

Mathematical Thinking Processes of Junior High School Students in Solving Contextual Problems Based on Learning Styles

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Abstrak

Masalah kontekstual menuntut proses berpikir matematis yang runtut, logis, dan reflektif. Penelitian ini bertujuan menganalisis proses berpikir matematis siswa dalam menyelesaikan masalah kontekstual berdasarkan kerangka Mason (tahap entry, attack, dan review) ditinjau dari gaya belajar. Menggunakan pendekatan kualitatif deskriptif, penelitian ini melibatkan siswa kelas VII SMP Negeri di Kota Cirebon. Tiga subjek dipilih secara purposif untuk mewakili gaya belajar visual, auditori, dan kinestetik. Data dikumpulkan melalui tes, angket gaya belajar, dan wawancara mendalam. Hasil menunjukkan perbedaan karakteristik berpikir: siswa visual memenuhi seluruh indikator pada semua tahapan; siswa auditori mampu pada tahap entry dan attack namun terbatas dalam mengembangkan solusi pada tahap review; sedangkan siswa kinestetik hanya memenuhi sebagian indikator dan kesulitan dalam justifikasi serta refleksi. Temuan ini menegaskan pengaruh gaya belajar terhadap kualitas proses berpikir matematis. Implikasinya, pembelajaran matematika perlu dirancang secara adaptif untuk memperkuat penalaran dan refleksi siswa sesuai karakteristik belajarnya.

Kata Kunci: Masalah Kontekstual; Gaya Belajar; Proses Berpikir Matematis.

Abstract

Contextual problems in mathematics require a mathematical thinking process that is coherent, logical, and reflective. This study aims to analyze students' mathematical thinking processes in solving contextual problems based on Mason's framework—comprising the *entry*, *attack*, and *review* phases—viewed through learning styles. Utilizing a descriptive qualitative approach, the study involved seventh-grade students at a state junior high school in Cirebon. Three subjects were purposively selected to represent visual, auditory, and kinesthetic learning styles. Data were gathered through mathematical thinking tests, learning style questionnaires, and in-depth interviews. The results reveal distinct characteristics: visual learners met all indicators across all phases; auditory learners succeeded in the *entry* and *attack* phases but struggled with developing alternative solutions during the *review* phase; while kinesthetic learners only met partial indicators and faced difficulties in providing justification and reflection. These findings underscore the influence of learning styles on the quality of mathematical thinking. Consequently, mathematics instruction should be adaptively designed to strengthen student reasoning and reflection according to their learning characteristics.

Keywords: Contextual Problems; Learning Styles; Mathematical Thinking Processes.

I. INTRODUCTION

Thinking constitutes both a prerequisite and a primary goal of the learning process, as it fundamentally functions as a cognitive bridge that connects new information, problem-solving activities, and prior knowledge to generate meaningful conclusions (Pande & Bharathi, 2020). Mason conceptualizes thinking as a continuous and interconnected process comprising the stages of entry, attack, and review, which involve idea generation, strategy selection, and decision-making in problem-solving contexts. This framework explicitly represents the dynamic nature of students' thinking processes, thereby enabling the tracing of how ideas emerge, develop, and are evaluated throughout the problem-solving process (Stacey et al., 2010).

In mathematics learning, the presence of this thinking process cannot be separated from the teacher's role (Kooloos et al., 2022), which extends beyond facilitating conceptual understanding and problem solving to ensuring that students are genuinely engaged in cognitive processes leading to informed decisions and meaningful conclusions. Thinking may be understood as a cognitive process that drives individuals to determine subsequent actions or steps based on the outcomes of their reasoning (Evans, 2019). Therefore, thinking needs to be deliberately and systematically embedded in every learning context to foster students' thinking skills.

However, in practice, developing students' thinking abilities is not a simple challenge for educators, as it requires diverse and contextually appropriate instructional actions and stimuli (Sarwari &

Kakar, 2023). Classroom realities indicate that many students exhibit resistance to engaging in thinking processes, particularly when confronted with mathematical problems. Such resistance is manifested through delayed responses, lack of seriousness, superficial engagement, or tendencies to imitate peers' answers or rely on existing solutions without engaging in independent thinking. This condition suggests that students have not been adequately facilitated to externalize and reflect upon the thinking strategies they employ. Consequently, teachers need to provide targeted support, one of which involves encouraging students to articulate the thinking strategies they apply when solving mathematical problems (Tachie, 2019). Through this approach, thinking processes do not remain implicit but can be observed, developed, and pedagogically strengthened.

In this context, teacher support becomes more meaningful when it is aligned with students' learning style differences (Pashler et al., 2008). Each learning style : visual, auditory, and kinesthetics represents a distinct way of receiving information, constructing understanding, and expressing thinking strategies (Sheromova et al., 2020; Sulisawati et al., 2019). Students with visual learning styles tend to organize information more effectively through images, diagrams, or symbols (Qasserras, 2024); those with auditory learning styles develop understanding more effectively through verbal explanations and discussions (Ozerem & Akkoyunlu, 2015); meanwhile, students with kinesthetics learning styles require active engagement and direct experiences to construct meaning (Abah et

al., 2024). These differences result in variations in students' mathematical thinking processes across each stage of problem solving, ranging from problem comprehension to reflection on the obtained solutions.

Such variations in thinking processes become increasingly evident when students are engaged with contextual problems in mathematics learning (Hariri et al., 2025; Sheromova et al., 2020). Contextual problems require students to interpret real-life situations, identify relevant information, and connect it with previously learned mathematical concepts and procedures (Afni, 2020). Under these conditions, learning style differences influence how students construct an understanding of the problem context, formulate solution strategies, and evaluate the validity of their solutions (Amalia et al., 2024; Manfreda Kolar & Hodnik, 2021). Consequently, contextual problems function not only as tools for assessing learning outcomes but also as effective means for revealing the dynamics of students' mathematical thinking processes in greater depth (Nur et al., 2020). Therefore, examining students' mathematical thinking processes in solving contextual problems is essential for understanding how they navigate context, concepts, and strategies based on their learning styles.

Numerous studies have investigated students' mathematical thinking processes, providing findings that support the present study. (Setiawan et al., 2020; Setiyani et al., 2025; Waluya et al., 2024) described students' thinking processes based on different cognitive styles and found

significant differences at the problem comprehension stage. Students with a Field Independent (FI) cognitive style demonstrated a better understanding of problems and mathematical content compared to those with a Field Dependent (FD) cognitive style. Meanwhile, (Wu & Molnár, 2022) reported that students with high problem-solving ability fulfilled all indicators of the thinking process across the entry, attack, and review stages. Students with moderate ability met the entry stage indicators but failed to fulfil all components at the attack stage (limited to *try* and *maybe*), and during interviews were unable to clearly justify their reasoning in the *why* component. At the review stage, these students were unable to connect their solutions with what had been identified during the entry stage. In contrast, students with low ability produced responses that did not align with the given instructions. Despite these findings, prior studies have not specifically examined students' mathematical thinking processes in solving contextual problems from the perspective of learning styles. Accordingly, the findings of this study are expected to enrich the theoretical discourse on mathematical thinking processes while also offering practical contributions for teachers in designing more adaptive, contextual, and pedagogically responsive instructional support aligned with students' learning characteristics.

II. METHOD

This research is a descriptive study using a qualitative approach. The purpose of this research is to provide an overview of how

students' mathematical thinking processes occur when solving contextual problems based on their learning styles. The study was conducted at SMP Negeri 12 Kota Cirebon on July 29, 2024. The subjects of this research were 32 students from class VIID at SMP Negeri 12 Kota Cirebon, with 3 students selected as the research sample. The selection of subjects for each learning style was based on several considerations, including the completeness of the mathematical thinking processes demonstrated by the students, willingness to participate as research subjects as indicated in the consent forms, fluency in verbal communication, recommendations from mathematics teachers, equivalence of initial mathematical abilities, and the achievement of data saturation.

The data collection techniques used in this study included tests, questionnaires, and interviews. The instruments used were a mathematical thinking skills test, a learning style questionnaire, and an interview guide. The mathematical thinking skills test consisted of two-story problems related to contextual mathematical issues created by the researcher. The mathematical thinking skills test was used to determine the mathematical thinking processes of the students in class VIID, the learning style questionnaire was used to identify the students' learning style tendencies, and the interview guide was used to clarify the test responses regarding their mathematical thinking processes.

The data analysis technique (Miles & Huberman, 1994) employed in this research consisted of three stages: 1) Data reduction, 2) Data presentation, and 3) Drawing conclusions. In the data reduction stage,

one sample representing each learning style was selected. In the data presentation stage, the students' mathematical thinking processes in solving the test instruments were described, referring to indicators of mathematical thinking processes. In the final stage, drawing conclusions, the researcher summarized the findings by describing the data that had been analyzed. The indicators of mathematical thinking processes in this research are examined based on three stages of problem-solving according to the framework (Stacey et al., 2010) : the entry, attack, and review stages.

Table 1.
Indicators of Student's Mathematical Thinking Processes

Stage	Aspect	Indicator
Entry	Know	1. Understanding the problem thoroughly 2. Attempting to identify the elements involved in the problem, such as what is known and what is being asked.
	Want	1. Desiring to categorize and organize information. 2. Desiring to solve the problem.
	Introduce	1. Selecting which elements need to be represented symbolically or choosing which symbols to use. 2. Organizing what is known from the problem.
Attack	Try	1. Formulating hypotheses about the solution to the problem. 2. Modifying incorrect hypotheses to make them correct.
	Maybe	1. Testing whether the hypotheses made can solve the problem.
	Why	1. Having logical reasoning for accepting or rejecting a hypothesis. 2. Convincing others that each step of the solution is correct, either verbally or through a

Stage	Aspect	Indicator
		written presentation of the systematic solution.
Review	Check	1. Checking the accuracy of calculations. 2. Checking the accuracy of reasoning in the solution steps. 3. Checking the alignment of the solution steps with the question.
	Reflect	1. Reflecting on the ideas in the solution, identifying which parts were difficult, and understanding what can be learned from the solution process. 2. Reflecting on the interim hypotheses.
	Extend	1. Creating a general form of the obtained result to be applicable in a broader context. 2. Exploring alternative solutions. 3. Attempting to solve similar problems with changes to the factors and questions.

III. RESULT AND DISCUSSION

The identification of students' learning styles constitutes an initial step to provide an empirical basis for grouping participants prior to examining variations in their thinking processes. Understanding the distribution of learning styles among the students is essential, as it serves as a reference for interpreting subsequent analyses related to how students engage with contextual mathematical problems. In this regard, Table 2 summarizes the results of the students' learning style questionnaire, showing the distribution of learning styles within the research participants.

Table 2.
Results of the Students' Learning Style Questionnaire

Types of Learning Styles	Number of Student's
Visual	13
Auditory	9
Kinesthetic	10
Total	32

Out of the 32 students in class VII, the researcher selected 3 students as subjects for the study based on the classification of learning styles, which includes Visual, Auditory, and Kinesthetic. Each type of learning style is represented by one dominant student, SV-01 (Visual), SA-01 (Auditory), SK-01 (Kinesthetic).

Mathematical Thinking Process of Students with Visual Learning Style

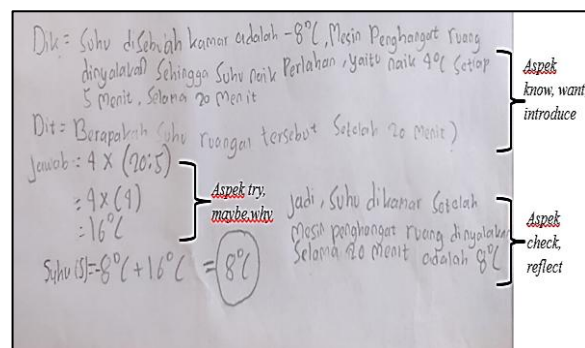


Figure 1. Response of Subject SV-01 to Contextual Problem Number 1.

Figure 1 is the interview result of subject SV-01 during the entry stage between the researcher (R) and the student (S):

R: After reading the problem, do you understand its meaning?

S: Yes, I understand the meaning.

R: What do you understand?

S: The initial temperature is -8°C , and then every 5 minutes, the temperature increases by 4°C . The question is about the temperature after 20 minutes. That's the main idea of the problem.

R: How do you plan to solve this problem?

S: To find the temperature after 20 minutes, we first need to calculate the temperature increase.

Based on the interview results with subject SV-01, it can be concluded that at

the entry stage, the student has successfully met the know aspect. This is demonstrated by the student's understanding of the problem and their ability to identify what is known and what is being asked. In the want aspect, the student also meets the criteria, as they are able to organize the information presented in the problem. Regarding the introduce aspect, the student has fulfilled this requirement as well, having symbolically represented the temperature with the variable S .

To understand the next stage, which is the attack stage, the researcher conducted the following interview:

R: How did you determine the temperature increase?

S: Since the temperature increases by 4°C every 5 minutes, the increase over 20 minutes would be 16°C .

R: Where did you get the 16°C result?

S: We divide 20 minutes by 5, then multiply the result by 4°C .

R: Why do you need to divide by 5?

S: Because the temperature increases every 5 minutes, so the divisor is 5. I thought that in 5 minutes, the temperature increases by 4°C , so in 10 minutes, it would be double that, and in 20 minutes, it would be four times. Then, multiplying by the temperature increase of 4°C gives a total increase of 16°C .

R: What is the next step?

S: Once the temperature increase is known, we just need to add it to the initial temperature.

At the attack stage, the student has demonstrated the try aspect by attempting to deduce that the temperature increase needs to be calculated first to solve the problem. The student has also met the maybe aspect, as evidenced by their attempt to find the temperature increase. The why aspect is also fulfilled, as the student can accurately explain how they obtained the temperature increase. Therefore, based on the interview results,

subject SV-01 has met the attack stage (try, maybe, why). The interview results with subject SV-01 at the review stage are as follows:

R: Are you confident about your answer?

S: Yes, I'm confident. (The student's face shows confidence.)

R: Have you double-checked your answer?

S: Yes, I checked it earlier, and it seems correct.

R: Did you think of solving the problem in another way?

S: No, I only thought about this method

R: Do you think this problem is difficult?

S: No, I don't think it's difficult. We had similar practice problems last week.

R: If I changed the numbers, would you still be able to solve the problem?

S: Insha Allah, I should be able to, as long as I know the method.

Based on the interview results, at the review stage, the student has met the check aspect, as they have reviewed their work to ensure the answer is correct. The reflect aspect is also fulfilled, as the student can explain the difficulty level of the problem and considers it easy to solve. The extend aspect is met because the student is capable of solving similar problems with different numbers and conditions. In the review stage, all aspects (check, reflect, and extend) have been satisfied by subject SV-01.

From the analysis of subject SV-01's responses, it is evident that the subject is able to explain the problem-solving process very well. The subject has planned the solution to the contextual problem accurately and can explain each detail of the solution precisely. According to Mason's stages of mathematical thinking, subject SV-01 has met all stages of Mason's thinking process: entry, attack, and review.

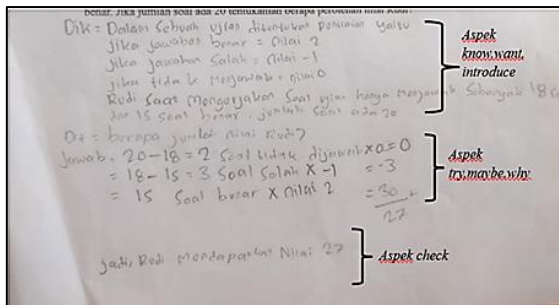


Figure 2. Response of Subject SV-01 to Contextual Problem Number 2.

Figure 2 is the interview result of subject SV-01 during the entry stage between the researcher (R) and the student (S):

R: What can you explain about problem number 2?

S: (while reading the problem) It's about scoring a test.

R: What information did you get from the problem?

S: If the answer is correct, it gets a score of 2; if the answer is wrong, it gets a score of -1; if the question is not answered, the score is 0.

R: How do you plan to solve this problem?

S: Multiply the number of correct answers by 2, the number of wrong answers by -1, and the number of unanswered questions by 0.

R: How did you determine the number of correct and wrong answers?

S: From this (pointing to the problem), out of 20 questions, 18 were answered, so 2 were not answered. And since there were 15 correct answers, that means there are 3 wrong answers.

Based on the interview results with subject SV-01, it can be concluded that at the entry stage, the student has met the know aspect. This is demonstrated by the student's understanding of the problem and their ability to identify what is known and what is being asked. The student has also met the want aspect, as they are able to organize the information provided in the problem. For the introduce aspect, the student has fulfilled this requirement by organizing what is known from the problem. To understand the next stage, which is the

attack stage, the researcher conducted the following interview:

R: Continue with the steps you took to solve the problem.

S: There are 15 correct answers, so $15 \times 2 = 30$. There are 3 wrong answers, so $3 \times (-1) = -3$. There are 2 unanswered questions, so $2 \times 0 = 0$. Then we add those values together.

R: Why do you need to add those values together?

S: Because the question is asking for the total score, so we need to add them up.

At the attack stage, the student has demonstrated the try aspect by attempting to determine the number of correct answers, wrong answers, and unanswered questions, and then applying the scoring criteria to each. The student has also met the maybe aspect, as evidenced by their attempt to sum up all the calculated scores based on the given criteria. The why aspect is fulfilled as well, as the student can explain and justify their steps accurately. Therefore, based on the interview results, subject SV-01 has met the attack stage (try, maybe, why). Here is the translation of the interview results with subject SV-01 at the review stage:

R: So, what is Rudi's total score?

S: The result is $30 + (-3) + 0 = 27$, Ma'am.

R: Did you check your answer again?

S: Let me check it again, Ma'am, just to make sure I didn't miss anything (examining the answer carefully). It's correct, Ma'am.

R: If I changed the numbers, would you still be able to solve the problem?

S: Yes, Ma'am, I think so, as long as the pattern remains the same (smiling). I'm just worried about being a bit careless with the calculations.

Based on the interview results, at the review stage, the student has met the aspects of checking, reflecting, and extending. The student has verified their answer to ensure its accuracy,

demonstrated an understanding of the difficulties in the problem, and considered alternative solutions.

The analysis of subject SV-01's answers shows that the student has effectively explained the problem-solving process, performed calculations accurately, and provided detailed explanations of their work. According to Mason's thinking process stages, the subject has fulfilled all stages: entry (know, want, introduce), attack (try, maybe, why), and review (check, reflect, extend).

Mathematical Thinking Process of Students with an Auditory Learning Style

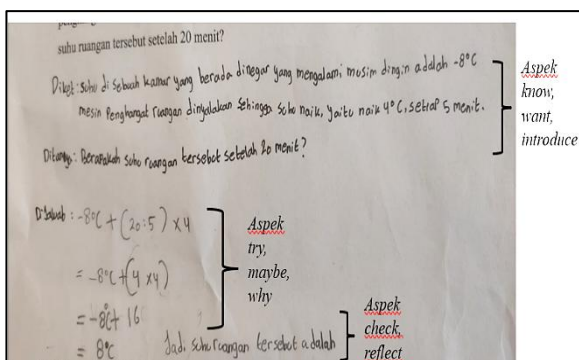


Figure 3. Response of Subject SA-01 to Contextual Problem Number 1.

Figure 3 are the results of the interview with Subject SA-01 during the entry phase between the researcher (R) and the student (S):

R: Have you understood what the problem is asking?

S: Just a moment, ma'am (while re-reading the question).

R: What do you understand?

S: The room temperature is -8°C and it increases slowly by 4°C every 5 minutes. What is being asked is the temperature after 20 minutes.

Based on the interview results with Subject SA-01 during the entry phase, it can be concluded that the student has met the aspect of "know," as shown by their understanding of the problem and their

ability to identify that the room temperature starts at -8°C and increases by 4°C every 5 minutes. For the "want" aspect, the student also meets the criteria, as they are able to organize the information presented in the problem. For the "introduce" aspect, the student is also compliant, as they are able to compile what is known from the problem. In the entry phase, Subject SA-01 has met all aspects (know, want, introduce).

To understand the subsequent stage, which is the attack phase, the researcher conducted the following interview:

R: How do you solve this problem?

S: Ummm... Do I divide it? (appears to ask back)

R: What do you divide?

S: The 20 minutes, ma'am, divided by 5, and then add the result to the initial temperature.

R: Is that the final temperature?

S: Oh, I was wrong. Before adding to the initial temperature, you need to multiply it by 4°C first.

R: Why do you need to multiply by 4°C ?

S: Because the temperature increases by 4°C .

In the attack phase, the student was able to demonstrate the aspect of "try", as shown by their attempt to solve the problem by dividing 20 minutes by 5. The student also met the "maybe" aspect, as evidenced by their attempt to determine the temperature increase. In terms of the "why" aspect, subject SA-01 was able to logically explain the solution, although there was an initial mistake that was later corrected. Therefore, based on the interview results, student SA-01 has fulfilled the attack phase, covering the aspects of try, maybe, and why.

The results of the interview with subject SA-01 during the review phase are as follows:

R: Is the answer correct?

S: Yes, it is, but I initially forgot to multiply by 4°C .

R: So, you have checked it again?
S: Yes, I have.
R: Do you think this problem is difficult?
S: It's moderate, hehehe.
R: Which part do you find difficult?
S: I was just a bit careless and forgot to multiply by 4°C.

Based on the interview results, during the review phase, the student was able to meet the aspect of "check" as they reviewed their work. They also met the aspect of "reflect" since they could identify the difficult part of the problem. However, the aspect of "extend" was not observed to be fulfilled.

The analysis of subject SA-01's responses indicates that the student was able to explain the problem-solving process quite well. They performed the calculations correctly, were able to correct mistakes, and explained their process accurately. According to Mason's thinking process stages, subject SA-01 met the stages of entry (know, want, introduce), attack (try, maybe, why), and review (check and reflect).

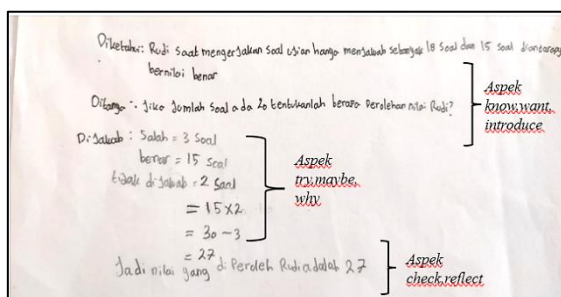


Figure 4. Response of Subject SA-01 to Contextual Problem Number 2.

Figure 4 is the results of the interview with subject SA-01 at the entry stage between the researcher (R) and the student (S):

R: How did you approach solving this problem?
S: The total number of questions is 20, and 18 were answered, so we need to find out how

many questions were answered correctly and how many were wrong.

R: Can you explain what you mean?
S: The number of correct answers is multiplied by 2, right? And if it's wrong, it's multiplied by -1?
R: According to your understanding, is that correct?

S: (Pauses) Yes, that's correct.

From the results of the interview with subject SA-01, it can be concluded that at the entry stage, the student was able to meet the aspects of know, want, and introduce.

To determine the next stage, attack, the researcher conducted the following interview:

R: What are the next steps in solving it?
S: 15 multiplied by 2 equals 30, then subtract 3, so the total score is 30 minus 3 equals 27.
R: Why did you solve it that way?
S: That's how it should be according to the rules. If you answer correctly, you get 2 points, and if it's wrong, you get -1 point.

At the attack stage, the student demonstrated the aspect of try by attempting to determine that solving the problem involves multiplying the number of correct answers by 2 and the number of wrong answers by -1. The student also met the maybe aspect, as evidenced by their attempt to verify their solution by multiplying all the values based on the scoring criteria. Regarding the why aspect, the student was able to explain and justify their approach to solving the problem. Based on the interview results, the student SA-01 fulfilled the attack stage (try, maybe, why)

The interview results with subject SA-01 at the review stage are as follows:

R: Are you sure your answer is correct?
S: Yes, I think so, I hope it's correct.
R: Did you check your answer again?
S: Yes, I've checked it again.

R: Do you think this question is difficult?

S: It's quite easy, ma'am.

R: Have you thought of solving it in a different way?

S: I don't know, ma'am.

Based on the interview results, at the review stage, the student has demonstrated proficiency in the aspect of checking, as the student rechecked their work to ensure that the answer was correct. In the aspect of reflecting, the student was able to explain the difficulties encountered in the problem. However, the student has not met the aspect of extending, as they were not able to think of alternative solutions for the problem. Thus, in the review stage, the subject fulfilled the aspects of checking and reflecting.

Based on the analysis of the subject SA-01's answers, it is evident that the subject has demonstrated a good understanding of the problem-solving process. The subject also performed calculations correctly. According to Mason's stages of mathematical thinking, the subject SA-01 meets the stages of entry (know, want, introduce), attack (try, maybe, why), and review (check, reflect).

Mathematical Thinking Process of Students with Kinesthetic Learning Style

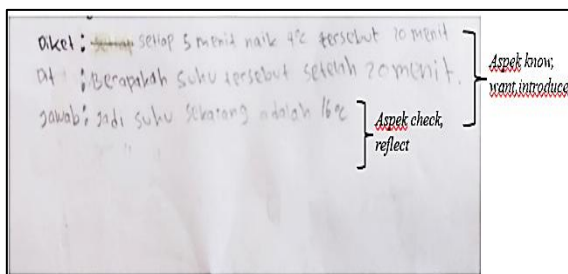


Figure 5. Response of Subject SK-01 to Contextual Problem Number 1.

Figure 5 is the results of the interview with subject SK-01 at the entry stage between the researcher (R) and the student (S).

R: Here is a question, try to read it carefully.

S: Yes, ma'am (while reading the question).

R: What do you understand?

S: Wait a moment, ma'am, I still don't understand.

R: Try reading it again carefully.

S: This, ma'am, is asking for the temperature after 20 minutes.

R: Do you understand the question now?

S: Yes, ma'am, I do.

R: So, how are you going to solve this problem?

S: (pauses and looks confused) We add it, right?

R: Why do you add? Add what?

S: Add the temperature.

Based on the results of the interview with subject SK-01, it is observed that the subject was confused when asked about solving the problem. It can be concluded that at the entry stage, the student has already met the aspect of "know," as indicated by the student's understanding of the problem in the question and ability to identify what is known and what is being asked, even though they had to read the question more than once. Regarding the "want" aspect, the student also appears to have met this criterion, as they were able to organize the information presented in the question. Lastly, for the "introduce" aspect, the student has met this as well, as evidenced by their ability to compile what is known from the question.

Next, to determine the following stage, which is the attack stage, the researcher conducted the following interview:

R: How do you add?

S: 4 times 4, ma'am, so it's 16.

R: Why 4 times 4?

S: Oh, I don't know, ma'am, I'm confused.

R: Try reading the question carefully again.

S: This is because the temperature increases by 4 degrees every 5 minutes, ma'am, so the result is 4 times 4.

R: Then, what's the next step?

S: So, the answer is 16°C, the result of 4 times 4.

R: Are you sure about the steps you took?

S: *I'm confused, haha (laughing), well, I guess I'm sure, ma'am.*

At the attack stage, the student appears to have demonstrated the "try" aspect, as evidenced by their attempt to solve the problem by using temperature addition, even though they were uncertain and confused during the interview. Regarding the "maybe" aspect, the student has met this criterion, as shown by their attempt to find the temperature increase. However, for the "why" aspect, subject SK-01 was unable to logically explain the problem-solving process and was not confident about their results. Kinesthetic students tend to construct understanding through direct action (*learning by doing*), exploration, and spontaneous responses to the situations they encounter. In this context, the act of multiplying 4×4 is not merely random, but represents an initial exploratory attempt to engage with the numerical information available in the problem. The student's inability to verbally explain the reasoning (*why*) does not necessarily indicate an absence of a thinking process; rather, it reflects that the cognitive processes involved remain implicit and have not yet been articulated reflectively. Thus, the "try" and "maybe" aspects at the *attack* stage represent an action-oriented kinesthetic thinking pattern, although it has not yet developed into mature conceptual reasoning. Therefore, based on the interview results, the student SK-01 has fulfilled the attack stage only in the "try" and "maybe" aspects, but has not yet managed to address the "why" aspect.

Interviewer's results with subject SK-01 during the review stage are as follows:

R: *Why do you seem unsure about your answer?*

S: *The sentence is confusing, so I'm hesitant.*

R: *Have you checked your answer again?*

S: *Yes, I have.*

R: *Do you think this question is difficult?*

S: *Yes, it's difficult. Please give easier questions (smiling).*

R: *Which part do you think is difficult?*

S: *Determining the temperature after 20 minutes is difficult. Why not just find the temperature after 5 minutes? It's easier, you just need to add 4.*

From the interview results, it appears that at the review stage, the student has met the check aspect because they have reviewed their work to ensure that their answers are correct. The student has also met the reflect aspect because they can identify the difficult parts of the question. However, the student could not explain possible alternative methods to solve the problem, so it can be concluded that the student has not met the extend aspect.

Based on the analysis of the answers and interview results of subject SK-01, it is evident that SK-01 struggles to manage the information provided in the question to solve contextual problems. The subject only answered the increase in temperature but did not address the question asked in the problem. Thus, the subject could not answer the question completely. The answer sheet shows that the subject jumped to the conclusion without writing down the process. During the interview, the subject appeared confused.

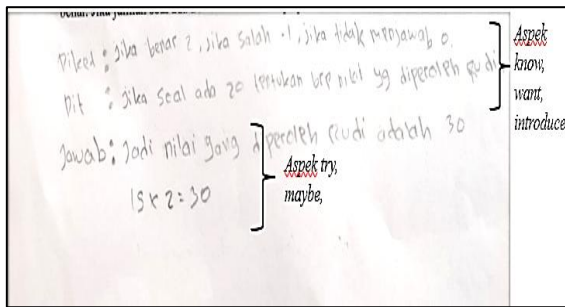


Figure 5. Response of Subject SK-01 to Contextual Problem Number 2.

The interview result of subject SK-01 for contextual problem number 2 at the entry stage between the researcher (R) and the student (S).

R: Have you read problem number 2?

S: Yes, I have read it, ma'am.

R: What information did you get from the problem?

S: It's about the exam where the scores are different; some are wrong, some are correct.

R: What should be done with the problem?

S: It seems like it should be multiplied, ma'am (appears confused).

From the interview with subject SK-01, it can be concluded that at the entry stage, the student has met the know aspect, as indicated by the student's understanding of the problem and their ability to identify what is known and what is being asked. The student also appears to have met the want aspect because they are able to systematically organize the information provided in the problem. For the introduce aspect, the student has met the requirement as they are able to outline what is known from the problem.

To determine the next stage, which is the attack stage, the researcher conducted the following interview:

R: What is being multiplied? Please explain in detail!

S: Well, they answered 15 correctly, ma'am, so it's multiplied: $15 \times 2 = 30$.

R: And then?

S: So, the answer is 30, Rudi's score.

R: What about the number of questions that were wrong or unanswered? Did you not pay attention to that?

S: It seems to me that it's not counted, ma'am; only the correct answers are counted. I'm not sure, I'm confused.

At the attack stage, the student seems to have demonstrated the try aspect, as evidenced by their attempt to guess that multiplying the number of correct answers would solve the problem. The student has also met the maybe aspect, as shown by their attempt to test their guess by multiplying the number of correct answers by 2. However, the student was unable to explain and justify their steps accurately for the why aspect. Therefore, based on the interview results, student SV-01 has met the attack stage only in the try and maybe aspects.

The results of the interview with subject SV-01 at the review stage are as follows:

R: So, what is Rudi's total score?

S: It's 30, ma'am.

R: Did you check the answer again?

S: No, ma'am. I just accepted it as it is.

R: Why did you just accept it? What was difficult about the problem?

S: I was confused, ma'am, about the wording.

From the interview results, it appears that at the review stage, the student did not meet the check aspect because they did not review their work. The student met the reflect aspect as they could explain the difficulty of the problem. However, the student did not meet the extend aspect because they did not consider alternative solutions for solving the problem. At the review stage, the subject only met the reflect aspect.

Based on the analysis of subject SK-01's answers, it appears that the subject struggles to explain the problem-solving

process. The subject has difficulty processing the information presented to solve the problem. There are steps that were missed, even though the teacher had provided guidance, and the subject was not perceptive, assuming their answer was correct. According to Mason’s stages of thinking, subject SK-01 meets the stages of Mason’s thinking process at the entry stage (know, want, introduce), attack stage (try, maybe), and review stage (only meets the reflect aspect).

Table 3.
Analysis of Mathematical Thinking Processes Based on Learning Styles

Stages of Mathematical Thinking Processes	Visual Learning Style	Auditory Learning Style	Kinesthetic Learning Style
Entry	Students with a visual learning style are able to understand the problems presented in the questions. They can write down what is known and what is being asked in the question. Students find it easier to create visualizations to understand the problem, such as making drawings or graphs.	Students with an auditory learning style are able to understand the problems presented in the questions. They can write down what is known and what is being asked. However, auditory learners need to read the question more than once to fully understand it	Students with kinesthetic learning styles were able to understand the problems presented in the tasks and could clearly write down the given information and what was being asked in the questions.
Attack	Students with a visual learning style are able to make accurate guesses for problem solutions and complete calculations correctly based on their guesses. They are also capable of explaining the procedures or steps for solving problems very well.	Students with an auditory learning style are able to make accurate guesses for solutions and complete calculations correctly based on their guesses. They often communicate with the teacher to confirm that the steps they have taken are correct. When it comes to explaining the steps for solving a problem, auditory learners excel in articulating their process	Students with a kinesthetic learning style are able to make guesses for problem solutions but struggle with completing calculations accurately. They have difficulty correcting errors in their calculations, which affects their ability to explain the correct steps for solving the problem
Review	Students with a visual learning style have a good level of accuracy; they carefully check their work and ensure that their answers are correct. They are able to analyze the difficulties in the problem and think of alternative solutions or approaches for different types of problems	Students with an auditory learning style are adept at identifying errors in their answers and can easily correct mistakes when they occur, ensuring that their final answers are correct. They are also capable of analyzing the difficulties in the problem	Students with a kinesthetic learning style are less meticulous in checking for errors and sometimes do not review their answers. However, they are capable of analyzing the difficulties in the problem

Based on the analysis of the answers provided by the research subjects, students with a visual learning style are able to meet each indicator of the stages of the thinking

process according to Mason (entry, attack, and review). Visual learners are able to understand the intent of the problem, describe what is known and what is being asked. They are capable of making problem-solving guesses and then effectively complete the solution with accurate steps, explaining the steps taken clearly. This is consistent with the findings of (Jatisunda et al., 2019) which indicates that students with a visual learning style have conceptual thinking processes, can solve problems effectively, and review their work. This aligns with the work of (Machromah et al., 2021) which states that students with a visual learning style can recognize problems, draw general conclusions, and tend to pay close attention to details. Cognitively, visual learners tend to be more effective in organizing information through diagrams, symbols, and spatial relationships, which aligns closely with the nature of mathematics as a discipline that requires abstract and structured representations. This ability enables visual learners to comprehend problems more holistically at the *entry* stage, design solution strategies systematically at the *attack* stage, and conduct more structured evaluation and reflection at the *review* stage. This is consistent with Cognitive Load Theory (Sepp et al., 2019), which posits that well organized visual representations can reduce cognitive load in working memory, thereby enabling more efficient and deeper information processing.

Students with an auditory learning style only meet some of the thinking process stages. They are able to understand the problem quite well and make accurate guesses, although they appear somewhat

hesitant in responding to the researcher's questions during interviews. However, these students can precisely explain the steps taken to solve the problem. Auditory learners often need to read the question more than once to fully comprehend it. This finding suggests that contextual problems, which are typically text-heavy, may inherently disadvantage auditory learners when they are not given opportunities to read the problem aloud or engage in verbal discussion prior to problem solving. Once they understand the problem, they are very good at communicating and presenting their results. (Antonietti, 2022) the importance of auditory-based strategies, such as listening to readings aloud and using rhythm and tone when learning new information.

Students with a kinesthetic learning style meet only some stages of the thinking process. They are able to understand the problem and identify what is known and what is being asked. However, these students are less accurate in making guesses for problem-solving. During interviews, kinesthetic learners have difficulty explaining the steps for solving the problem. According to (Irvine, 2019), kinesthetic learners tend to be less effective in planning strategies and tactics because many do not write down their assumptions when solving problems. (Ikawati & Kowiyah, 2021) notes that kinesthetic learners often have limitations in making final decisions and tend to be restless, frequently moving while working on problems. (Mavilidi et al., 2018) states that integrating physical movement into learning supports cognitive and social development, as well as enhances

engagement and understanding of the material.

This study can be further optimized in several aspects. The limited number of research subjects, consisting of only three students, means that the findings are primarily contextual and should be interpreted with caution when considering broader generalization. In addition, the analysis focuses on students' mathematical thinking processes based on learning styles, leaving opportunities to enrich future studies by incorporating other factors that may influence thinking processes, such as learning motivation, self-confidence, prior learning experiences, and instructional context. Future research involving a larger number of participants and a wider range of supporting variables is expected to provide a more comprehensive understanding of students' mathematical thinking processes.

IV. CONCLUSION

Based on the analysis of the answers from subjects SV-01, SA-01, and SK-01, it can be concluded that students with a visual learning style have successfully met the stages of mathematical thinking as outlined by Mason. At the entry stage, they have met all three aspects (know, want, introduce). At the attack stage, they have fulfilled all three aspects (try, maybe, why). Finally, at the review stage, they have met all three aspects (check, reflect, and extend). Therefore, visual learners cover all aspects in each stage of mathematical thinking according to Mason's theory.

Students with an auditory learning style have met the stages of mathematical thinking according to Mason as follows: at

the entry stage, they have fulfilled all three aspects (know, want, introduce); at the attack stage, they have met all three aspects (try, maybe, why); however, at the review stage, they have met only two aspects (check and reflect).

Students with a kinesthetic learning style have also met the stages of mathematical thinking according to Mason: at the entry stage, they have fulfilled all three aspects (know, want, introduce); at the attack stage, they have met two aspects (try and maybe); and at the review stage, they have met two aspects (check and reflect).

Based on the research findings, several recommendations are provided: 1) As educators, teachers should encourage students to review their answers to minimize errors in problem-solving. 2) Teachers should regularly provide contextual problems to practice thinking processes and improve students' proficiency in solving mathematical problems. 3) Further research is needed on mathematical thinking processes for different topics.

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