P-ISSN 2527-5615
E-ISSN 2527-5607

Kalamatika: Jurnal Pendidikan Matematika
Volume 7, No. 2, November 2022, pages 163-176

MATHEMATICAL PROBLEM SOLVING BASED ON THE CHARACTERISTICS OF THE STUDENT'S THINKING STYLE

Ade Vidyaningrum[1], Sigit Raharjo[2], Barra Purnama Pradja[3]

[1]Universitas Muhammadiyah Tangerang, jl. Perintis Kemerdekaan, Babakan, Cikokol, Kota Tangerang, Banten 15118
avidyaningrum@gmail.com
[2]Universitas Muhammadiyah Tangerang, jl. Perintis Kemerdekaan, Babakan, Cikokol, Kota Tangerang, Banten 15118
sigitraharjo42@gmail.com
[3]Universitas Muhammadiyah Tangerang, jl. Perintis Kemerdekaan, Babakan, Cikokol, Kota Tangerang, Banten 15118
barrapradja@gmail.com

ABSTRACT

This study aims to analyze the ability to solve mathematical problems based on the characteristics of students' thinking style: Concrete Sequential (CS), Abstract Sequential (AS), Concrete Random (CR), and Abstract Random (AR). This research was carried out at one of the junior high schools in Tangerang, Indonesia. The subjects were 20 Year 7 students, with different thinking style. This research employed a qualitative approach. The instruments used are problem-solving tests and non-problem-solving tests on the characteristics of students' thinking style and a test of mathematical problem-solving ability accompanied by interview results. The data were analyzed descriptively to describe the test results of students' mathematical problem-solving abilities. The results showed that CS-type students could understand the problem in accordance with the indicators. Type AS students can understand but do not write the steps in detail. AR students are as well-understood but less thorough about their calculations. Meanwhile, CR students can understand only a few parts of problem-solving.

ARTICLE INFORMATION

Keywords

Problem Solving
Mathematics
The Way of Thinking

Article History

Submitted *Aug 3, 2022*
Revised *Nov 24, 2022*
Accepted *Nov 28, 2022*

Corresponding Author

Barra Purnama Pradja
Universitas Muhammadiyah Tangerang
Jl. Perintis Kemerdekaan I No.33, RT.007/RW.003, Babakan, Cikokol, Kec. Tangerang, Kota Tangerang
Email: barrapradja@gmail.com

How to Cite

Vidyaningrum, A., Raharjo, S., & Pradja, B.P. (2022). Mathematical Problem Solving Based on the Characteristics of the Student's Thinking Style. *Kalamatika: Jurnal Pendidikan Matematika*, *7*(2), 163-176.

https://doi.org/10.22236/KALAMATIKA.vol7no2.2022pp163-176

INTRODUCTION

One of the objectives of learning mathematics is to develop problem-solving abilities. This indicates that problem-solving is one of the most essential abilities to be sharpened in learning mathematics. (Kristianti et al., 2013). Mathematics is a subject that can equip students with the systematic acquisition of knowledge or how to solve mathematical problems. (Wulandari, Mujib, & Putra, 2016). Problem-solving in mathematics is an activity to find solutions to the mathematical problems faced and does not demand any special patterns regarding the way or strategy of solving them. The problem-solving process is the process of overcoming the difficulties encountered in achieving the expected goals. Problems are part of human life, both from within and from the surrounding environment. Almost everyone faces a problem that needs a solution (Hartono, 2014).

Problem-solving is the application of concepts and skills. Problem-solving usually involves some combination of concepts and skills in new or different situations (Mulyono, 2012). In the teaching of mathematics, problem-solving refers to a series of operations performed by the human being to achieve specific objectives (Runtukahu & Kandou, 2014). Problem-solving skills must be provided to learners, not just used to help learners solve mathematical concepts and answer questions about learning that require cognitive aspects. (Masfuah & Pratiwi, 2020). Students in Indonesia can only answer memorization questions and cannot answer questions requiring reasoning (Markawi, 2015).

Anthony Gregorc in (DePorter, Bobbi & Mike Hernacki, 2000) divided the thinking style into two axes and, consequentially, four quadrants. The Y axis is based on the perceptual preference, and the X is the ordering preference. The perceptual preference runs from concrete to abstract, and the ordering preference from sequential to random. These styles are Concrete Sequential (CS), Abstract Sequential (AS), Concrete Random (CR), and Abstract Random (AR).

The results on mathematical problem-solving ability in terms of the characteristics of students' thinking style show that students' problem-solving ability with the characteristics of Abstract Sequential (AS) thinking is higher than that of students with characteristics of Concrete Sequential thinking, concrete random, and abstract random (Lestanti, Supriyono & Isnarto, 2015).

Another study conducted by Panjaitan stated that students' problem-solving ability with

a Concrete Sequential (CS) thinking is higher than that of students with characteristics of an AS, CR, and AR thinking. This circumstance is because students with the characteristics of the CS way of thinking have reached systematic, orderly, meticulous, and logical indicators in carrying out solutions solving problems (Panjaitan, 2018). Students with a high level of prior knowledge think deeply algorithmically and solve mathematical problem-solving problems that can understand the problem correctly and smoothly. Students with the initial level of knowledge think about imperfect algorithms in solving problem-solving problems. A student with a low initial knowledge thinks heuristically in solving mathematical problem-solving questions (Netriwati, 2016)

The tendency of students with thinking style of the Concrete Sequential (CS) category dominate the highest academic achievement, and those with Concrete Random category only dominate the lower level of academic achievement (Mirfani & Susilana, 2019). The characteristics of the CS thinking style students are having problems when understanding problems because they are not careful and lack scrupulousness. The problem-solving ability of students with AS thinking style is higher than that of students with CS, CR, and AR thinking style (Robiyanti, 2018).

Problem-solving abilities of students with the characteristics of the CS type of thinking solve problems according to what is planned. They check the answers they have done by recalculating, returning the questions they are looking for, looking for these answers in other ways, and writing conclusions. Problem-solving abilities of students with AS thinking style solve problems even though they are not planned. They check the answers done by writing conclusions. Students' problem-solving abilities with CR thinking style solve problems according to what is planned. They check the answers done by doing re-calculations and writing conclusions. Problem-solving abilities of students with AR thinking style solve problems even though they were not planned and did not check the answers (Rohman, Mahmudah & Siswanah, 2022).

This is in accordance with the facts in the field based on an interview with one of the mathematics teachers. Several problems were found in students that only 20 students in one class could achieve their mathematical problem-solving ability. Students did not pay attention during teaching and learning activities, were shy and fear of asking the teacher the questions. The solution given by the teacher was to re-explain the material that is not understood by

students and provide evaluation questions with the same problems with examples of problems, with only the numbers were replaced. Therefore, in this study, researchers are interested in examining students' abilities in problem-solving in terms of the characteristics of students' thinking styles.

METHOD

The method used in this study is qualitative research. Qualitative research is a research method based on the philosophy of post-positivism, used to examine the condition of natural objects, where the researcher is a key instrument, sampling is carried out purposively, data analysis is induction/qualitative, and the results emphasize meaning rather than generalization (Sugiyono, 2017).

The type of research method used is descriptive research. A descriptive assessment method is a study that seeks to describe a symptom or event that occurs at the present. Descriptive researchers focus on actual problems as they are during the study. Through descriptive research, researchers try to describe the events and events that are the center of attention without giving special treatment.

The types and sources of data used in this study are primary and secondary; primary data was obtained by conducting interviews, questionnaires, and giving questions to informants by conducting problem-solving tests and non-problem-solving tests characteristic of students' way of thinking. Secondary data is indirect data obtained or received from other parties, not directly.

RESULT AND DISCUSSION

The researchers conducted problem-solving and non-problem-solving tests. Next, based on the result of those tests, students were divided into Concrete Sequential (CS), Concrete Random (CR), Abstract Random (AR) and Abstract Sequential (AS) thinking style. The purpose of carrying out the test is to see the ability of students to solve the problems. The results of the test on the characteristics of thinking style conducted by 20 students are as follows.

Table 1. Results of problem-solving and non-problem-solving tests based on characteristics of students' thinking style

Student Code	Characteristics of The Way of Thinking	Score
AH	CR	48
AZD	AS	36

Student Code	Characteristics of The Way of Thinking	Score
ABB	AS	36
CSK	CS	36
FM	AR	36
IDR	CR	40
JF	AR	40
MZ	CS	40
MF	AS	48
NNF	CS	52
NZA	AR	52
NL	CS	40
RA	AR	44
RK	CS	52
SH	CS	40
SK	AR	56
SAR	CR	44
SA	AS	44
ZRA	AR	40
ZA	CS	48

Table 1 presents the results of the test characteristics of Year 7 students' thinking style. There are seven students with the Concrete Sequential (CS) type. Students with this type believe in a reality in information and see it directly. They like to pay attention and easily remembers information. These seven CS students adhere to reality and information processes in an orderly, linear, and sequential way. For these students, reality consists of what they can know through their physical senses, namely the senses of sight, touch, listening, taste, and smell. They easily pay attention to and remember reality and facts, information, formulas, and special rules. Notes or papers are the best way for students with this characteristic. They should organize the tasks into a step-by-step process and strive to obtain perfection at each stage, as well as special direction and pro-education.

There are four students with the characteristics of abstract sequential (AS) students' thinking style. AS students can easily analyze critical information and have logical, rational, and intellectual thinking. These four students with AS thinking style think in concepts and analyze information. They appreciate people and events that are neatly organized. It is easy for them to look at the essentials, such as critical points and important details. Their thinking processes are logical, rational, and intellectual

There are also three students with characteristics of Concrete Random (CR) students' thinking style. Students with this thinking style have a sense of eagerness to try. They hold on to reality, have the desire to try, and have an experimental attitude accompanied by less

structured behavior. Unlike Concrete Sequential, they are based on reality but want to take a trial-and-error approach. Hence, they often make the intuitive leaps necessary for actual creative thinking. They have a strong drive to find alternatives and do things their way. Time is not a priority for students of this thinking style. They tend not to care about time, especially when looking at an exciting situation and are more oriented towards the process than the result.

Six students are with the characteristics of Abstract Random type (AR) thinking style. They can absorb new ideas and have a strong feeling. Their feelings can affect their learning improvement. They organize information through reflection and participate in a disorganized environment oriented toward people. They absorb ideas, information, and impressions and organize them with reflection. Sometimes, this takes so long that others do not think that these students have opinions or reactions. They remember well if the information is personified. Feelings can also further enhance or influence their learning.

The discussion of the results of this study analyzes three problems about mathematical problem-solving ability. This analysis was carried out to determine students' mathematical problem-solving abilities based on test results and interviews. The results of the data analysis are as follows.

The problem-solving ability of students who have the characteristics of a Concrete Sequential (CS) thinking style

For question number 1, the subject has met the systematic indicators in solving the problem because the subject understood the problem in the question. Students could translate the information from the problem by writing what is known and what is asked. They could also solve problems according to planning and write the steps in detail. At the completion stage, the student examined the answers and solves the problem meticulously in work done by re-examining and making conclusions from the answers obtained.

In the interview, students with this CS thinking style characteristic could understand what is being asked and correctly determine the answer. In the interview, students could explain what is known and asked in the question. The example question and interview results with students are presented as follows.

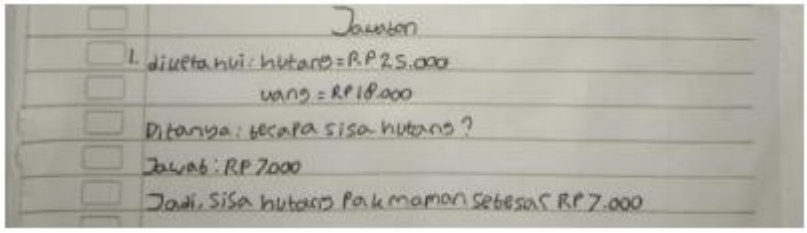

Figure 1. Sample Question No. 1

Researcher : “What do you think the questions you do are easy, medium, or difficult?'

Student : "Easy, miss."

Researcher : "Do you understand what does it mean?"

Student : "Yes, I do."

Researcher : "From that question, what is known and what is asked?"

Student : " I know that Pak Maman owes 25,000. Pak Maman has 18,000 and what being asked is how much is the remaining of Pak Maman's debt."

Researcher : " How did you solve the problem?"

Student : "I calculated the debt equal to the money Pak Maman has, then deduct it and continue to get the results."

Researcher : "Did you make reasons or other examples to make the question easier?"

Student : "No, miss."

Researcher : "What concept do you use to solve the problem?

Student : "I use subtraction to calculate the remaining debt."

Researcher : "Are you having difficulty solving the problem?"

Student : " No, miss."

Researcher : "After doing the questions, are you sure your answers are correct?"

Student : "Yes, I’m sure."

Researcher :” Why are you sure that the answer is correct?"

Student : "Based on the problem that I have calculated."

Researcher :" Does you always check the answer you wrote every time you do a question?"

Student :” Yes, miss."

For question number 2, the subject has satisfied the indicators when solving the problem since the subject understood the problem, and the student could translate what is obtained from the problem by writing the information in question. The student could solve the problem according to the plan and write the steps in detail. At the completion stage, the

student re-examined the answers obtained, draw conclusions, check the answers, and carefully solve the problems in the work they develop.

In the interview, students with CS thinking style characteristic could understand the content of the question and could determine the answer correctly. In the interview, students could also explain what is known and ask in the questions. Next, after the students completed the questions, the students also double-checked the answers.

For question number 3, the subject has reached the target when solving the problem because the subject understood the problem in the question, and the students could translate what is obtained from the question by writing the known information and the information asked. Next, the student could solve the problem according to the plan and write the steps in detail. However, at the completion stage, the student did not write and draw conclusions back to the answers that have been concluded.

For question number 3, in the interview, students with CS thinking style could understand the content of the question and could determine the answer correctly. In the interview, students could also explain what is known and ask in the questions. However, the student did not rewrite the final result of the question answer.

Problem Solving Ability of Students who have the Characteristics of Abstract Sequential (AS) Thinking Style

For question number 1, the subject has met the systematic indicators in solving the problem because the subject understood the problem in the question. Students could translate the information obtained from the question by writing what is known and what is asked but not in their language. Next, students could also solve problems according to planning and write the steps in detail. And at the completion stage, the student examined the answers and solved the problem meticulously. They also re-examined and made conclusions from the answers obtained.

For question number 1, in the interview, this student with the AS thinking style could understand the content of the question and could determine the answer correctly. In the interview, the student could also explain what is known and asked in the question. Next, the student also double-checked the answers.

For question number 2, students have reached the problem-solving because students already understand the questions, and students could translate the information obtained from

the questions by writing what is known and asked but not using their language. The student could also solve the problem according to the plan and write the steps in detail. At the completion stage, students re-examined the answers and draw conclusions. They examined the answers and could carefully solve the problem.

For question number 2, in this interview, students with the AS thinking style could already understand the content of the question and could determine the answer correctly. In the interview, the student could also explain what is known and asked in the question. Students also understand the meaning of the given questions. The students also re-checked the answers.

For question number 3, students with AS thinking style can only work on some parts of problem-solving. In the section on understanding the problem, the subject of AS wrote fully the elements that are known and asked. Next, the student could work with the correct steps but not with its sentences. If AS feels they do not understand a question, AS chooses to blank the answer sheet.

For question number 3, in the interview, students with the CS thinking style could understand the content of the question and could determine some of the answers correctly. Later in this interview, the student could also explain what is known and asked in the question. However, students do not answer the questions thoroughly because they feel they did not understand.

Problem Solving Ability of Students who have the Characteristics of Abstract Random (AR) Thinking Style

For question number 1, a student with AR thinking style could do most problem-solving correctly. Students with AR thinking style could understand the questions and write what is known and what the questions are asked. Students could combine work with various completion methods and were not focused on one method alone. Students could also write the complete steps of completion. However, in the completion section, AR student did not check and prove the correctness of the answers.

For question number 1, in the interview, this student with the AR thinking style could already understand the content of the question and could determine the answer correctly. In the interview, the student could also explain what is known and what is asked in the question. Then the student double-checks the results of the answer.

In question number 2, the subject met the indicators when solving the problem since the subject understood the problem in the problem, and the student could translate what is obtained from the problem by writing the known information and the information in the question. Then, the student can solve the problem according to the plan and write the steps in detail. At the completion stage, students did not re-examine the answers and did not write the final results of the answers.

For question number 2, in the interview, this student with the AR thinking style could already understand the content of the question and could determine the answer correctly. In the interview, the student could also explain what is known and asked in the question. Next, the student also checked or double-checked the answers.

For question number 3, the subject has reached the target when solving the problem because the subject already understood the problem in the question, and the student could translate what is obtained from the question by writing the known information and the information asked. Next, the student could solve the problem according to the plan and write the steps in detail. However, at the completion stage, the student did not write and draw conclusions back to the answers.

For question number 3, in the interview, students with the AR thinking style could understand the content of the question and could determine the answer correctly. In the interview, students could explain what is known and asked in the questions. However, the student did not rewrite the final result.

Problem Solving Ability of Students who have the Characteristics of a Concrete Random (CR) thinking style

In the first stage of understanding the problem, CR students understood the problem but did not write and reveal what is known and asked. At the stage of drawing up a plan, CR students could not plan problem-solving based on the information in the problem. When carrying out the plan, CR students could make accurate calculations when solving problems. At the re-examination stage, CR students did not perform the re-examination step and did not check the match between those found and the questions in the questions.

For question number 1, in the interview, CR student could understand the content of the question and could determine the answer correctly. In the interview, students could explain what is known and asked in the questions. However, the student did not rewrite the final

result.

For question number 2, in the stage of understanding the problem, CR students did not understand the problem well and could write and express what is known and asked. At the stage of drawing up a plan, CR students could not plan problem-solving based on the information in the problem. At the stage of carrying out the plan, the CR student could not make accurate calculations when solving the problem, but he understood its steps. At the re-examination stage, the CR students did not perform the re-examination step and did not check whether the solution match the problem.

For question number 2, in the interview, CR students could understand what is being asked. However, students had difficulty in solving the problem. However, students could explain what is known and asked in the question. However, students did not re-examine the results of the answers, and students were also less careful in calculating.

For question number 3, in the stage of understanding the problem, CR students could understand the problem well but could not write and express what is known and asked. At the stage of drawing up a plan, CR students cannot plan problem-solving based on the information in the problem. At the stage of implementing the plan, the CR student could not make accurate calculations when solving the problem, but he understood the steps of the completion. At the re-examination stage, the CR students did not perform the re-examination step and did not check whether the solution match the problem.

For question number 3, in the interview, CR students could understand what is being asked. Students found it challenging to solve the given questions. They could explain what is known and asked in the question. However, they were not careful in doing the questions, did not check the results of the answers and were also less careful in calculating.

This study confirms that the Problem-Solving Ability of CS students has met the indicators of understanding the problem, planning the solution, implementing the solution, and re-examining the solution. AS students understand problems, plan solutions, implement solutions, and re-examine the solutions. CR students meet the indicators of understanding problems and solving problems. In addition, AR students has not yet reached indicators of understanding, planning, and implementing the problem.

CONCLUSION

Based on the analysis results and discussion described in the previous section, the

following conclusions can be drawn. Seven students had the characteristics of the CS-type way of thinking. They could understand problems, plan problems, implement problems, check answers and be able to prove the truth of the answers but they could not write them.

Four students had the characteristics of the AS-type way of thinking. They met systematic indicators in solving problems because they understood the problems in the problem. Students could translate the information obtained from the problem by writing what is known and what is asked but not in their language. They could also solve problems according to planning and write down the steps in detail. At the stage of completion, the students conducted an examination and can solve the problem meticulously.

Three students were with CR thinking style. They could understand, plan, and implement problems but were less thorough at the completion stage and did not write the final answer.

Finally, six AR students can do some parts of problem-solving. In the section on understanding the problem, CR students do not write down the known and asked elements but can explain in the interview using the same language in the problem. In the completion section, CR students were able to sort out the questions so that the solution was brief and they were not careful in calculations. The CR students also did not examine and prove the correctness of the solution.

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