Characteristics of Student Metacognition in Mathematical Problem Solving Viewed from Personality Types

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ABSTRAK

The ability to solve a problem is one of the main aspects of learning mathematics in schools, starting from elementary school to high school. Many factors need to be considered in solving mathematical problems, one of which is metacognition and personality type. The purpose of this research is to describe the metacognitive characteristics of students in solving mathematical problems in terms of personality type. Data collection methods that researchers use are questionnaire methods, test methods, and interview methods. The results show that, students with high levels of metacognitive ability are able to identify what is known and what is asked, are able to think of action plans, are able to build alternative solutions, and feel they do not need to check again when they are finished working, students with moderate metacognitive abilities able to identify what is known and what is asked, able to think of action plans, able to build alternative solutions, and feel the need to re-check the answers that have been made, students with low-level metacognitive abilities are not able to identify what is known and what is being asked, not able to think of an action plan, unable to develop alternative solutions, and feel no need to check again when finished working.

Keywords: Metacognition, Mathematical Problem Solving, Personality Type

1. INTRODUCTION

In Indonesia, mathematics is taught to students at every level of education, from elementary to higher education. The higher the level of education, the more complex the knowledge of mathematics that is learned in order to support its ability to deal with various kinds of problems (Alfiyah & Siswono, 2014). Mathematics education has a very important role because mathematics is a basic science that is widely used in various fields of life. In order to use mathematics well in everyday life, we need to master one aspect of the world of mathematics, namely the ability to solve problems.

The ability to solve a problem is one of the main aspects of learning mathematics in schools, starting from elementary school to high school. In solving problems, students will be faced with problems that they have never found or have found before. This is very necessary for students to train them in using the knowledge and skills they have so that their thinking skills increase. Through solving mathematical problems, students are directed to develop their

abilities, including building new mathematical knowledge, solving problems in various contexts related to mathematics, applying various necessary strategies, and reflecting on the process of solving mathematical problems (Anggo, 2011).

Problem solving itself is a mental activity or individual effort that is directed directly to overcome or find the correct solution to a problem. To do this, a person needs to manage his mind well by utilizing the knowledge he already has, controlling and reflecting on the processes and results of his own thinking, what he thinks can help him solve a problem. This awareness of the thought process is referred to as metacognition (Purnaningsih & Siswono, 2014). Meanwhile, according to Rachmady, Anggo, & Busnawir (2019), metacognition is that students think about how to make an approach to a problem, choose the strategy used to find a solution to the problem and ask themselves about the problem.

When in the classroom the educator asks students to solve a math problem, then there must be students who have been able to solve the problem correctly and there are also those who have made mistakes in solving the problem. It is intended that students know how to solve the problem properly. They will be self-conscious about the thought process of solving the problem correctly and they will also evaluate themselves against the results of their thought process, so that this will minimize students' mistakes in solving problems. The process of thinking in problem solving is an important thing that needs attention. Because this will really help students in developing their abilities.

However, in the current learning system, educators evaluating the achievement of learning outcomes only emphasize cognitive goals without showing cognitive processes, especially metacognitive knowledge and metacognitive skills (Rosiani, Anggo, & Saudia, 2019). As a result, efforts to introduce metacognition in solving mathematical problems to students are lacking or even tend to be ignored. Metacognition plays an important role in regulating and controlling one's mindset in solving problems. So it can be said that metacognition is the foundation of a person in solving problems. In addition to solving problems students also need characteristics.

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The characteristics of students also have an important role in problem solving. The characteristics of students relate to the personality of students. Each student is different in dealing with problems according to their respective personality types. One way to differentiate is to look at the personality type of each student. Subanti (2016) explains that each student has their own difficulties in doing metacognition when solving math problems based on their personality type. According to John L. Holland there are 6 personality types, namely realistic, intellectual, social, conventional, business, and artistic. In this case John L. Holland places more emphasis on the interests of students, so this research will be aimed at SMK (Vocational High School) students.

Based on this description, the researcher was encouraged to conduct research with the title "Characteristics of Student Metacognition in Mathematical Problem Solving in View of Personality Types".

2. RESEARCH METHODS

The type of research used is descriptive research with a qualitative approach. The purpose of this research is to describe the characteristics of students' metacognition in solving

problems in terms of the students' personality types. The subjects in this study were 29 students at SMK Ahmad Yani Probolinggo Class XII, the TITL (Electric Power Installation Engineering) Department.

There are several data collection methods used in this study, namely 1) Questionnaire Method, there are 2 questionnaires that will be given, namely the personality type questionnaire to determine the personality of each student and the metacognition questionnaire to determine the metacognitive characteristics of students. 2) Test Method, the results of this test are used to determine the characteristics of students' metacognitive abilities in solving mathematical problems. 3) Interview method, aims to find out the thinking process of students in working on test questions.

In addition there are several instruments used by researchers, namely 1) Mathematical Problem Solving Test Sheet, this test item consists of 4 description questions and is given a special answer sheet that refers to indicators of solving mathematical problems. 2) Personality Type Questionnaire Sheet, this questionnaire uses a modified questionnaire from several Holland interest inventory tests developed from interest model theory and consists of 216 statements. 3) Metacognition Questionnaire Sheet, adopted by Schraw and Dennison (1994), namely the Metacognitive Awareness Inventory (MAI), which has been modified in terms of language and suitability of statements with learning mathematics and consists of 52 statements. 4) Interview Guide, contains as many as 38 questions related to solving mathematical problems and metacognition processes.

Furthermore, there are several stages of data analysis used in this study, namely 1) Data Analysis of Mathematical Problem Solving Tests, the data collected from this test is the score. The way to determine the total score is by adding up all the scores on all indicators, the maximum total score is 40. To get the value a calculation will be carried out by adding up all the scores then dividing by the maximum score after that multiplied by 100. 2) Data Analysis Personality Type Questionnaire, collected data is the score of each statement then recapitulated according to the personality type indicator. After that, the highest number of indicators will be seen.

3) Metacognition Questionnaire Data Analysis, the data collected is the score of each statement then recapitulated according to metacognition indicators. After that, the total score will be seen and the level of metacognition ability can be seen.

Table 1. Metacognition Ability Level Interval

High	> 75
Medium	$61 - 75$
Low	≤ 60

Source: Schraw dan Dennison (1994: 470)

3. RESULTS AND DISCUSSION

Researchers will describe the results of the study as follows:

1) Description of the Research Preparation Stage

The research preparation phase was carried out to prepare for all needs related to this research, this preparatory stage consisted of: a) Initial Research Phase, researchers carried out permits and coordinated with the school. b) The Research Instrument Preparation Stage,

consisting of 4 instruments, namely math problem solving tests, personality type questionnaires, metacognitive questionnaires, and interview guidelines.

2) Description of the Research Implementation Stage

The research was carried out in 3 meetings, namely March 31, 2021, April 1, 2021, and April 3, 2021. On March 31, 2021, the researchers made introductions via the whatsapp group and gave math problem solving test questions. On April 1, 2021 the researcher gave a personality type questionnaire via Google form. And on April 3, the researcher gave a metacognition questionnaire via google form.

3) Data Analysis Stages

In this stage the researcher conducted data analysis, namely (a) Data Analysis of Mathematical Problem Solving Tests, this test was followed by all class XII TITL 1 of 29 students. The final score of the recapitulation results of the math problem solving test will be presented in the following table:

Table 2. Recapitulation of Math Problem Solving Test Scores

No.	Name	Question Number				Total	Value
		1	2	3	4		
1.	ATP	6	7	2	11	26	65
2.	AH	6	7	2	11	26	65
3.	AFR	6	7	2	11	26	65
4.	AEP	6	7	2	11	26	65
5.	AJ	6	7	2	11	26	65
6.	AT	6	7	2	11	26	65
7.	ABNC	6	6	3	11	26	65
8.	AF	6	7	2	11	26	65
9.	ALF	6	6	2	11	25	62,5
10.	AFK	6	6	11	2	25	62,5
11.	ALH	6	6	2	11	25	62,5
12.	BD	5	7	2	11	25	62,5
13.	BAH	6	7	2	11	26	65
14.	DAS	6	7	2	11	26	65
15.	DW	6	7	2	11	26	65
16.	DGS	5	7	2	2	16	40
17.	DTP	1	1	13	12	27	67,5
18.	DS	5	3	12	12	32	80
19.	EP	6	7	2	11	26	65
20.	FTP	6	7	3	11	27	67,5
21.	FA	5	3	9	12	29	72,5
22.	HA	6	7	2	11	26	65
23.	HS	6	7	2	11	26	65
24.	HOL	6	7	2	11	26	65
25.	HNEP	6	7	1	11	25	62,5
26.	IM	5	7	2	11	25	62,5
27.	IRP	6	7	2	11	26	65
28.	LF	6	6	3	11	26	65
29.	LA	5	4	10	3	22	55
Total							1862,5
Average							64,2

(b) Analysis of Personality Type Questionnaire Data, this questionnaire was filled in by all class XII TITL 1 of 29 students. There are students with realistic personality types as many as 7 students, students with intellectual personality types as many as 1 student, students with social personality types as many as 8 students, students with entrepreneurial personality types as many as 7 students, students with personality types 1 student conventional, 1 student with realistic and artistic personality types, 1 student with intellectual and conventional personality types, 1 student with social and entrepreneurial personality types, 1 student with personality

type realistic, social, and entrepreneurial as much as 1 student, and students with realistic, artistic, and social personality types as much as 1 student. Based on these results, 8 students will be taken with the dominant personality type, namely the social personality type. The final results of the personality type questionnaire recapitulation will be presented in the following table:

Table 3. Summary of Personality Type Questionnaire Results

No.	Name	Score						Category
		R	I	A	S	E	C	
1.	AFK	12	0	6	15	4	4	S
2.	EP	21	1	3	19	17	13	R
3.	AJ	17	6	16	19	20	5	E
4.	ABNC	14	8	9	19	21	18	E
5.	IRP	17	13	19	28	21	25	S
6.	FA	34	36	35	34	33	36	I, C
7.	IM	10	5	7	15	10	7	S
8.	BAH	21	3	16	18	23	18	E
9.	DTP	15	20	12	23	17	21	S
10.	LA	24	34	29	27	27	19	I
11.	HOL	15	3	11	15	15	12	R, S, E
12.	AT	18	4	1	14	16	13	R
13.	DGS	18	2	3	15	11	3	R
14.	LF	8	3	8	8	6	7	R, A, S
15.	AFR	21	12	5	6	4	13	R
16.	HS	11	10	8	18	23	20	E
17.	BD	25	10	25	29	32	18	E
18.	DAS	29	26	23	26	26	21	R
19.	FTP	5	1	5	8	1	2	S
20.	ALH	23	21	24	30	30	33	C
21.	AEP	8	1	7	10	5	1	S
22.	HNEP	2	0	6	10	3	1	S
23.	ATP	32	15	32	29	27	23	R, A
24.	ALF	6	10	21	25	21	4	S
25.	HA	20	8	22	25	25	24	S, E
26.	AF	20	1	4	15	13	6	R
27.	DW	16	4	6	15	13	11	R
28.	AH	14	3	9	21	24	15	E
29.	DS	13	2	7	14	20	8	E

(c) Metacognition Questionnaire Data Analysis, this questionnaire was filled in by all class XII TITL 1 with a total of 29 students. There were 8 students with high metacognition level, 8 students with moderate metacognition level, and 13 students with low metacognition level. The final results of the recapitulation of the metacognition questionnaire will be presented in the following table:

Table 4. Recapitulation of Metacognition Questionnaire Results

No.	Name	Indicator Number								Total	Metacognition Level
		1	2	3	4	5	6	7	8		
1.	EP	100	100	100	100	80	100	100	100	85	High
2.	DGS	62,5	100	100	85,7	90	100	100	66,7	77,4	High
3.	AJ	37,5	50	40	57,1	60	71,4	60	83,3	50,3	Low
4.	ABNC	50	75	60	42,9	40	71,4	20	66,7	47,9	Low
5.	DAS	87,5	100	100	100	90	100	80	100	82,2	High
6.	AFK	87,5	100	80	100	100	100	100	83,3	81,4	High
7.	DW	50	50	80	57,1	60	57,1	60	100	57,1	Low
8.	AT	75	100	100	100	100	100	100	100	84,4	High
9.	IM	37,5	50	80	71,4	60	57,1	80	16,7	47,7	Low
10.	BD	75	50	80	71,4	100	100	60	50	64,4	Medium
11.	AF	75	75	100	85,7	50	85,7	80	83,3	68,6	Medium

12.	AEP	12,5	25	20	0	10	0	60	0	15,9	Low
13.	ATP	87,5	100	100	100	100	100	100	100	85,9	High
14.	AH	25	100	80	100	90	85,7	100	100	72,6	Medium
15.	IRP	50	75	60	85,7	60	100	60	66,7	67,7	Medium
16.	LF	37,5	25	60	57,1	60	42,9	40	33,3	37,3	Low
17.	LA	62,5	75	80	57,1	80	71,4	60	66,7	61,9	Medium
18.	FA	100	100	100	100	100	100	100	100	87,5	High
19.	FTP	62,5	75	40	57,1	20	57,1	40	66,7	45,2	Low
20.	AFR	100	50	100	71,4	70	71,4	60	50	62,7	Medium
21.	ALH	75	75	80	85,7	70	71,4	60	83,3	64,3	Medium
22.	HOL	62,5	25	20	57,1	60	28,6	60	16,7	34,1	Low
23.	HS	87,5	75	100	85,7	80	85,7	20	100	68,5	Medium
24.	HNEP	0	0	0	28,6	0	0	0	16,7	2,1	Low
25.	HA	62,5	75	80	85,7	40	85,7	60	50	56,7	Low
26.	DS	62,5	50	40	57,1	70	42,9	20	50	41,9	Low
27.	BAH	50	75	60	85,7	80	71,4	80	66,7	60,4	Medium
28.	DTP	37,5	75	40	71,4	80	28,6	60	50	46,4	Low
29.	ALF	75	100	100	85,7	80	85,7	100	83,3	78	High

(d) Analysis of Mathematical Problem Solving Tests with Social Personality Type Subjects based on Level of Metacognition Ability. At this stage, the researcher only analyzed subjects who had social personality types because they were the dominant personality type in class XII TITL 1 at SMK Ahmad Yani Probolinggo. Analysis was carried out on the results of problem solving tests based on high, medium, and low metacognition levels. Subjects who have social personality types in class XII SMK Department of TITL 1 are 8 subjects. The following is a table of the level of metacognition ability possessed by class XII subjects at the TITL 1 Vocational School with social personality types:

Table 5. Level of Metacognitive Ability with Social Personality Types

No.	Name	Total	Metacognition Level
1	AFK	81,4	High
2	ALF	78	High
3	IRP	67,7	Medium
4	IM	47,7	Low
5	DTP	46,4	Low
6	FTP	45,2	Low
7	AEP	15,9	Low
8	HNEP	2,1	Low

Based on the sampling technique, namely purposive sampling, 3 students with high, medium, low metacognition levels will be taken from social personality types, namely ALF, IRP and DTP.

4) Discussion

The following is a researcher's discussion of the characteristics of subjects with social personality types in class XII SMK TITL 1 Department in solving a problem based on their level of metacognitive ability. (a) Description of the Characteristics of High-Level Metacognition, students with high-level metacognitive abilities are able to identify what is known and what is asked, are able to think of action plans, are able to build alternative solutions, and feel they do not need to check again when they have finished working. (b) Description of Medium Level Metacognition Characteristics, students with moderate metacognition ability are able to identify what is known and what is being asked, able to think

of action plans, able to build alternative solutions, and feel the need to re-check the answers that have been made. (c) Description of the Characteristics of Low-Level Metacognition, students with low-level metacognitive abilities are unable to identify what is known and what is being asked, are unable to think of action plans, are unable to build alternative solutions, and feel they do not need to check again when they have finished working.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of distributing metacognition questionnaires in class XII TITL 1 SMK Ahmad Yani Probolinggo showed that there were 8 students with high metacognition levels, 8 students with medium metacognition levels, and 13 students with low metacognition levels.

The results of distributing personality type questionnaires in class XII TITL 1 SMK Ahmad Yani Probolinggo showed that there were 7 students with realistic personality types, 1 student with intellectual personality types, 8 students with social personality types, 7 students with enterprising personality types, 1 student with conventional personality types, 1 student with realistic and artistic personality types, 1 student with intellectual and conventional personality types, 1 student with social and entrepreneurial personality types of 1 student, students with realistic, social, and entrepreneurial personality types of 1 student, and students with realistic, artistic, and social personality types of 1 student. Of the six personality types, there is a dominant personality type, namely social personality.

From this social personality, an analysis of mathematical problem solving tests was carried out based on high, medium, and low levels of metacognition abilities. The results of the analysis show that, students with high levels of metacognitive ability are able to identify what is known and what is asked, are able to think of action plans, are able to build alternative solutions, and feel they do not need to check again when they are finished working, students with moderate metacognitive abilities able to identify what is known and what is asked, able to think of action plans, able to build alternative solutions, and feel the need to re-check the answers that have been made, students with low-level metacognitive abilities are not able to identify what is known and what is being asked, not able to think of an action plan, unable to develop alternative solutions, and feel no need to check again when finished working.

5. REFRENCES

Alfiyah, N. & Siswono, T. Y. E. 2014. *Identifikasi Kesulitan Metakognisi Siswa dalam Memecahkan Masalah Matematika*. Jurnal Ilmiah Pendidikan Matematika Vol 3 No 2 Hal 131-138.

Anggo, Mustamin. 2011. *Perlibatan Metakognisi dalam Pemecahan Masalah Matematika*. Edumatica Vol 1 No 1 Hal 25-32.

Purnaningsih, N. E. & Siswono, T. Y. E. 2014. *Profil Metakognisi Siswa dalam memecahkan Masalah Matematika Ditinjau Berdasarkan Tipe Kepribadian Koleris dan Phlegmatis*. Jurnal Ilmiah Pendidikan Matematika Vol 3 No 3 Hal 152-159.

Rachmady, R., Anggo, M., & Busnawir. (2019). Analisis Metakognisi dalam Pemecahan Masalah Matematika Siswa SMP. *Jurnal Pembelajaran Berpikir Matematika*, 37.

Rosiani, Anggo, M., & Saudia, M. (2019). Pengaruh Pembelajaran Berbasis Masalah Kontekstual dengan Pendekatan Metakognisi terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas VIII SMP. *Jurnal Pembelajaran Berpikir Matematika*, 72.

Schraw, G., & Dennison, R. S. (1994). *Assessing meta-cognitive awareness. Contemporary educational psychology*, 19(4), 460-475.