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**Student's Metacognition Process in Solving Mathematical Problems
Reviewed From Holis-Serialist Cognitive Style Class XI Natural Sciences
MAN 5 Kediri**

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ABSTRACT :

Problem solving is a process to overcome the difficulties faced to achieve the expected goals. In the problem solving process, there is one requirement for mastery of problem solving, namely metacognitive ability. To improve metacognitive ability, it is necessary for students to have awareness at every step of their thinking. The purpose of this study is to describe the metacognitive process of students with a *holistic serialist cognitive style*. in solving mathematical problems . This research uses a qualitative approach with a case study research type. The results obtained are the first *holistic* metacognition process, *planning* , at this stage there are several processes that are missed by students but students can make analogies to make it easier to solve problems. Next *monitoring*, students are able to determine a strategy or plan to solve the problem that has been given. Finally, *evaluation*, at this stage students with a *holistic cognitive style* have re-examined their work . The first *serialist* metacognition process, *planning*, occurs well, students are able to write down the existing introduction and students can also make analogies to make it easier to solve problems. Next, *monitoring* , students are able to determine a strategy or plan to solve the problem that has been given, but there are some students who still make mistakes in their work or operations. The last stage is *evaluation*, they have re-examined their work.

Key words: Metacognition, Cognitive Style, *Holist-Serialist*, Problem Solving

INTRODUCTION

Mathematics is a basic science that can be used as a tool to help solve problems in various fields of science.¹ *The National Council of Teachers of Mathematics* (NCTM) in mathematics learning sets five standards of mathematical abilities that must be possessed by students, namely problem solving abilities, communication abilities, connection abilities, reasoning abilities, and representation abilities . Problem solving abilities are important in mathematics learning, because problem solving abilities are one of the important aspects in making students have mathematical

¹ Ayu Silvi Lisvian Sari et al., "Pemahaman Konsep Siswa Ditinjau Dari Kecerdasan Matematis Logis," *Numeracy* 9, no. 2 (2022): 78–92.

abilities.² Problem solving is a process to overcome the difficulties faced to achieve the expected goals.³

Student metacognition plays an important role in problem solving, especially in regulating and controlling students' cognitive activities in solving problems so that learning and thinking carried out by students in solving mathematical problems become more effective and efficient.⁴ Metacognition is divided into three components, namely *planning*, *monitoring* and *evaluation*. At the *planning stage*, it is related to understanding the problem and recalling prerequisite materials that help complete the task; *monitoring* refers to monitoring the implementation of problem-solving activities and the last *evaluation* refers to improvement strategies if there are errors and evaluating the results obtained.⁵

Metacognition greatly supports the process of learning mathematics, especially in problem solving. Students need to be aware of the thinking process within themselves and evaluate the results of the thinking process, so that it is expected to minimize student errors in solving problems. If related to each other, metacognition also has a relationship with the way students build structures regarding the thinking process within themselves which is supported by students' ability to choose the right way to solve problems.⁶

Metacognition plays an important role in regulating and controlling a person's cognitive processes in learning and thinking. In formulating and describing problems and finding solutions or arguments, of course not all students have the same solution or opinion, this can be seen from the student's cognitive style. Cognitive style is a student's unique way of learning, both in relation to how to receive and process information, attitudes towards information, and habits related to the learning environment.⁷

Experts classify individual cognitive styles in different ways, Pask divides cognitive styles into *Holist* and *Serialist*. The concept of *holist-serialist cognitive style* specifically refers to a person's

² Aryo Andri Nugroho dan Ida Dwijayanti, "Analisis Kemampuan Pemecahan Masalah Mahasiswa Calon Guru Matematika Pada Mata Kuliah Program Linier," *AKSIOMA: Jurnal Matematika dan Pendidikan Matematika* 10, no. 2 (2019): 277–84

³ Salma Rofifah Pratami, Rostina Sundayana, dan Deddy Sofyan, "Kesalahan kemampuan pemecahan masalah matematis siswa berdasarkan prosedur newman pada materi sistem persamaan linear dua variabel Pendahuluan Pendidikan merupakan upaya untuk membentuk sumber daya manusia yang dapat," *Jurnal Inovasi Pembelajaran Matematika* 02, no. 02 (2023): 165–74.

⁴ Atma Murni, "Metakognisi Dalam Pembelajaran Matematika," *Jurnal Prinsip Pendidikan Matematika* 1, no. 2 (2019): 1–14

⁵ Qurrotul Aini, "Identifikasi Kemampuan Metakognisi Siswa SD dalam Pemecahan Masalah Berdasarkan Disposisi Matematis," *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang* 3, no. 1 (2019): 97

⁶ I Made Dharma Atmaja, "Koneksi Indikator Pemahaman Konsep Matematika Dan Keterampilan Metakognisi1," *Nusantara: Jurnal Ilmu Pengetahuan Sosial* 8, no. 7 (2021): 2048–56.

⁷ Nur Eva Zakiah, "Level kemampuan metakognitif siswa dalam pembelajaran matematika berdasarkan gaya kognitif," *Jurnal Riset Pendidikan Matematika* 7, no. 2 (2020): 132–47

response tendencies in solving problem-solving tasks. According to Mampadi et al, a person with a *holist cognitive style* utilizes a large amount of information from the beginning, seeking to achieve understanding by identifying and focusing on patterns or tendencies in the majority of data. In contrast, a person with a *serialist cognitive style* operates with a step-by-step approach to solving problems, choosing to deal with only a small amount of material at a time, before connecting the steps that have been taken. Differences in cognitive styles result in differences in a person's ability to organize their cognition.⁸

Serialist cognitive style type tends to think algorithmically or systematically and focuses on the specific or detailed. While the *holistic cognitive style* emphasizes learning that is centered on students as a whole, both in intellectual, emotional, physical, artistic, creative, and spiritual aspects, this approach is more oriented towards the overall picture and analogy.⁹ The difference in cognitive style types will greatly affect the metacognitive process of students in solving a problem.

Based on the research context that has been described, the focus of this research is how the metacognition process of students with *holistic* and *serialist cognitive styles* in solving mathematical problems on the material of three-variable linear equation systems for grade eleven natural sciences at Senior High School 5 Kediri. Based on the focus of the research, the purpose of this research is to describe the metacognition process of students with *holistic* and *serialist* cognitive styles. in solving mathematical problems on the material of three-variable linear equation systems class XI IPA MAN 5 Kediri.

Methods

The approach used in this study is a qualitative approach. This study uses a case study research type. The data generated from this study are in the form of words that are presented as they are in the field, experienced, felt, and thought by participants or data sources. Through a qualitative approach, all facts, both oral and written, from various data sources obtained from participants will be described clearly so that they can answer the problems in this study.

Primary data in this study were obtained from observation results, questionnaire data, test data, and interview data. While secondary data is data obtained indirectly from the subjects studied. Secondary data in this study comes from documentation and other supporting documents. The data source referred to in the study is the subject from which the data can be obtained and has

⁸ Benny N. Trisna, "Profil metakognisi mahasiswa calon guru matematika dalam pemecahan masalah kombinatorika berdasarkan gaya kognitif holist-serialist dan gender," *Ringkasan Disertasi* 1, no. 1 (2018): 1

⁹ Muh Fajaruddin Atsnan et al., "Explorasi metakognisi mahasiswa : Perbandingan gaya kognitif holist-serialist Exploration of student metacognition : A comparison of holist-serialist cognitive style" 11, no. 1 (2023): 26–37.

clear information on how to take the data and how the data is processed. This study will take 4 students of class XI Natural Sciences 1 as subjects consisting of 2 students with a *holistic* cognitive style and 2 students with a *serialist* cognitive style.

The data collection techniques used were observation, questionnaires, tests, interviews, *think aloud* and documentation. The components in data analysis are data reduction, data presentation, and drawing conclusions. Checking the validity of the data in this study focused on the activities and completeness of student learning by using 2 strategies, namely observation persistence and triangulation.

Result

Students' metacognition process in solving mathematical problems of SPLTV material for class XI IPA MAN 5 Kediri with a *holistic* cognitive style

② Misal : jeruk = x
 Sariola = y
 Manggis = z

$1) A \rightarrow x + 3y + 2z = 58.000 \dots (1)$
 $1) B \rightarrow 2x + y + z = 45.000 \dots (2)$
 $1) C \rightarrow x + 2y + 3z = 55.000 \dots (3)$

Figure 1. Subject Answer

Based on the test above, it shows that the subject has brought up indicators of metacognition processes in the questions. This is indicated by the stages of subject problem solving when understanding the problem, choosing a problem-solving plan or strategy, solving the problem, and interpreting and verifying the results of problem solving. This can also be seen from the conformity between the results of the tests, interviews and *think alouds* that have been conducted and analyzed. Subject has implemented all indicators in the metacognition *planning*, *monitoring* and *evaluation process* well and in a structured manner.

The metacognition process that occurs with students with a *holistic* cognitive style, the first at the *planning stage*, occurs less well, because there are several processes that are missed by students, but students can make analogies to make it easier to solve problems. The next stage is *monitoring*, students with this stage occur well and are able to determine strategies or plans to solve the problems that have been given. The last stage is *evaluation*, at this stage students with a *holistic* cognitive style have re-examined their work well and this can be seen from interviews and *think aloud videos*.

This is also in accordance with the characteristics of the *holistic* cognitive style, students with a *holistic* cognitive style have a character that they are not happy if they have to start with a prefix but go straight to the text, this can be seen from the subject's answer who did not write down first

what was known and asked. They immediately use an example to work on the given problem. Students with a *holistic cognitive style* also concentrate more on rereading the problem if necessary, this can also be seen in the interview stage that they recheck their answers by reading them again to make sure that their answers are correct without any mistakes.

Students' metacognition process in solving mathematical problems of SPLTV material for class XI IPA MAN 5 Kediri with *serialist cognitive style*

2. Diketahui Bu Rani = 1 kg Jeruk, 3 kg Salak, 2 kg Manggis
 Bu Sri = 2 kg Jeruk, 1 kg Salak, 1 kg Manggis
 Bu Yanti = 1 kg Jeruk, 2 kg Salak, 3 kg Manggis
 Ditanya: Bentuk Persamaan?
 x = Jeruk
 y = Salak
 z = Manggis
 $1x + 3y + 2z = 58.000$
 $2x + 1y + 1z = 15.000$
 $1x + 2y + 3z = 55.000$

Figure 2. Subject Answer

Based on the test above, it shows that the subject has brought up indicators of metacognition processes in the questions. This is shown by the stages of problem solving of the subject when understanding the problem, choosing a problem-solving plan or strategy, solving the problem, and interpreting and verifying the results of the problem solving. This can also be seen from the conformity between the results of the test, interview and *think aloud video* that have been conducted and analyzed. Subject has implemented all indicators in the metacognition *planning, monitoring and evaluation process* well and in a structured manner.

The metacognition process that occurs with students with a *serialist cognitive style*, the first stage in the *planning stage* occurs well, students are able to write the existing introduction and students can also make analogies to make it easier to solve problems. The next stage is *monitoring*, students with this stage occur well and are able to determine strategies or plans to solve the problems that have been given but there are some students who are still not quite right in their work or operations. The last stage is *evaluation*, at this stage students with a *serialist cognitive style* have re-examined their work well and this can be seen from interviews and *think aloud videos*.

This is also in accordance with the characteristics of the *serialist cognitive style*, students with a *serialist cognitive style* have the character that they read the introduction first before going to the main text, this can be seen from the subject's answer who first wrote down what was known and asked. Students with a *serialist cognitive style* also do something sequentially from beginning to end, this can

also be seen in the interview stage that they recheck their answers by reading them again to ensure that their answers are correct without any mistakes.

Discussion

Metacognitive Process of Students with *Holist Cognitive Style* in Solving Problems of SPLTV Material for Class XI IPA MAN 5 Kediri

Metacognition is an awareness of the thinking process in terms of planning, monitoring ability, ability to organize and evaluate the process and results of students' thinking when solving mathematical problems.¹⁰ *Holistic* thinking style in problem solving connects little to previous knowledge because they often fail to remember, they solve many problems using reasoning.¹¹

Students with a *holistic cognitive style* can carry out the metacognition process well. Students are able to explain that the information they get from the problem is enough to find the answer. This is in line with previous research which said that students try to relate the information in the question and remember it with the problems they have studied.¹² Although at the *planning stage*, students start by directly using analogies in working on the problems given. At the *monitoring stage*, it concerns students' awareness regarding their understanding and quality of work while completing certain cognitive tasks.¹³ *Holist* students choose their strategy or planning according to what they know beforehand about the problem. Students know the steps to solve and the efficiency of the steps used.¹⁴ At this stage, students use substitution and elimination in their work. This is in accordance with research which states that students write down the plans they think about in the problem. After students compile their mathematical model, students will eliminate and substitute the existing equations. Thus, students compile a problem-solving plan by writing down the model and the method they think about.¹⁵ Here the students do it well and sequentially without any mistakes. This is in accordance with research that says that students solve the problems given correctly, sequentially.

¹⁰ Siti Nur Fatima, Zainul Munawwir, dan Lisma Dian Kartika Sari, "Analisis Kemampuan Metakognisi Siswa dalam Pemecahan Masalah Menggunakan Soal TIMSS ditinjau dari Perbedaan Gender," *Jurnal Pendidikan Dan Kewirausahaan* 9, no. 2 (2021): 349–66,

¹¹ Aning Wida Yanti, Kusaeri Kusaeri, dan Mia Kustianingsih, "Profile of Cybernetic Thinking of Students in Mathematical Problem Solving Based on Serialist and Holist Thinking Style," *JTAM (Jurnal Teori dan Aplikasi Matematika)* 4, no. 2 (2020): 122,

¹² Atsnan et al., "Eksplorasi metakognisi mahasiswa : Perbandingan gaya kognitif holist-serialist Exploration of student metacognition : A comparison of holist-serialist cognitive style."

¹³ Patrisius Afrisno Udil, "Proses Metakognisi Dalam Pemecahan Masalah," *Seminar Nasional Pendidikan Matematika* 3, no. 9 (2019): 81–88.

¹⁴ Atsnan et al., "Eksplorasi metakognisi mahasiswa : Perbandingan gaya kognitif holist-serialist Exploration of student metacognition : A comparison of holist-serialist cognitive style."

¹⁵ Dian Mayasari, Dwi Priyo Utomo, dan Yus Mochammad Cholily, "Analisis Metakognisi Siswa Dalam Memecahkan Masalah Matematika Ditinjau Dari Tipe Kepribadian Hipocrates," *Jurnal Kajian Pembelajaran Matematika* 3, no. 1 (2019): 10,

At the *evaluation stage*, students with a *holistic cognitive style* appear to be more concentrated by rereading the problems given, so that students feel very confident with the answers they have worked on. This is in line with research that students feel confident with the strategies used, so students make decisions about what they think.¹⁶ However, *holistic students* are less aware of rechecking the solutions to the problems they have made and in the work stage, students are already convinced that the stages of work are in accordance with their plans and knowledge.¹⁷ Students are able to understand the problem consciously and evaluate their understanding of the problem from the problem.¹⁸

Metacognitive Process of Students with *Serialist Cognitive Style* in Solving Problems of SPLTV Material for Class XI Science

Metacognition as a process where someone thinks about thinking in order to build strategies to solve problems.¹⁹ In research it is said that metacognition ability has a strategic role in solving problems in mathematics learning.²⁰ Students who have a *serialist thinking style* in understanding concepts associate more with previously acquired knowledge and the problem-solving material provided, students forget certain concepts because students use memorization methods in learning.²¹

Students with a *serialist cognitive style* can carry out the metacognition process well. At the *planning stage*, students can write down what is known and asked based on the problem given. In accordance with research which states that students have written down everything they know, reviewed that what is asked in the question is in accordance with what is meant and reviewed the sentences used in restating the question do not conflict with the intent of the question.²² In addition, students make examples of what is known to make it easier for them to solve the problem. This is in line with previous research which states that at the stage of understanding the problem, the subject consciously monitors what is known and what is asked in the problem.

¹⁶ Lisa Dwi Afri dan Retno Windasari, "Analisis Metakognisi Siswa Kelas X Sma Dalam Pemecahan Masalah Sistem Persamaan Linear Tiga Variabel," *AXIOM: Jurnal Pendidikan dan Matematika* 10, no. 1 (2021): 110

¹⁷ Atsnan et al., "Explorasi metakognisi mahasiswa : Perbandingan gaya kognitif holist-serialist Exploration of student metacognition : A comparison of holist-serialist cognitive style."

¹⁸ Afri dan Windasari, "Analisis Metakognisi Siswa Kelas X Sma Dalam Pemecahan Masalah Sistem Persamaan Linear Tiga Variabel."

¹⁹ Rida Weni, Elda Herlina, dan Nola Nari, "Analisis Kemampuan Metakognisi Siswa Dalam Memecahkan Masalah Matematis Di Smpn 3 X Koto Singgalang Kabupaten Tanah Datar Ditinjau Dari Gender," *AGENDA: Jurnal Analisis Gender dan Agama* 2, no. 1 (2020): 43

²⁰ Prahesti Tirta Safitri et al., "Analisis Kemampuan Metakognisi Siswa dalam Memecahkan Masalah Matematika Model PISA," *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang* 4, no. 1 (2020): 11,

²¹ Yanti, Kusaeri, dan Kustianingsih, "Profile of Cybernetic Thinking of Students in Mathematical Problem Solving Based on Serialist and Holist Thinking Style."

²² Mu'jizat Fadiana dan Andriani Andriani, "Metakognisi Siswa Operasional Konkret Dalam Pemecahan Masalah Matematika," *ANARGYA: Jurnal Ilmiah Pendidikan Matematika* 4, no. 1 (2021),

Students express the information obtained in the problem, students mention the relationship between what is known and what is asked to determine each value.²³ The *serialist* cognitive style tends to be better able to identify the stages that will be carried out after understanding the problem. Then link the information that has been obtained to the problems that have been studied with the problems faced effectively.²⁴

In the *monitoring stage*, *serialist* students choose a strategy or plan well, but during the calculation process these students make mistakes so that the final answer is still not quite right. The *serialist* thinking style in understanding concepts is more associating previously acquired knowledge, and the problem-solving material provided, students forget certain concepts because students use memorization methods in learning.²⁵

At the *evaluation stage* related to rechecking and adjusting between the results of students' work and the processes they carry out.²⁶ *Serialist* students are able to re-check their work well. This can be seen from students making a planning strategy for completion and implementing the planning in evaluating their answers is good and correct. This is in line with research that says that students feel confident with the strategy used. So, students make decisions about what they think.²⁷ Metacognitive *evaluation* occurs when students judge their answers to be correct after checking them repeatedly.²⁸ This can be seen from *serialist cognitive style students* who check their answers repeatedly.

Conclusion

Based on the results of the research and discussion that have been described, the following conclusions are obtained, namely that students with a *holistic cognitive style* are able to carry out metacognition processes and fulfill metacognition indicators, namely *planning*, *monitoring* and *evaluation*. At the *planning stage*, students are still unable to understand the problem. Students with a *serialist cognitive style* are able to carry out metacognition processes. Students with a *serialist cognitive style* are able to fulfill metacognition indicators, namely *planning*, *monitoring* and *evaluation*, although at the *monitoring stage* the solution produced is wrong.

²³ Afri dan Windasari, "Analisis Metakognisi Siswa Kelas X Sma Dalam Pemecahan Masalah Sistem Persamaan Linear Tiga Variabel."

²⁴ Atsnan et al., "Explorasi metakognisi mahasiswa : Perbandingan gaya kognitif holist-serialist Exploration of student metacognition : A comparison of holist-serialist cognitive style."

²⁵ Yanti, Kusaeri, dan Kustianingsih, "Profile of Cybernetic Thinking of Students in Mathematical Problem Solving Based on Serialist and Holist Thinking Style."

²⁶ Udil, "Proses Metakognisi Dalam Pemecahan Masalah."

²⁷ Afri dan Windasari, "Analisis Metakognisi Siswa Kelas X Sma Dalam Pemecahan Masalah Sistem Persamaan Linear Tiga Variabel."

²⁸ Zainuddin Untu Riani, Asyri, "Metakognisi Siswa dalam Memecahkan Masalah Matematika," PRIMATIKA 11, no. 1 (2022): 51–60.

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