence and evidence. They tend to observe other people and keep in the background to see, observe, and consider other people's input.

#### 4.1.3. The Level of Students' Metacognitive Skills in Solving Students' Mathematical Problems with Pragmatic Learning Styles

Students with a high level of problem solving in the pragmatic learning style category are at the level of metacognitive ability reflective use at 12.5% and strategic use at 37.5%, meaning that students have good awareness in several stages of metacognitive skills, ie students are able to write things that are known and asked correctly. Students with problem solving levels are at the aware use metacognition ability level of 25%, meaning that students lack awareness in mathematical problem solving. Students with low problem solving levels at the tacit use metacognition ability level of 25%, it means students do not use awareness thinking in mathematical problem solving.

Students with dominant pragmatic learning styles at the level of strategic use metacognitive skills. In other words students with this learning style, students realize that he must use a problem solving step by giving an explanation why he chose to use these steps. This was reinforced by Aljebri (2015) who stated that "Pragmatics are individuals who are marked by their efforts to produce ideas, theories, and applications to test them in reality in a positive and practical way. They take advantage of all opportunities to try things in practical and applicable situations, and tend to be impatient in lengthy discussions. Their philosophical motto is "There is always a better way" and "If it works, it's good", and students with this learning style are very suitable for mathematical problem solving.

#### 4.1.4. The Level of Students' Metacognitive Skills in Solving Students' Mathematical Problems with the Theorist learning Style

Students with the level of problem solving are at the level of metacognitive skills of strategic use and aware use, each at 20% and 20%, meaning that students have enough awareness in several stages of metacognitive skills, ie students are able to write information from questions in the form of things that are known and asked appropriately and correctly, students are also able to represent problems into their mathematical models, students are also able to choose and implement appropriate strategies to solve problems, but the drawbacks are that students have not done calculations correctly and correctly. Students with theorist learning style with a low level of problem solving at the level of Tacit Use metacognition ability of 40 %, it means students do not use awareness when solving mathematical problems. Students who are at the level of metacognitive skills aware use and tacit use is in the highest position that is equal to 40%, then followed by students who are at the level of metacognitive skills tacit use and aware use.

In other words, students with this theorist learning style are predominantly aware of the level of metacognition aware use, which means that students with theorist learning styles do not realize that they have to use the problem solving step by not giving an explanation in

solving the problem. This is reinforced by Arum (2016) which states that individual theorists in their learning activities like to understand theory before taking action, and tend to read books and make decisions based on theory.

## 4.2. Types of Difficulties Experienced by Students in Solving Mathematical Problems in Terms of Learning Styles

Based on the findings regarding the metacognitive difficulties of VII grade students of MTs Negeri 1 Labuhanbatu Selatan, it was found that the types of difficulties experienced by students in solving mathematical problems were 9 factual difficulties amounting to 26.47%, 11 people (32, 35%) had difficulty Concepts, students who experienced principle difficulties were 13 people (38.23%), and students who experienced procedural difficulties were 21 people (61.76%).

## 5. Conclusion

Based on the results of the analysis and discussion in chapter IV in terms of learning styles, several conclusions are obtained which are answers to the questions raised in the problem statement. These conclusions are:

1. The level of metacognition ability of 34 students in mathematical problem solving in terms of learning styles is as follows:

- a. Students with reflector learning styles at the level of strategic use metacognitive skills have high and medium problem solving abilities. At the level of metacognition ability, aware use has moderate solving abilities. At the level of metacognitive skills, tacit use has low problem solving abilities.
- b. Students with reflector learning styles at the level of strategic use metacognitive skills have high and medium problem solving abilities. At the level of metacognition ability aware use students have moderate solving abilities.
- c. Students with pragmatic learning styles at the level of reflective metacognitive skills and strategic use have high problem solving abilities. At the level of metacognition ability, aware use has moderate problem solving abilities. At the level of metacognitive skills tacit use students have low problem solving abilities.
- d. Students with theorist learning styles at the level of metacognition skills aware use have moderate problem solving abilities. At the level of metacognitive skills, tacit use has low problem solving abilities.
- e. There are no students with Activist learning styles.

2. Metacognition difficulties experienced by students with pragmatic learning styles, reflectors, and theorists in mathematical problem solving are:

- a. Difficulty of facts, namely representing mathematical symbols to design mathematical models of the given problem.
- b. Concept difficulties, namely difficulties in applying the method of substitution, elimination, mixed methods, and determinant methods to solve problems.

- c. The difficulty of principle, namely the difficulty in applying mathematical formulas and rules as well as the difficulty in connecting the concepts given to solve problems.
- d. Difficulty of procedures, namely difficulty in presenting steps to solve problems in an orderly and correct manner, inaccuracy in presenting problem solving, as well as difficulties in devising problem solving strategies effectively and efficiently.

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