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Literacy of student numeration in solving problems HOTS based given thinking style

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Abstract

Background: Understanding the relationship between students' thinking styles and their numeracy literacy, especially in solving Higher Order Thinking Skills (HOTS) questions, is essential in educational research.
Aim: This study aims to explore how students' thinking styles influence their numeracy literacy in addressing HOTS-based questions.
Method: A descriptive qualitative approach was employed in this research. The study involved eight students from Larangan 1 Public Middle School, selected through a thinking style questionnaire. Two students were chosen from each of the four identified thinking style categories. Data were collected using tests comprising two HOTS-based questions and interviews.
Results: The findings indicate that students' numeracy literacy varies significantly according to their thinking styles when solving HOTS questions. Students identified as SK and SA exhibited higher numeracy literacy, effectively utilizing various symbols and numbers, analyzing tabular information, and interpreting these analyses to make decisions. In contrast, students labeled as RK were only able to fulfill two numeracy literacy indicators and struggled with information analysis. RA students faced challenges in correctly writing numbers or symbols, analyzing information, and articulating problem-solving processes and conclusions. The study also found that students who process information sequentially exhibited better numeracy literacy in solving HOTS-based questions.
Conclusion: The study concludes that students' thinking styles play a crucial role in their numeracy literacy, particularly in solving HOTS-based mathematical problems. This insight underscores the importance of considering individual cognitive styles in educational strategies to enhance mathematical problem-solving skills.

INTRODUCTION

In the era of globalization, education must produce high-quality and high-quality human resources by integrating knowledge skills, attitudes and skills (Mardhiyah et al., 2021). Mathematics lessons can build students' skills and abilities (Gatot, 2018). Currently, students are required to have mathematical skills, namely numeracy literacy (Geo-JaJa & Majhanovich, 2016). Numerical literacy skills are not just counting but also provide patterns and regularity in critical thinking to solve any given problem (Alberta, 2018; Ismafitri et al., 2022; Lamada et al., 2019; Mustofa, 2020). Students with high numeracy literacy have a great chance of success in the future because their application refers to the context of everyday life.

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However, Indonesian students still have low numeracy literacy (OECD, 2015). Low numeracy literacy is caused by students' poor understanding of the concepts studied and inaccurate numeration representations. Students who struggle to use symbols and numbers also experience difficulties in solving conceptual problems (Utaminingsih & Subanji, 2021).

Conceptual problem-solving in mathematics is a skill that students must have in mathematics lessons (Pratiwi & Munandar, 2019). So, solving mathematical problems indicates students' achievement of numeracy literacy because students' numeracy literacy in mathematics involves many activities to solve problems that arise in everyday life through scientific stages so that students can learn knowledge related to these problems and, at the same time, use students' way of thinking to solve problems.

Dassa et al., (2018) stated that students' numeracy literacy abilities are greatly influenced by thinking style. Haerudin (2018) also stated that students' numeracy literacy skills would impact their thinking patterns and habits in relating a number to an existing problem to make it easier and simpler. Diversity in the learning process arises from different ways of receiving and processing information in one's mind, so the conclusions drawn are undoubtedly different (Negara et al., 2021).

Thinking style is how a person receives and processes information according to his potential (Novitasari et al., 2021; Tarigan et al.,2019). Anthony Gregorc (Novitasari et al., 2021) grouped thinking styles into four types, namely, Concrete Sequential (CS), Concrete Random (CR), Abstract Sequential (AS), and Abstract Random (AR). Differences in students' thinking styles can influence how students see problems and use appropriate strategies to deal with them. Therefore, there is no good or bad style of thinking. Each style of thinking has its advantages and disadvantages (Munahefi et al., 2020).

Thinking style is not a component of the definition of numeracy literacy. However, this is an essential prerequisite for numeracy literacy. Tarigan et al., (2019) revealed that thinking style contributed 17.4% to the effect of problem solving. Therefore, a person's thinking style affects the level of success in solving math problems. HOTS-based questions need to be applied to learning mathematics. Thus, mastery of HOTS questions and numeracy literacy can interpret something thoroughly and deeply in a different way according to the context (Hardianto et al., 2016; Ismafitri et al., 2022; Sumini et al., 2019).

Patta et al., (2021) revealed that students' numeracy literacy abilities had not reached their maximum, only 34.7%. Further research conducted by Mustofa (2020) revealed that there was no difference in the numeracy literacy of male and female students. Other research regarding the analysis of numeracy literacy abilities in terms of mathematics anxiety, showed that the level of mathematics anxiety experienced by students tends to be high, so that it can influence students' numeracy literacy abilities both directly and indirectly (Putri et al., 2021). Of the several studies that have been conducted, there has been no research that has looked at whether there is a relationship between numeracy literacy abilities and students' learning styles, especially in solving HOTS questions. Therefore, the aim of this research is to describe students' numeracy literacy in solving HOTS-based questions regarding students' thinking styles.

METHODS

Design Research

Type of research used in this research is descriptive qualitative research. The subjects in this study were eight students of class IX.5 at SMP Negeri 1 Larangan. Subject selection was based on a thinking style questionnaire adopted from the Quantum Learning book designed by Jhon Parks Le Tellier in Bobbi Deporter and Mike Hernacki. The list of students' thinking style acquisition can be seen in Table 1.

Table 1. Acquisition of Prohibition Student's Thinking Style at SMP Negeri 1

Class	Thinking Style				Total
	Concrete Sequential	Abstract Sequential	Concrete Random	Abstract Random	
Class IX	5	7	9	5	26

Participant

This study chose two students to represent each style of thinking. The selection of this subject refers to the scores obtained by each student. Selected subjects were given a numeracy literacy test and interviewed based on the results of their written tests. The research subject codes are SK1, SK2, SA1, SA2, RK1, RK2, RA1 and RA2.The research instruments used in this study were test sheets and interviews—HOTS-based numeracy literacy test sheet, which contains the three numeracy literacy indicators. The numeracy literacy indicator by (Han et al., 2017; Salvia et al., 2022) is presented in Table 2. The questions have been tested for validity by experts. Interviews were conducted to collect data and information about the numeracy literacy of eight students with this thinking style's characteristics.

Table 2. Numerical Literacy Indicator

No	Numerical Literacy Indicator (N)	Description
1	Using various symbols and numbers related to basic mathematics in solving contextual problems	Write down various symbols and numbers related to solving mathematical problems.
2	Analyze information in tables, graphs, charts and diagrams	Write down the known data from the tables, graphs, charts and diagrams presented and what is asked in the questions
3	Interpret analysis results to make predictions in decision-making	Write down the problem-solving process and draw conclusions

Instruments

Data collection techniques in this study used tests and interviews. The test used in this research is HOTS-based questions. The interviews in this study used semi-structured interviews, which were informal, meaning that the questions asked were free but still referred to indicators of numeracy literacy. The validity of this research data is done by source triangulation.

Data Analysis

Data analysis techniques are based on Miles and Huberman's three steps in analyzing research data: 1) At the condensation stage, the researcher condenses the data by summarizing it. By summarizing the data, the results of the numeracy literacy tests and interviews can be linked

by researchers. 2) In research, display data that has been condensed will then be presented logically and systematically.

RESULTS AND DISCUSSION

Results

a. Concrete Sequential Subject

Subjects were identified as SK1 and SK2. SK1 and SK2 are correct in writing numbers and symbols related to algebraic operations and can understand the meaning of the symbols written where the numbers and symbols mean quantity. The following is an example of SK1's answer presented in Figure 1.

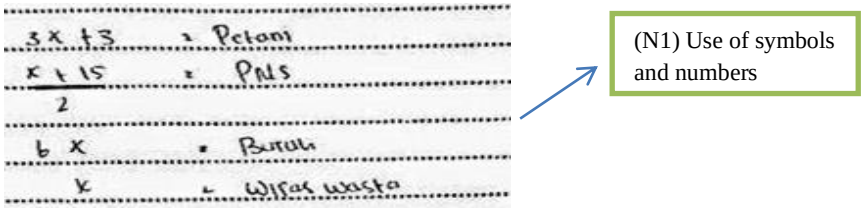

Figure 1. SK1 Work Results

In the interview process SK1 and SK2 showed the following results.

P : After reading the questions, what do you understand?

S : There are four types of work sis from 315 parents of students.

P : What does it mean by $3x + 3 = petani, \frac{x+15}{2} = PNS$*, etc?*

S : That means,the number of farmers $3x + 3$*people, PNS as many* $\frac{x+15}{2}$ *people, workers as many* $6x$ *people, and self-employed x people*

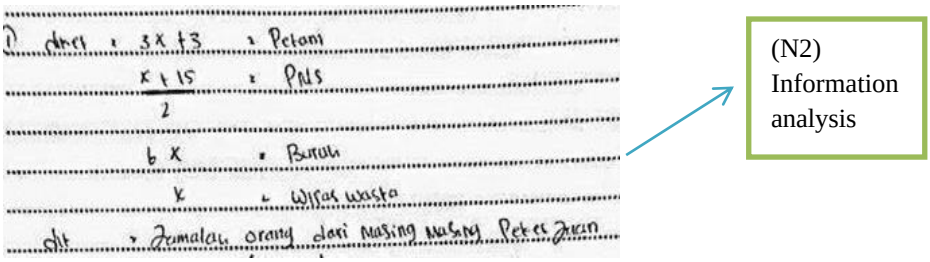

Figure 2. SK1 Work Results

SK1 and SK2 can analyze and write down the information obtained in the table into mathematical symbols by assuming $3x + 3 = lots\ of\ farmers, \frac{x+15}{2} = lots\ of\ PNS, 6x = lots\ of\ workers, x = lots\ of\ self - employed$, and can write exactly what is asked in the question, namely the number of people from each job. Based on the results of the interviews, SK1 and SK2 were able to answer well the information data that was known in the table presented and what was asked in the questions.

P : What information do you know in the table, and what question is asked?

S : The number of farmers $3x + 3$ *people, and civil servants is* $\frac{x+15}{2}$ *people, labourers 6x people and self-employed x people. The question asked, ie how many people are from each job?*

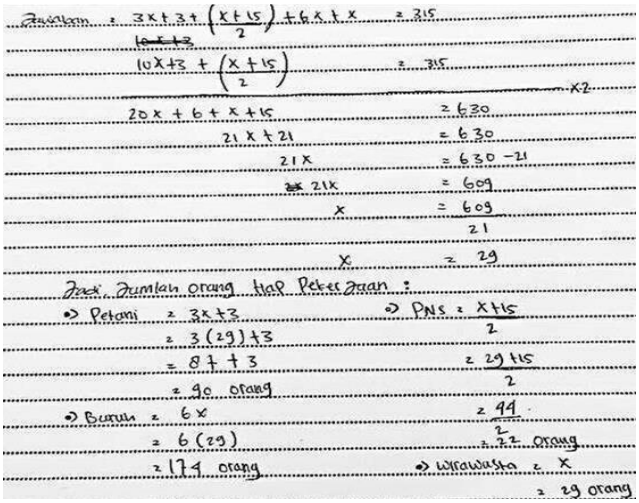

Figure 3. SK1 Work Results

SK1 and SK2 can correctly write down the problem-solving, adding up all the symbols that represent the work of the students' parents. Then, look for values $x$and substitute the x values into each job shown in rows 12 to 18 so that the conclusion is obtained that there are 90 farmers, 22 civil servants, 174 workers and 29 self-employed people. In the interview process, SK1 and SK2 showed the following results.

P : How do you get the answer?

SSK1 : I added all Miss(new $3x + 3 + \frac{x+15}{2} + 6x + x = 315$*) x results are obtained. Then, the value of x is already known, so it remains substituted for each job.*

b. Abstract Sequential Subject

Subjects were identified as SA1 and SA2. SA1 and SA2 can use symbols and numbers related to algebraic operations. The following is an example of the results of the SA1 answer in Figure 4.

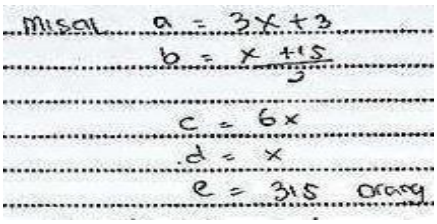

Figure 4. Results of Work on SA1

Seen in Figure 4. SA1 immediately gave an example of $a = 3x + 3, b = \frac{x+15}{2}, c = 6x, d = x, e = 315\ orang$, and did not write down the meaning of the symbols or numbers given. However, during the interviews, SA1 and SA2 could explain each symbol verbally, for example, as a representation of the number of people in each job.

P : After reading the questions, what do you understand?

S : there are 4 types of work.

P : What does it mean by $a = 3x + 3, b = \frac{x+15}{2}$*, etc?*

S : I suppose first the number of farmers as much $3x + 3$ *people, as many civil servants* $\frac{x+15}{2}$ *people, workers* $6x$ *people, and self-employed as many as x people.*

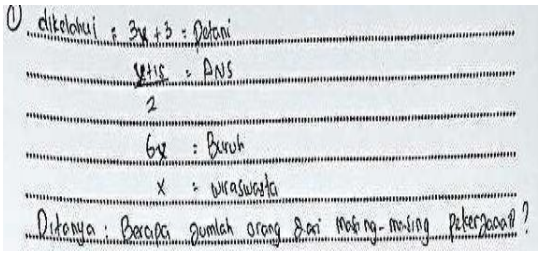

Figure 5. Results of Work on SA1

SA1 and SA2 were able to analyze information by writing down the data known from the table, namely the number of farmers $3x + 3\ people$, $\frac{x+15}{2}$ civil servants, as many workers $6x$ and as many x entrepreneurs, and write down what is asked in the questions correctly. This is supported by interviews conducted with SA1 and SA2 as follows.

P : What is known in the table for question number 1?
S : What is known is the farmer as many as 3x + 3 people, as many as PNS people, workers as many as 6x people, self-employed as many as x people $\frac{x+15}{2}$
P : what is asked in the problem?
S : how many people from each job sis.

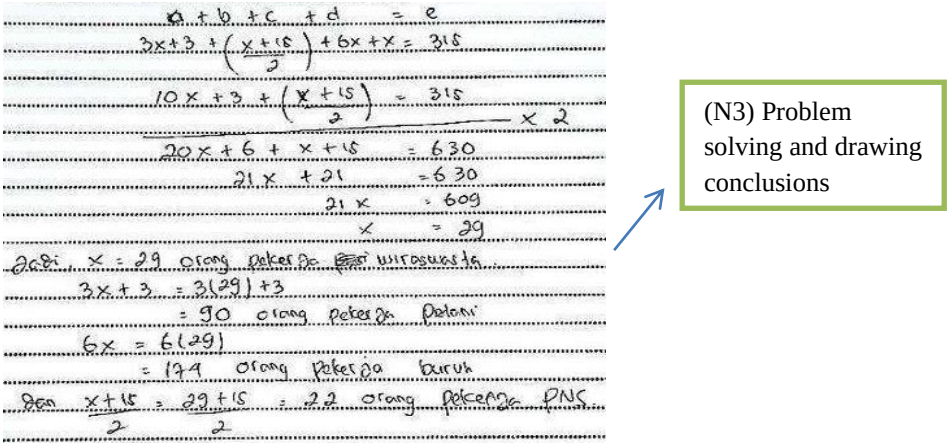

Figure 6. Results of Work on SA1

As seen in Figure 6, SA1 can write down the problem-solving process appropriately. SA1 sums up all the symbols that represent the work of the student's parents, then looks for the value x and substitutes it into each job. So that students can draw conclusions, namely 29 private workers, 90 farmer workers, 174 labour workers and 22 civil servant workers. In the interview process, SA1 and SA2 showed the following results.

P : How do you get the answer?
S :Yes, for example, first to make it easier to do, Then $a = 3x + 3$, $b = \frac{x+15}{2}$, $c = 6x, d = x$ *, and* $e = 315$, *all* $(a + b + c + d = e)$ *later the x if have found substituted for each job. And meet the results ma'am (pointing to the answer sheet)*

c. Concrete Random Subjects

Subjects were identified as RK1 and RK2. RK1 and RK2 can use symbols and numbers related to algebraic operations. The following is an example of the results of RK1's answer in Figure 7.

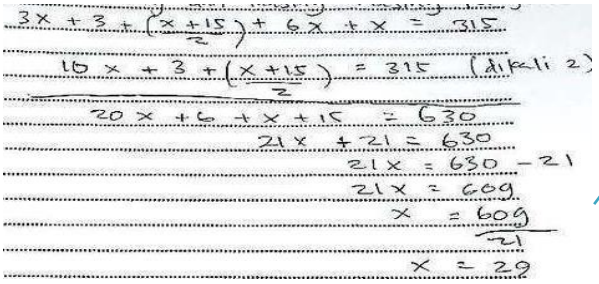

Figure 7. Results of Work on RK1

As seen in Figure 7, RK1 is precise in writing numbers and mathematical symbols associated with algebraic operations. During the interview, SAK1 was able to verbally explain that the symbol $3x + 3, \frac{x+15}{2}, 6x, and\ x$ was the number of people from each job. RK1 could not write down the known data from the table and what was asked in the questions, so (N2) was not fulfilled. RK1 and RK2 admitted that they did not write down the information data on the questions because they were not used to doing so and were directly involved in the problem-solving process.

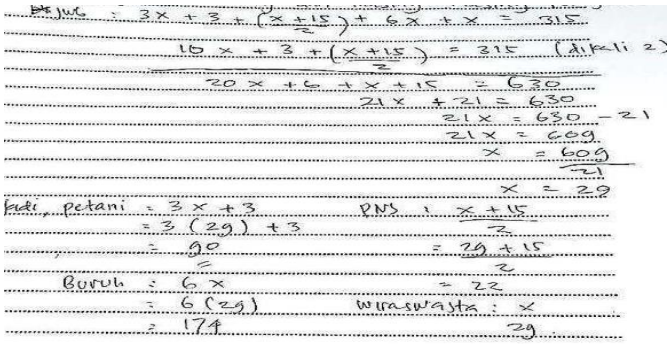

Figure 8. Results of Work on RK1

As seen in Figure 8, RK1 correctly determines the problem-solving formula and can conclude at the end correctly. In rows 1 to 11, RK1 adds up all the symbols equal to the sum of all the parents of the students, i.e. $(3x + 3 + \frac{x+15}{2} + 6x + x = 315)$. Then, in line 12 to line 17, substitute values and calculate each job$x$ so that the results obtained are 90 farmers, 22 civil servants, 174 workers and 29 entrepreneurs. Based on the interview results, RK1 was able to explain the completion steps well.

P : How do you get the answer?

S : I add all that is known $3x + 3 + \frac{x+15}{2} + 6x + x = 315$*,Then look for the value of x. If you have found it, substitute it back to each job. You'll see the results later.*

d. Abstract Random Subject

Subjects were identified as RA1 and RA2. RA1 and RA2 are less precise in using symbols and numbers related to algebraic operations. RA1 and RA2 could not interpret the meaning of the symbols in the questions. The following is an example of the results of RA2's answers in Figure 9.

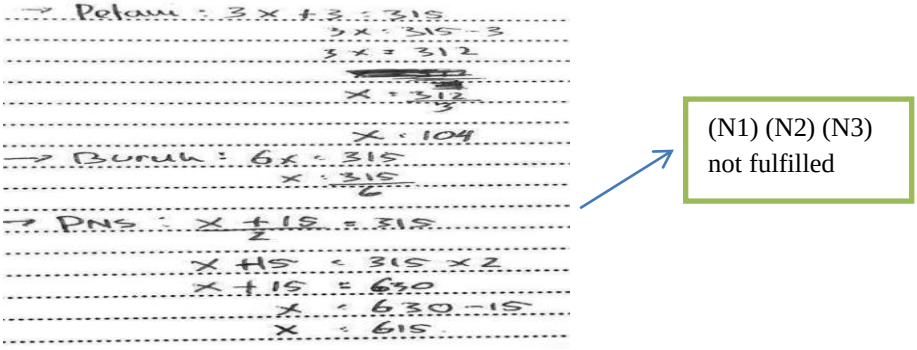

Figure 9.RA2 work results

In the interview process, RA1 and RA2 showed the following results.

P : After reading the questions, what do you understand?
S : Asked how many people work as farmers, Civil servants, workers and self-employed.
P : What does it mean by $farmers : 3x + 3 = 315$, *PNS:* $\frac{x+15}{2}$, *etc?*
S : Then look for the value of x
P : What is the meaning of the symbol the x?
S : That is a variable

The results of RA2 processing are in Figure 9. RA2 can be seen not writing down what is known from the table presented and what is asked in the questions so the second numeracy literacy indicator (N2) is not fulfilled. Lines 1 to 7 in Figure 9 immediately write down the problem solving, but the problem solving by RA2 is not quite right, so RA2 cannot answer the number of people in each job. RA does not add up all the symbols that represent parents' work. This results in indicator (N3) also not being met. In the interview process RA1 and RA2 unable to explain problem solving and realize mistakes when calculating.The following is a snippet of the interview.

P : How do you get the answer?
S : Look for the value of x, sis, one by one for each job.
P : What is the value of x?
S : There are 104 and615
P : Are you sure about this answer?
S : No sis, because I have not been able to find the answer

The results showed that not all subjects in this study could fulfill the three indicators of numeracy literacy in solving HOTS-based questions. The following table presents all descriptions of students' numeracy literacy for each indicator based on their thinking style.

Table 3. Student Numerical Literacy Viewed from Thinking Style

Subject	N1	N2	N3
SK1	√	√	√
SK2	√	√	√
SA1	√	√	√
SA2	√	√	√
RK1	√	–	√
RK2	√	–	√
RA1	–	–	–
RA2	–	–	–

Discussion

Based on the description above, students' numeracy literacy differs from their thinking styles. Subjects with the SK thinking style in solving problems can fulfill all three indicators of numeracy literacy. This can be seen in how SK did not experience difficulties writing down the steps for completion and could explain them well orally in line with research by Hadiastuti & Soedjoko (2019), which states that students with the SK thinking style have good symbolic representation abilities. Djadir et al., (2018) also stated that SK solves problems in stages. This is reinforced SK tends to remember formulas and information quickly and solves problems gradually.

Subjects with the SA thinking style in solving problems could also meet the three indicators of numeracy literacy.This can be seen from the students' study process, which is correct for questions in tables and stories. According to research Utami et al., (2020), Subjects with an Abstract Sequential thinking style have a good understanding of studying the information displayed in graphs, tables, pictures and diagrams. Subjects with an Abstract Sequential thinking style can also make generalizations based on sound reasoning in aspects of written text.

Subjects with RK thinking styles in solving problems only fulfilled two indicators, namely the first (N1) and third (N3) numeracy literacy indicators. This means that RK1 and RK2 cannot analyze the information displayed in the table but can interpret the analysis results to make decisions. Kholiqowati et al., (2016) state that students with the Random Concrete thinking style can develop their logical thinking. Different from Sanvi & Diana (2022) stated in their research that students did not yet have good numeracy skills because they could not meet the information analysis indicators. Students are not used to rewriting the information obtained and directly in problem-solving. Widodo (2016) states that errors occur due to habit, language interpretation, and conceptual and procedural errors.

Subjects with RA thinking style in solving problems did not meet the three indicators. Students make mistakes in interpreting symbolic language. This can be seen from the steps to solving the problem, which are not quite right. Also stated that students with the RA thinking style had minimal symbolic and verbal mathematical representation abilities in solving HOTS-based math problems. Errors in interpreting symbols in learning mathematics often occur because of the experience of learning mathematics and the lack of understanding of symbols as a whole. This is confirmed by research Hartatik & Nafiah (2020), who also researched numeracy skills. According to (Hasanah et al., 2020; Mahmudi, 2016), the lack of ability to make conclusions shows that students' abilities have not developed properly. This is

reinforced by Djadir et al., (2018) in their research, which states that subjects with RA thinking styles tend to use guessing strategies and show fundamental differences in processing information and concluding. Rahmy et al., (2019) also stated that subjects with a Random Concrete thinking style were better at making arguments than subjects with an Abstract Random thinking style.

This research's novelty lies in numeracy literacy ability based on the thinking style. This study found that students with Concrete Sequential (SK) and Abstract Sequential (SA) thinking styles showed higher numeracy literacy skills so that they could fulfill the three numeracy literacy indicators compared to other subjects. Students who manage information sequentially or tend to use the left brain are better at solving problems than students who often manage information randomly. Numbers and algebra require logical-mathematical skills, which are more in the left or sequential brain (Niswani & Asdar, 2016). This is reinforced by Rahmy et al., (2019) where students with a concrete sequential thinking style are better at exploring ideas and formulating problems than students with an abstract random thinking style. This is contrary to research by Munahefi et al., (2020), which states that students with RK and RA thinking styles are considered to have aspects of mathematical creative thinking.

CONCLUSIONS

Based on the analysis results, it can be concluded that students' numeracy literacy differs from their thinking styles in solving HOTS questions. SK and SA subjects demonstrated higher numeracy literacy skills so that they could use various symbols and numbers related to solving mathematical problems, analyze information in tables, and interpret the analysis results to make decision-making decisions compared to other subjects. Meanwhile, RK subjects can only fulfill two numeracy literacy indicators. However, RK subjects tend not to be able to analyze information, unlike RA subjects, who could not fulfill the three indicators of numeracy literacy. Students who manage information sequentially have better numeracy literacy in solving HOTS-based questions.

AUTHOR CONTRIBUTIONS STATEMENT

SNH as article writers. DPU & AS as mentors inwriting articles.

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