Mathematical Literacy on Rectangles And Triangles Based on The Characteristics of Students' Way of Thinking

B A Nurnugroho\textsuperscript{1}, Nurul Arfinanti\textsuperscript{2}, and Ika Kartika\textsuperscript{2}

\textsuperscript{1}Mathematics Education Department, Universitas Ahmad Dahlan, DIY, Indonesia
\textsuperscript{2}Mathematics Education Department, UIN Sunan Kalijaga, DIY, Indonesia

E-mail: burhanudin@pmat.uad.ac.id

Abstract. This study aimed to describe students mathematical literacy on rectangles and triangles based on the characteristics of a students' way of thinking by Anthony Gregorc. The different ways of thinking produce different ways of learning and ways of thinking. This study is a descriptive qualitative study. The object of this study is seven grades students at MTs Plus Az Zahro Gandrumangu Cilacap. The Instrument to collect data such as test, questionnaire, interview, observation, and documentation. The validity of the data result checked by data triangulation. To analyze the data collected, we use Miles and Huberman's model. The results of this study show that each student has different ways of thinking. All the characteristics of students' way of thinking can be said to achieve almost the same literacy abilities. The difference in the characteristics way of thinking is apparent in writing the information obtained from the problem and writing in its solution. Different ways of thinking students require teachers in the learning process to apply a variety of learning models. Varied learning allows students to be able to learn according to their way of thinking so they can achieve better learning outcomes.

1. Introduction

Based on school mathematics learning standards, according to NCTM (2000), one of the necessary abilities that must be mastered in mathematics learning is mathematical literacy ability \cite{1}. Much research discusses the ability of mathematical literacy. The number of studies shows that mathematical literacy ability is indeed a fascinating study material \cite{2-4}.

NCTM determine the five necessary mathematical abilities, i.e. problem solving, reasoning and proof, communication, connections, and representation. Mathematical literacy ability is the ability individuals in formulating, using and interpreting Mathematics in various contexts. Mathematical reasoning and using mathematical concepts, procedures, facts and tools to describe, explain and predict a phenomena included in mathematical literacy \cite{2}. The basic abilities needed in literacy skills are: (1) Communication, which can understand and recognize a problem that is finally able to interpret information from the problem given, then present and explain the solution; (2) Mathematising, i.e.transform problems from the real world into mathematical models and interpret mathematical results to in the initial/real-world problem; (3) Representation, presents problems using the mathematical representation like, diagrams, tables, graphs and others; (4) Reasoning and The argument, able to provide reasoning and giving logical argument; (5) Devising strategies for solving the problem, the ability to use strategies for mathematical problem solving; (6) Using symbolic, formal and technical language and operation, ability understanding, interpreting, manipulating and utilizing language...
symbols formal and technical languages and operations; and (7) Using mathematical tools, using mathematical tools [5].

In teaching mathematics literacy skills, we also need to consider the characteristics of student learning styles. Each child has their privileges; they are not the same and cannot be compared. This feature also applies to the way of thinking of each individual. Anthony Gregorc (1979) defines the characteristics of one's way of thinking as a way for someone to formulate information and experience for learning that transcends certain areas so that one's way of thinking is the person's attitude in various aspects of life [6].

Various studies make the characteristics of students' way of thinking as one of the variables [7, 8, 9, 10]. The number of studies shows that the characteristics of students' way of thinking are exciting things to study. Therefore, the way of thinking also affects children in learning, constructing knowledge, and others. The different ways of thinking produce different ways of learning and ways of thinking. In learning mathematics, the way students answer math problems also varies. Therefore, the mathematics teacher must be able to understand the difference in the way students think. By understanding the different ways of thinking of these students, it is hoped that they can help each student to achieve their best abilities. Studies on improving mathematical literacy skills have also been carried out. However, there are no studies that examine the ability of student literacy in terms of the characteristics of students' way of thinking. Yet by knowing the characteristics of the way of thinking of students, we can plan the learning process that can improve students' mathematical literacy abilities.

2. Method
This research is a qualitative descriptive study. Qualitative descriptive research is a research method aims to describe in full, and depth about social reality and various phenomena that occur in the community that is the object of research so described the characteristics, character, nature, and model of the phenomenon [11]. This research aims to provide a complete and factual description of mathematical literacy skills of grade VII students at MTs Plus Az-Zahro Gandrungmangu by paying attention to the characteristics of students' way of thinking. Subjects in this study were 21 students. Data collection instruments used in this study were researchers as the main instrument, mathematics literacy ability test, questionnaire sheets characteristic of thinking, interview guidelines, observation sheets, and smartphones.

3. Results and Discussion
This study aims to determine the students' mathematical literacy ability based on the characteristics of students' way of thinking. The first step taken was to give a questionnaire characteristic of the way of thinking adopted by Anthony Gregorc [12]. The results of questionnaire characteristics of students' way of thinking in Table 1 as follows.

| Concrete Sequential (CS) | Abstract Sequential (AS) | Abstract Randoms (AR) | Concrete Randoms (CR) | Mix |
|-------------------------|--------------------------|-----------------------|-----------------------|-----|
| AH                      | ER                       | AK                    |                       | BM  |
| DK                      | MA                       | DF                    |                       | IMP |
| DKh                     | UK                       | HN                    |                       | KHa |
| KH                      |                          | IAM                   |                       |     |
| PK                      | LR                       | RA                    |                       |     |
| VV                      |                          | RO                    |                       |     |
| 6                       | 3                        | 7                     | 0                     | 5   |

Note: AH, ER, and so on are the initial names of the research subjects.
Table 1 shows that six students are having the characteristics of Concrete Sequential thinking (CS). Three students were having the characteristics of Abstract Sequential thinking (AS). Seven students were having the characteristics of Abstract Random (AR) type of thinking. Five students have the characteristics of mixed type thinking, which includes CS-AR, CS-AS, and AS-AR. Whereas for Random Concrete type (RK) there is none.

The next step is to provide a mathematical literacy ability test to measure the achievement of students' mathematical literacy abilities. The achievement of students' mathematical literacy abilities can be seen in Table 2 as follows.

| No | Initial Name | Characteristics of Thinking | Mathematical Literacy Ability Score |
|----|--------------|-----------------------------|-------------------------------------|
| 1  | LR           | AR                          | 32                                  |
| 2  | DKH          | SK                          | 5                                   |
| 3  | MA           | AS                          | 4                                   |
| 4  | VV           | SK                          | 7                                   |
| 5  | KHA          | SK/AS                       | 12                                  |
| 6  | AH           | SK                          | 21                                  |
| 7  | DF           | AR                          | 35                                  |
| 8  | RA           | AR                          | 21                                  |
| 9  | IM           | SK/AS                       | 19                                  |
| 10 | PK           | SK                          | 21                                  |
| 11 | RO           | AR                          | 24                                  |
| 12 | ER           | AS                          | 12                                  |
| 13 | KH           | SK                          | 30                                  |
| 14 | MZ           | SK/AR                       | 12                                  |
| 15 | NF           | AS/AR                       | 12                                  |
| 16 | BM           | SK/AR                       | 1                                   |
| 17 | IAM          | AR                          | 14                                  |
| 18 | DK           | SK                          | 7                                   |
| 19 | HN           | AR                          | 32                                  |
| 20 | UK           | AS                          | 15                                  |
| 21 | AK           | AR                          | 15                                  |

The majority of students who get high mathematical literacy ability test scores are students with the characteristics of Abstract Random (AR) and Concrete Sequential (CS) thinking. Of the seven students who have the AR thinking way of thinking, there are two students with scores below 20. For the characteristics of the Concrete Sequential (CS) way of thinking, three students have a mathematical literacy ability test score below 20 of 5 students with these thinking characteristics. Three students have Abstract Sequential (AS) way of thinking, and all three have mathematical literacy ability scores below 20. Students with mixed thinking characteristics have five students, and all of them have mathematical literacy ability scores below 20.

The next step is to choose the subject that is considered the most representative. The selection of this subject based on the characteristics of students' way of thinking and each character is taken that gets the highest score. That is because the subject who gets the highest score is the subject that best represents
the characteristics of the way of thinking. Based on the selection of subjects by looking at the results of the questionnaire obtained 6 subjects that are considered to represent PK subjects with SK thinking characteristics, ER subjects with US thinking characteristics, RA subjects with AR thinking characteristics, MZ subjects with CS-AR thinking characteristics, IMP subjects with characteristics of CS-AS ways of thinking, and NF subjects with characteristics of AS-AR ways of thinking. The six subjects are then analyzed their mathematical literacy abilities based on the fundamental abilities that need to be achieved. The essential abilities achieved by the six subjects can be seen in Table 3 as follows.

| Basic Skills Achieved       | CS   | AS   | AR   | CS-AR | CS-AS | AS-AR |
|------------------------------|------|------|------|-------|-------|-------|
| Communication                | √    | √    | √    | √     | √     | √     |
| Mathematising                | √    | √    | √    | √     | √     | √     |
| Representation               | -    | -    | √    | -     | -     | -     |
| Reasoning and Argument       | -    | -    | -    | -     | -     | -     |
| Devising strategies for solving problem | √    | √    | √    | -     | √     | √     |
| Using symbolic, formal and technical language and operation | -    | -    | √    | -     | -     | -     |
| Using mathematical tools     | -    | -    | -    | -     | -     | -     |

3.1 Characteristics of Students with Concrete Sequential Thinking (CS)

3.1.1 Communication
Students who have the characteristics of CS thinking can write information that is asked from the problem — being able to write responses in the form of formulas that are used to solve problems even though there are still errors.

3.1.2 Mathematising
Students who have the characteristics of CS thinking can translate everyday language into mathematical form even though it is still in a simple problem.

3.1.3 Devising strategies for solving problems
Students who have the characteristics of CS thinking can write down problem-solving strategies. Nevertheless, for each of the stages of the solution is still unclear.

Figure 1 is the example of CS student’s worksheet.

![English Translation:](image)

**English Translation:**
Noted: Area of kite = diagonal 1 x diagonal 2
Asked: Area of the paper and length of thread needed by you
Answered:
Area of the paper = \( \frac{42 \times 32}{2} = \frac{1344}{2} = 672 \text{ cm} \)
Length of thread = 20 cm + 34 cm = 54 cm
54 cm x 2 = 108 cm

**Figure 1.** CS student’s worksheet
Figure 1 shows that the answers given by subjects with CS thinking are in line with the characteristics of CS thinking. The characteristics of CS thinking that tends to follow the directions and according to facts, makes it easy for students to understand and write information from the questions. Besides, students with the characteristics of CS thinking tend to be easy to remember formulas and rules. However, because in understanding the information obtained from the problem is still incomplete, the results of the resolution are still not quite right.

3.2 Characteristics of students with Abstract Sequential Thinking (AS)

3.2.1 Communication

Students who have the characteristics of the AS way of thinking can understand the information that is known and asked from the problem using their language. Being able to write responses in the form of calculations used to solve problems even though there are still errors.

3.2.2 Mathematising

Students who have the characteristics of the AS way of thinking can translate everyday language into mathematical form even though it is still in a simple problem.

3.2.3 Devising strategies for solving problems

Students with the characteristics of the AS way of thinking are quite capable of planning a strategy to solve the problem. However, the explanation of each stage is still unclear and not yet able to implement the strategy.

Figure 2 shows that students with AS thinking are students who randomly solve problems. Students with this way of thinking solve problems directly into the form of calculations without having to write the formula first. Information obtained from the questions is written in their language. This result is following the characteristics of the AS way of thinking that can capture information without having to use demonstration concretely. Therefore in Figure 2, the subject can achieve the ability of Communication and Mathematising in mathematical literacy.
3.3 Characteristics of students with Abstract Random Thinking (AR)
3.3.1 Communication
Students who have the characteristics of the AR way of thinking can understand the information that is known and asked of the problem — being able to write responses in the form of formulas that are used to solve problems even though there are still errors.
3.3.2 Mathematising.
Students who have the characteristics of AR thinking can translate everyday language into mathematical form even though it is still in a simple problem.
3.3.3 Reasoning and Argument
Students with the characteristics of AR thinking in providing reasoning and arguments are still elementary and still incomplete to produce conclusions.
3.3.4 Devising strategies for solving problem
Students with the characteristics of the way of thinking AR can plan and implement a strategy to solve problems and can explain the stages of resolution even though it seems less coherent.
3.3.5 Using symbolic, formal and technical language and operation
Students with the characteristics of AR thinking can use symbols in the process of solving a given problem.

Figure 3 is the example of AR student’s worksheet.

**Figure 3.** AR student’s worksheet

Based on Figure 3, students with AR thinking types write information in their language. For students with the characteristics of how to think AR feelings can also increase or influence learning activities. One of the characteristics of students with this type of AR thinking is that they are uncomfortable when they have to solve problems in a restricted environment. This result makes it possible to be a factor that affects the achievement score of mathematical literacy ability of AR students because, at the time of the test, the researcher does not limit the completion time.

3.4 Characteristics of Students with CS-AR Thinking
3.4.1 Communication
Students who have the characteristics of CS-AR way of thinking can understand the information that is known and asked of the problem even though there is a solution where information about the problem...
is not written. Also, students are quite able to write responses in the form of formulas used to solve problems even though there are still errors.

3.4.2 Mathematising.
Students who have the characteristics of CS-AR way of thinking can translate everyday language into mathematical form even though it is still in a simple problem. Figure 4 is the example of CS-AR student’s worksheet.

![Figure 4. CS-AR student’s worksheet](image)

**English Translation:**
Answered:
$$\frac{1}{2} \times \frac{1}{2} = \frac{42 \text{ cm} \times 32 \text{ cm}}{2} = 340$$

Based on Figure 4, students with mixed CS-AR thinking ways solve problems without writing down information according to the questions but can provide solutions to the problems asked. Besides, in writing the solution also tends to be more orderly and coherent even though in some parts, there are still less regular. This result enables students with mixed CS-AR thinking ways to achieve communication skills in mathematical literacy.

3.5 Characteristics of Students with CS-AS Thinking
3.5.1 Communication
Students who have the characteristics of the CS-AS way of thinking can understand the information that is known and asked of the questions. Being able to write responses in the form of calculations used to solve problems even though there are still errors.

3.5.2 Mathematising.
Students who have the characteristics of the CS-AS way of thinking can translate everyday language into mathematical form even though it is still in a simple problem.

3.5.3 Devising strategies for solving problems
Students with the characteristic of CS-AS way of thinking can plan a strategy to solve the problem, but each stage of the solution is still unable to explain it.
Figure 5 is the example of CS-AS student’s worksheet.

| English Translation: |
|---------------------|
| Note : Area of kite = diagonal 1 x diagonal 2 |
| Asked : Paper area and length of thread needed by Andi |
| Answered: paper area = \( \frac{42 \times 32}{2} = \frac{1344}{2} = 672 \text{ cm}^2 \) |
| Length of thread 20 cm + 34 cm = 54 cm x 2 = 108 cm |

**Figure 5.** CS-AS student’s worksheet

Based on Figure 5, students with CS-AS mixed thinking tend to be more organized in solving problems and use their language in writing information obtained from questions.

3.6 Characteristics of Students with AS-AR Thinking

3.6.1. Communication

Students who have the characteristics of the AS-AR way of thinking can write information that is known and asked of the problem. Able to write responses in the form of calculations used to solve problems but still incomplete.

3.6.2. Mathematising.

Students who have the characteristics of AS-AR way of thinking can translate everyday language into mathematical form even though it is still in a simple problem.

3.6.3. Devising strategies for solving problems

Students with the characteristics of the AS-AR way of thinking can plan a strategy to solve the problem but have not been able to explain each stage in solving the problem even though they have tried to implement the strategy.

Figure 6 is the example of AS-AR student’s worksheet.

| English Translation: |
|---------------------|
| Noted : Andi’s bamboo is 42 cm and 32 cm respectively. And the size of the thread as shown next. With the size of bamboo and thread that Andi has, what is the paper area and length of thread what Andi needs to make the kite. |
| Answered : 20 + 20 + 34 + 34 = 708 |

**Figure 6.** AS-AR student’s worksheet
Based on Figure 6, students with AS-AR mixed thinking characteristics tend to write information according to the questions without using their language. Also, in solving problems, students do not write formulas and words as an explanation even if asked.

4. Conclusion
The results of this study show that each student has different ways of thinking. All the characteristics of students' way of thinking can be said to achieve almost the same literacy abilities. The difference in the characteristics way of thinking is apparent in writing the information obtained from the problem and writing in its solution. Different ways of thinking students require teachers in the learning process to apply a variety of learning models. Varied learning allows students to be able to learn according to their way of thinking so they can achieve better learning outcomes.

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