JUPE : Jurnal Pendidikan Mandala
Vol. 11 No. 2 Juni 2026
P-ISSN: 2548-5555, *E-ISSN:* 2656-6745
DOI: https://ejournal.mandalanursa.org/index.php/JUPE/index

Students' Critical Thinking Process in Solving Contextual Problems Reviewed from Sensing and Intuition Learning Styles

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Article Info

Article history:
Accepted: 12 Juni 2026
Publish: 26 Juni 2026

Keywords:
Critical thinking;
Sensing;
Intuition;
Learning style;
Probability.

Abstract

Critical thinking is a cognitive activity involving the ability to understand, analyze, evaluate, conclude, explain, and regulate thoughts systematically and objectively. This qualitative case study aims to describe students' critical thinking processes in solving contextual problems, specifically examining sensing and intuition learning styles. The research involved two 10th-grade students, one with a sensing style and one with an intuition style, selected via purposive sampling. Data collection utilized learning style questionnaires, math ability tests, contextual problem-solving tasks, and interviews. Data analysis was based on Mason et al. (2010) problem-solving stage indicators. The study found that the critical thinking processes of students with sensing and intuition learning styles are similar across the entry, attack, and review stages. In the entry stage, students gather important information, relate it to existing knowledge, and determine initial problem-solving steps. In the attack stage, they design a problem-solving strategy and execute it. In the review stage, students review solution steps, reflect on difficult parts, and explore alternative solutions.

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1. INTRODUCTION

The thinking process is a fundamental cognitive activity for individuals in understanding, analyzing, and solving problems. In the learning context, thinking is the main key to obtaining an understanding of a concept. Thinking itself is a mental process that enables a person to organize experiences and information in order to produce effective problem solving (Piaget, 1952). The thinking process includes several stages, such as receiving information, processing it, and drawing conclusions based on existing data (Santrock, 2018). A deep understanding of students' thinking processes is important for improving the effectiveness of learning, especially in mathematics, which requires systematic problem solving. One form of thinking that plays a very important role in problem solving is critical thinking (Facione, 2015).

Critical thinking is defined as the ability to analyze and evaluate information logically and systematically in order to reach an appropriate conclusion. Ennis (1985) states that critical thinking includes skills in interpreting, analyzing, evaluating, and drawing rational conclusions based on available facts and evidence. Facione (1990) adds that critical thinking involves reflective thinking skills that enable individuals to identify valid and relevant arguments. Critical thinking ability is very important in education, particularly in subjects that require logical reasoning such as mathematics. Through critical thinking, students can develop problem-solving skills with a more structured and in-depth approach. However, students' critical thinking ability in Indonesia remains relatively low, as reflected in international studies such as the Trends in International Mathematics and Science Study (TIMSS). The study shows that Indonesian students have consistently been placed in low rankings, for example, 44th out of 49 countries in TIMSS 2015 (Hadi & Novaliyosi, 2019). Therefore, critical thinking needs to be developed as a provision for students to solve problems and adapt to the challenges of the times (Ash-Showy et al., 2022).

Problem solving is one form of higher-order thinking that involves the ability to analyze, evaluate, and create solutions (Iolanessa et al., 2020). NCTM (2000) emphasizes that problem solving should be the main focus of mathematics learning because it trains students to think critically and systematically. This ability is useful not only in academic contexts but also in everyday life (Polya, 1973). Effective problem solving requires a deep understanding of concepts, the application of appropriate strategies, and the ability to evaluate results (Schoenfeld, 1992). In mathematics learning, the problems given should be contextual so that they become more meaningful for students (Hiebert et al., 1996).

Contextual problems are problems related to real situations experienced by students in their daily lives (Nurhayati et al., 2022). The presentation of problems that are close to students' reality can optimally develop critical thinking and problem-solving processes (Hiebert et al., 1996). However, each student has a different approach to solving problems because of variations in learning styles (Kolb, 1984). Learning style is closely related to students' conceptual understanding and critical thinking ability (Hidayati et al., 2022). Based on Jung's (1921) personality theory, which was developed by Kolb (1984), there are two main learning styles that are relevant to this study, namely sensing and intuition. Students with a sensing learning style tend to learn based on concrete facts and direct experience (Felder & Silverman, 1988). They prioritize observable information and think systematically and in detail. In contrast, students with an intuition learning style prefer to understand concepts through patterns, relationships, and abstract concepts (Kolb, 2015). They tend to use intuition and imagination in solving problems.

Differences in learning styles influence the way students think critically and solve contextual mathematical problems. This is in line with the study by Arfia and Handican (2024), entitled "Sensing vs Intuiting: Analysis of Students' Critical Thinking Ability in Solving HOTS (Higher Order Thinking Skills) Problems." The study revealed that sensing and intuiting learning styles influence students' critical thinking ability. The results showed that sensing students are superior in identifying important elements, handling details, and arranging structured solution steps, but they are less strong in evaluating solutions deeply and seeking creative alternatives. Conversely, intuition students are more creative and exploratory in finding solutions, but they are less systematic and often have difficulty explaining solution steps logically. Therefore, understanding students' learning styles is an important aspect in designing more effective learning strategies that suit their cognitive characteristics (Jonassen & Grabowski, 1993).

Based on the explanation above, the researcher is interested in conducting a study entitled "Students' Critical Thinking Process in Solving Contextual Problems Reviewed from Sensing and

Intuition Learning Styles." This study aims to describe the critical thinking processes of students with sensing and intuition learning styles in solving contextual problems. This study involved two tenth-grade students, each of whom had a dominant sensing or intuition learning style, selected purposively based on the results of a learning style questionnaire and a Mathematics Ability Test (TKM). Data were obtained through a learning style questionnaire, a Mathematics Ability Test, a contextual Problem-Solving Task (TPM) on probability material, and interview guidelines prepared based on critical thinking indicators. The results of this study are expected to contribute to the development of more effective learning methods, thereby improving the quality of education, especially in mathematics learning.

2. METHOD

This study used a qualitative approach with a case study research design. A case study attempts to obtain an in-depth understanding of a situation and to give meaning to something involved in it (Merriam in Siswono, 2019). This method was chosen because the study aims to describe the critical thinking processes of students with sensing and intuition learning styles in solving contextual problems. The main data in this study were obtained from the results of contextual problem-solving tasks on probability material and interviews conducted after students completed the problem-solving tasks in order to explore their critical thinking processes more deeply.

The subjects of this study were two tenth-grade senior high school students in the 2024/2025 academic year who had studied probability material. The subjects were selected using purposive sampling with the same gender variation because the study by Nurcholis et al. (2021) shows that male and female students' mathematical problem-solving abilities are not significantly different. The subjects were chosen based on the recommendation of the mathematics teacher: one student with a sensing learning style and one student with an intuition learning style. Both had equivalent high mathematical ability, with a test score difference of no more than 5 points and scores of $75 \leq$ test score ≤ 100 (Ratumanan & Laurens, 2011). The study was conducted at SMAS Hang Tuah 4 Surabaya. The selected subjects analyzed in this study are presented below.

Table 1. Research Subject Qualification

Category	Code
Sensing	S
Intuition	I

The research instruments consisted of a main instrument and supporting instruments. The researcher served as the main instrument because the researcher acted as the planner, implementer, data collector, and data analyst. The supporting instruments included the Index of Learning Styles Questionnaire (ILSQ), adapted from Richard M. Felder and Barbara A. Soloman to categorize sensing and intuition learning styles; a mathematics ability test; a contextual problem-solving task on probability material; and interview guidelines. The data were analyzed through data reduction, data display, and conclusion drawing (Miles & Huberman, 1994). The indicators of critical thinking processes in solving contextual problems used in this study are presented below.

Table 2. Indicators of Critical Thinking Processes in Solving Contextual Problems

Problem Solving Stage	Aspect	Critical Thinking Indicator	Critical Thinking Activity	Code
Entry	Know	Interpretation	Reading the problem carefully	EI1
		Interpretation	Finding information in the problem	EI2
		Interpretation	Restating the question in one's own words	EI3
		Interpretation	Connecting information with prior knowledge	EI4
	Want	Analysis	Identifying information not stated in the problem	EA1
		Analysis	Grouping and sequencing information	EA2
	Introduce	Analysis	Creating a picture, pattern, or other representation to understand the problem	EA3
		Analysis	Selecting elements that need to be represented in symbolic form	EA4
		Analysis	Organizing the known information and the question asked in the problem	EA5
Attack	Try	Inference	Proposing a conjecture regarding the solution of the problem	AI1
		Inference	Modifying an incorrect conjecture so that it becomes correct	AI2
	Maybe	Evaluation	Trying the conjecture that has been made to determine whether it can solve the problem	AE1
	Why	Evaluation	Having logical reasons for accepting or rejecting a conjecture	AE2
		Explanation	Convincing others through a systematic solution orally or in writing	AP1
Review	Check	Evaluation	Checking the accuracy of the calculation	RE1
		Evaluation	Checking the accuracy of the reasons in the solution steps	RE2
		Evaluation	Checking the suitability of the solution steps with the question	RE3
	Reflect	Self-Regulation	Reflecting on ideas in the solution, identifying difficulties, and identifying learning gained from the solution	RR1
	Extend	Self-Regulation	Seeking another method of solution	RR2
		Self-Regulation	Showing other problems that can be solved in the same way	RR3

The explanation of the interview transcript presentation codes is presented below.

Table 3. Codes for Interview Transcript Presentation

Code	Description
P_S-n	The n-th question from the researcher to the sensing subject
P_I-n	The n-th question from the researcher to the intuition subject
S-n	The answer of the sensing subject to the n-th researcher question
I-n	The answer of the intuition subject to the n-th researcher question

3. RESULTS AND DISCUSSION

This study involved 29 tenth-grade students. After administering the learning style test and evaluating their mathematical ability, 15 students with a sensing learning style and 2 students with an intuition learning style were identified as having high mathematical ability. To obtain a more comprehensive understanding of students' critical thinking processes in solving contextual problems on probability material, one subject from each category was selected for deeper analysis and interview, especially regarding the completion of the problem-solving task. The detailed data from the two subjects representing each learning style are presented as follows.

Sensing Subject

The following is the result of the problem-solving task of the student with a sensing learning style in solving a contextual problem on probability material.

Entry Stage

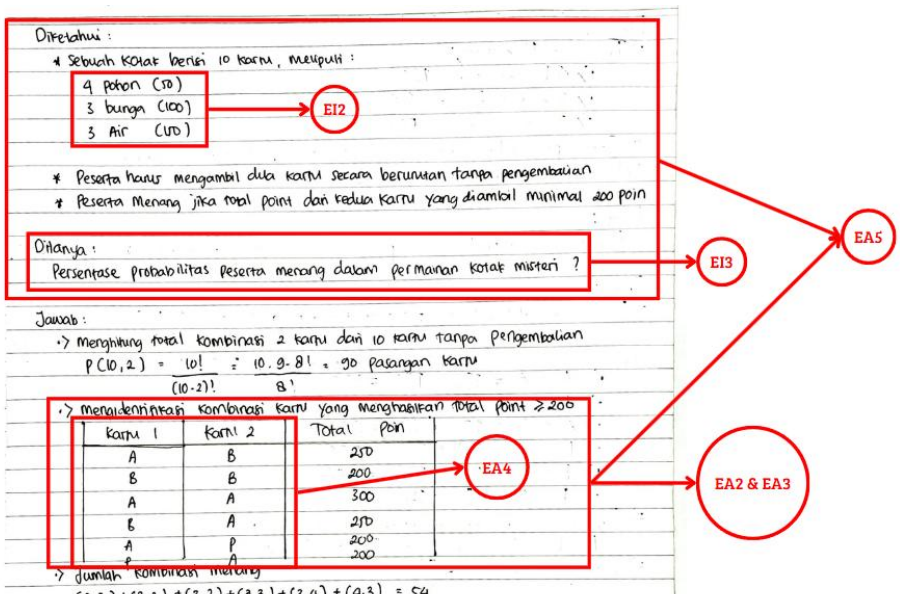

Figure 1. Answer of Subject S in the Entry Stage

Figure 1 above is a section of the work of subject S who has completed the problem at the entry stage. The following is an excerpt from the interview with subject S at the entry stage.

P_S-1	:	When you first read the "Mystery Box" problem, how did you understand its content? Was there any important information that you immediately found and noted from this problem?	
S-1	:	I immediately looked at the number of cards and their point values. I noted that there were 4 Tree cards (50 points), 3 Flower cards (100 points), and 3 Water cards (150 points). I considered this important information because it determines the probability.	EI1, EI2

P_S-2	:	Can you explain in your own words what the "Mystery Box" problem is actually asking?	
S-2	:	The problem asks us to calculate the percentage probability that a participant wins the mystery box game.	EI3
P_S-3	:	What mathematical concept or material did you remember or connect with the "Mystery Box" problem from previous lessons that you think is relevant and can be used to solve it?	
S-3	:	I remembered probability and combination material from previous lessons, especially taking two objects without replacement.	EI4
P_S-4	:	Was there any information that you felt was incomplete or not included in the "Mystery Box" problem, even though you needed it to solve the problem?	
S-4	:	All the information I needed was already there. I did not feel anything was missing.	EA1
P_S-5	:	How did you group or sequence the information you obtained from the "Mystery Box" problem, such as the details of the Tree, Flower, and Water cards and their points?	
S-5	:	I arranged all the cards based on their types and points, then made a list of possible card pairs whose total was 200 or more.	EA2
P_S-6	:	Did you make a sketch, table, diagram, or certain pattern to help you understand the "Mystery Box" problem at the beginning? If yes, please explain.	
S-6	:	I made a table of two-card combinations and their total points to make it easier to count those that met the winning requirement.	EA3
P_S-7	:	Were there any elements of the "Mystery Box" problem, such as the types of cards or points, that you represented using symbols or variables? Why did you choose those symbols?	
S-7	:	I used initials such as T for Tree, F for Flower, and W for Water to simplify my notes.	EA4
P_S-8	:	After all the information was collected, how did you organize or summarize what was known and what was asked in the "Mystery Box" problem before you started calculating its probability?	
S-8	:	I rewrote the known data and what was asked at the top of the answer sheet, then immediately calculated the combinations that could produce $\geq$ 200 points.	EA5

Based on Figure 1 and the interview excerpt above, it can be seen that in the entry stage, subject S was analyzed through several aspects as follows. (1) Know aspect: subject S was able to read the problem carefully and understand its content. This was shown when subject S immediately found and recorded important information from the problem. This is in line with the interpretation indicator "finding information in the problem" (EI2). Subject S was also able to restate what the problem asked using his own words, fulfilling the interpretation indicator "restating the question in one's own words" (EI3). In addition, subject S successfully connected the information in the problem with prior knowledge about probability and combinations, especially drawing two objects without replacement. This ability shows the interpretation indicator "connecting information with prior knowledge" (EI4). (2) Want aspect: subject S could determine that all information needed was already available in the problem and that nothing was missing. This supports the analysis indicator "identifying information not stated in the problem" (EA1). Subject S was also able to group and sequence information by arranging all cards based on type and point value and then making a list of possible card pairs with a total of at least 200 points. This shows the analysis indicator "grouping and sequencing information" (EA2). (3) Introduce aspect: to help understand the problem, subject S made a table of two-card combinations and total points that met the winning requirement. This represents the analysis indicator "creating a picture, pattern, or other representation to understand the problem" (EA3). Subject S used initials (T for Tree, F for Flower, and W for Water) as symbols to simplify his notes, which is in accordance with the analysis indicator "selecting elements that need to be represented in symbolic form" (EA4). Furthermore, subject S reorganized the known and asked information at the top of his answer sheet before directly calculating the combinations that produced at least 200 points. This shows the analysis indicator "organizing the known information and the question asked in the problem" (EA5).

Attack Stage

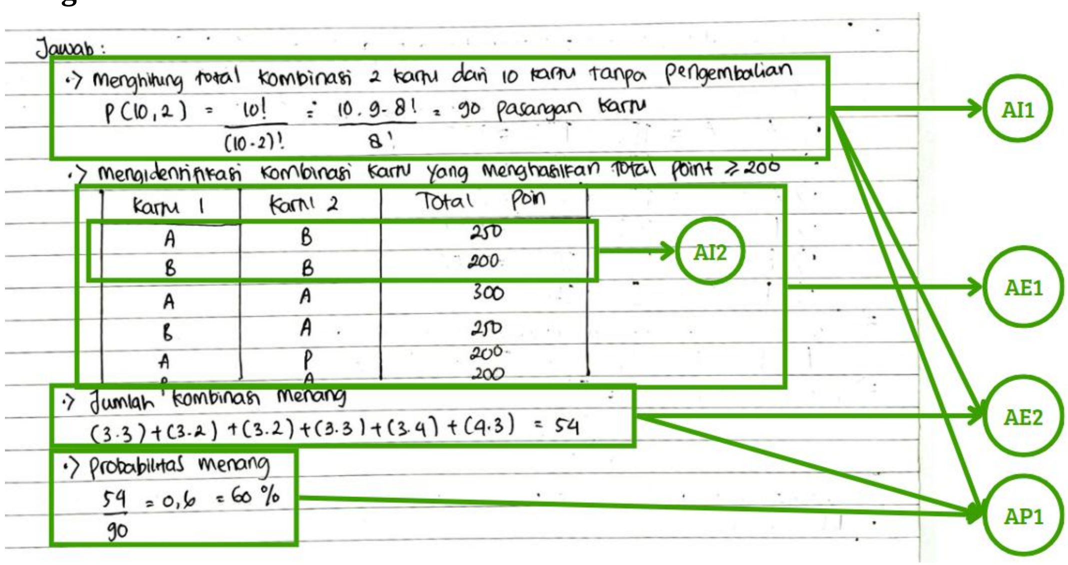

Figure 2. Answer of Subject S in the Attack Stage

Figure 2 above is a fragment of subject S's work in solving the problem at the attack stage. The following is an excerpt from the interview with subject S at the attack stage.

P_S-9	:	When you started solving the "Mystery Box" problem to obtain the probability of winning the game (at least 200 points), what was your initial conjecture or idea about how to solve it?	
S-9	:	My initial idea was to calculate all possible card pairs using the permutation formula that gives (10 x 9 = 90), then find those whose point total was at least 200.	AI1
P_S-10	:	Was there any initial conjecture or approach that turned out to be less appropriate or unsuccessful when you tried it on the "Mystery Box" problem? If yes, how did you modify it or find another approach?	
S-10	:	At first, I only counted Water and Flower combinations, but it turned out that Flower-Flower could also make 200, so I added it.	AI2

P_S-11	:	How did you test or try the conjecture you made to see whether it could solve the "Mystery Box" problem? Were you immediately sure it would work, or did you need to try several card combinations first?	
S-11	:	I checked the combinations one by one from the table I made, so I could make sure the result was correct.	AE1
P_S-12	:	Why did you choose this approach or solution step for the "Mystery Box" problem, such as calculating the total possible card pairs first or adding the probabilities of certain card combinations? What is the logical reason behind your choice?	
S-12	:	I started from the total number of combinations (90), then counted how many were winning combinations, because that was the most certain and clear way.	AE2
P_S-13	:	Can you explain your solution steps systematically for the "Mystery Box" problem, as if you were explaining them to a friend or teacher so they could understand?	
S-13	:	First, I found the total combinations, then counted the winning combinations, then divided the number of winning combinations by the total combinations. That gave the probability.	AP1

Based on Figure 2 and the interview excerpt above, it can be seen that in the attack stage, subject S was analyzed through several aspects as follows. (1) Try aspect: subject S proposed an initial conjecture for solving the problem, namely calculating all possible card pairs using the permutation formula (10 x 9 = 90), and then finding combinations whose total was at least 200 points. This shows the inference indicator "proposing a conjecture regarding the solution of the problem" (AI1). Subject S also showed the ability to modify an incorrect conjecture so that it became correct. Initially, he only counted Water and Flower combinations, but later realized that Flower-Flower could also reach 200 points, so he added it to the calculation. This is in line with the inference indicator "modifying an incorrect conjecture so that it becomes correct" (AI2). (2) Maybe aspect: subject S tested his conjecture by checking the combinations one by one from the table he had made to ensure that the result was correct. This fulfills the evaluation indicator "trying the conjecture that has been made to determine whether it can solve the problem" (AE1). (3) Why aspect: subject S had a logical reason for choosing his approach, namely starting from the total number of combinations (90) and then counting how many were winning combinations because he considered that method the most certain and clear. This shows the evaluation indicator "having logical reasons for accepting or rejecting a conjecture" (AE2). Subject S was also able to explain his solution steps systematically: first finding the total combinations, then counting the winning combinations, and finally dividing the number of winning combinations by the total number of combinations to obtain the probability. This is in line with the explanation indicator "convincing others through a systematic solution orally or in writing" (AP1).

Review Stage

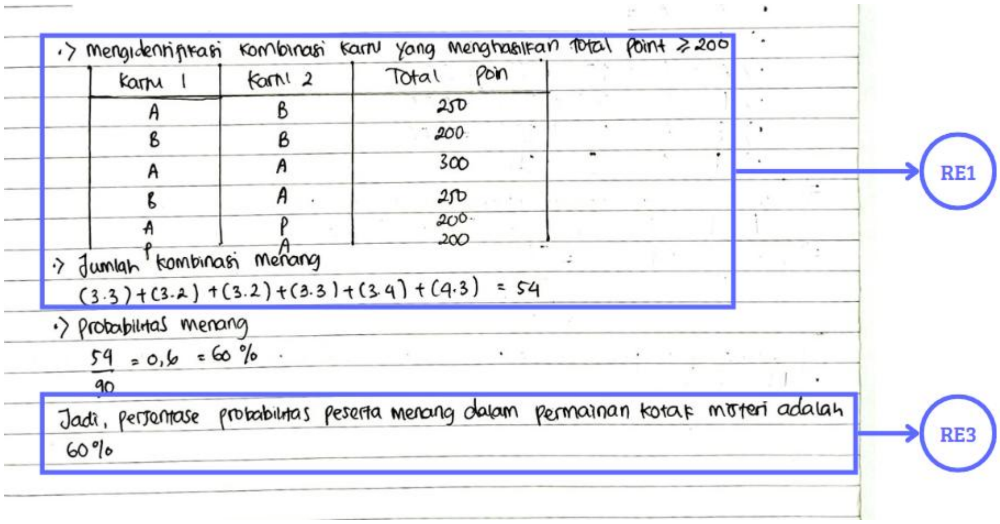

Figure 3. Answer of Subject S in the Review Stage

Figure 3 above is a fragment of subject S's work in solving the problem at the review stage. The following is an excerpt from the interview with subject S at the review stage.

P_S-14	:	After you obtained the final probability of winning the "Mystery Box" game, how did you make sure that your calculation was correct?	
S-14	:	I recalculated the number of winning pairs and made sure no combination was missed.	RE1
P_S-15	:	Did you recheck the reasons behind each solution step in the "Mystery Box" problem? Were all of them logical and appropriate to the problem?	
S-15	:	Yes, I made sure that all the steps matched what was asked and that all possible combinations were included.	RE2
P_S-16	:	Did the final probability solution you obtained fully answer the question in the "Mystery Box" problem? How did you make sure?	
S-16	:	It already answered the question because I obtained the probability in percentage form and it matched what the problem asked.	RE3
P_S-17	:	Which part of the "Mystery Box" problem or its solution process did you find most difficult? What did you learn from this difficulty for similar problems in the future?	
S-17	:	The part of counting combinations without replacement was rather difficult because I had to be careful. From that, I learned to be more thorough.	RR1
P_S-18	:	Is there another way that could be used to solve the "Mystery Box" problem besides the method you chose? If yes, please mention or briefly explain it.	
S-18	:	It might also be solved manually, but I chose to calculate using the permutation formula because I was more confident.	RR2
P_S-19	:	Are there other similar problems, perhaps in everyday life, that can be solved using the same method or strategy you used for the "Mystery Box" problem? Give an example if any.	
S-19	:	A real-life example might be drawing two prizes from a box or taking cards in a game without replacement.	RR3

Based on Figure 3 and the interview excerpt above, it can be seen that in the review stage, subject S was analyzed through several aspects as follows. (1) Check aspect: subject S ensured the accuracy of the calculation by recalculating the number of winning pairs and making sure that no combination was missed. This shows the evaluation indicator "checking the accuracy of the calculation" (RE1). Subject S also rechecked the reasons behind each solution step, ensuring that all steps were in accordance with the question and that all possible combinations were included. This fulfills the evaluation indicator "checking the accuracy of the reasons in the solution steps" (RE2). Subject S verified that the final solution, namely the probability in percentage form, fully answered the question according to the problem request. This shows the evaluation indicator "checking the suitability of the solution steps with the question" (RE3). (2) Reflect aspect: subject S reflected on the most difficult part of the problem, namely counting combinations without replacement because it required caution, and stated that from this difficulty he learned to be more thorough. This is in line with the self-regulation indicator "reflecting on ideas in the solution, identifying difficulties, and identifying learning gained from the solution" (RR1). (3) Extend aspect: subject S was able to show that another method could be used to solve the problem, such as a manual method, although he chose to use the permutation formula because he was more confident. This is in accordance with the self-regulation indicator "seeking another method of solution" (RR2). He was also able to identify similar real-life problems that could be solved using the same method, such as drawing two prizes from a box or drawing cards in a game without replacement. This shows the self-regulation indicator "showing other problems that can be solved in the same way" (RR3).

Intuition Subject

The following is the result of the problem-solving task of the student with an intuition learning style in solving a contextual problem on probability material.

Entry Stage

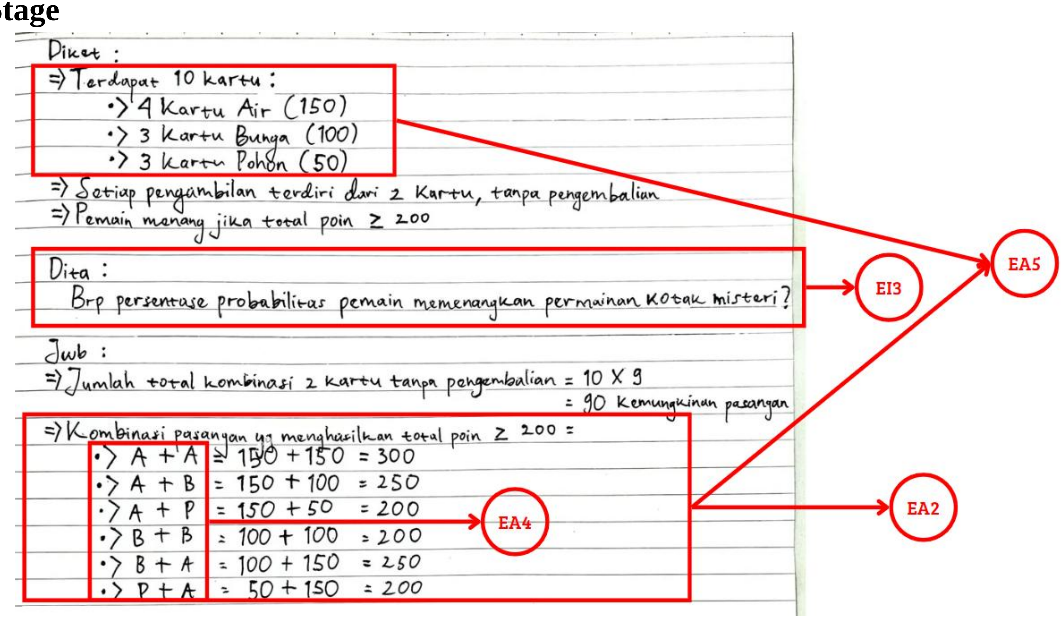

Figure 4. Answer of Subject I in the Entry Stage

Figure 4 above is a fragment of subject I's work in solving the problem at the entry stage. The following is an excerpt from the interview with subject I at the entry stage.

P_I-1 : When you first read the "Mystery Box" problem, how did you understand its content? Was there any important information that you immediately found and noted from this problem?

I-1 : I first imagined the situation. Oh, this is a game of drawing cards and it must reach at least 200 points. I immediately focused on which card combinations could win. EI1

P_I-2 : Can you explain in your own words what the "Mystery Box" problem is actually asking?

I-2 : In essence, we have to take two cards and then see the percentage probability that the player wins the mystery box game. EI3

P_I-3 : What mathematical concept or material did you remember or connect with the "Mystery Box" problem from previous lessons that you think is relevant and can be used to solve it?

I-3 : I immediately remembered probability material, especially the probability of two consecutive events without replacement. EI4

P_I-4 : Was there any information that you felt was incomplete or not included in the "Mystery Box" problem, even though you needed it to solve the problem?

I-4 : The information was sufficient. I only thought for a moment that if the cards could be replaced, the answer might be different. EA1

P_I-5 : How did you group or sequence the information you obtained from the "Mystery Box" problem, such as the details of the Tree, Flower, and Water cards and their points?

I-5 : I grouped the points of each card and then thought about which combinations would result in ≥ 200. EA2

P_I-6 : Did you make a sketch, table, diagram, or certain pattern to help you understand the "Mystery Box" problem at the beginning? If yes, please explain.

I-6 : I did not make a table, but I made a list of combinations directly in my mind or sometimes used small lines. EA3

P_I-7 : Were there any elements of the "Mystery Box" problem, such as the types of cards or points, that you represented using symbols or variables? Why did you choose those symbols?

I-7 : I just used letter abbreviations, such as W for Water and F for Flower, so it would not be complicated to write. EA4

P_I-8 : After all the information was collected, how did you organize or summarize what was known and what was asked in the "Mystery Box" problem before you started calculating its probability?

I-8 : I summarized everything: there were 10 cards, 3 types, different points, and the problem asked for the probability of winning with ≥ 200. Then I thought about which combinations could reach it. EA5

Based on Figure 4 and the interview excerpt above, it can be seen that in the entry stage, subject I was analyzed through several aspects as follows. (1) Know aspect: subject I showed understanding by imagining the situation in the problem and directly focusing on card combinations that could produce a win, namely at least 200 points. This shows the interpretation indicator "reading the problem carefully" (EI1). Subject I was able to restate the problem question in his own words, namely calculating the percentage probability that a player wins the "Mystery Box" game. This is in accordance with the interpretation indicator "restating the question in one's own words" (EI3). Subject I also immediately recalled the concept of probability of two consecutive events without replacement as the relevant mathematical material. This fulfills the interpretation indicator "connecting information with prior knowledge" (EI4). (2) Want aspect: subject I considered the information in the problem sufficient, although he briefly thought about what would happen if the cards could be replaced. This shows that he was able to identify the required information and consider the problem constraints, in line with the analysis indicator "identifying information not stated in the problem" (EA1). He also grouped information by grouping the point values of each card and thinking about combinations whose results were ≥ 200 points. This is in accordance with the analysis indicator "grouping and sequencing information" (EA2). (3) Introduce aspect: subject I did not make a formal table but imagined or made a list of combinations in his mind or through small lines. This is a form of visualization to understand the problem, in accordance with the analysis indicator "creating a picture, pattern, or other representation to understand the problem" (EA3). Subject I used letter abbreviations, such as W for Water and F for Flower, to make writing more practical. This shows the ability to select symbols, in accordance with the analysis indicator "selecting elements that need to be represented in symbolic form" (EA4). Subject I summarized all known information, namely 10 cards, 3 types, different points, and the requirement to find the probability of winning with ≥ 200 points, and then thought about combinations that could reach the target. This shows the ability to organize known and asked information, in accordance with the analysis indicator "organizing the known information and the question asked in the problem" (EA5).

Attack Stage

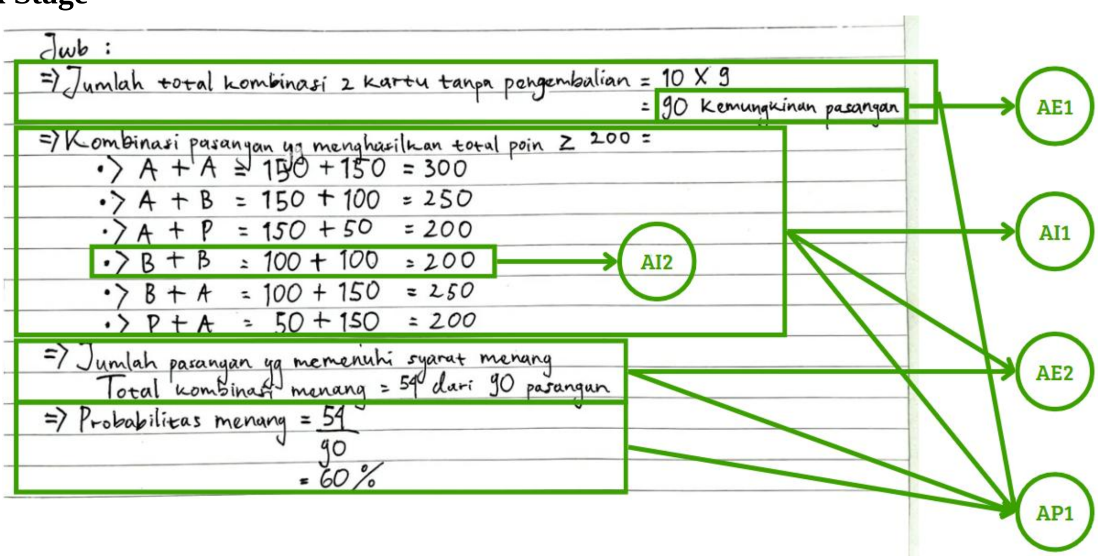

Figure 5. Answer of Subject I in the Attack Stage

Figure 5 above is a fragment of subject I's work in solving the problem at the attack stage. The following is an excerpt from the interview with subject I at the attack stage.

P_I-9	:	When you started solving the "Mystery Box" problem to obtain the probability of winning the game (at least 200 points), what was your initial conjecture or idea about how to solve it?	
I-9	:	I immediately thought that Water + Water, Water + Flower, and Flower + Flower must win. Water + Tree might also reach exactly 200, and so on for the next combinations.	AI1
P_I-10	:	Was there any initial conjecture or approach that turned out to be less appropriate or unsuccessful when you tried it on the "Mystery Box" problem? If yes, how did you modify it or find another approach?	
I-10	:	At first, I forgot to count Flower + Flower because I thought it was not enough. But after thinking again, 100 + 100 = 200, so I added it.	AI2
P_I-11	:	How did you test or try the conjecture you made to see whether it could solve the "Mystery Box" problem? Were you immediately sure it would work, or did you need to try several card combinations first?	
I-11	:	I first tried it using logic and estimation. After that, I matched it with the number of possible combinations.	AE1
P_I-12	:	Why did you choose this approach or solution step for the "Mystery Box" problem, such as calculating the total possible card pairs first or adding the probabilities of certain card combinations? What is the logical reason behind your choice?	
I-12	:	I chose the combinations that definitely win first, then added several ways to obtain them because it went directly to the answer.	AE2
P_I-13	:	Can you explain your solution steps systematically for the "Mystery Box" problem, as if you were explaining them to a friend or teacher so they could understand?	
I-13	:	I looked at the card pairs whose values were ≥ 200, counted how many there were, and then compared them with all possible two-card draws.	AP1

Based on Figure 5 and the interview excerpt above, it can be seen that in the attack stage, subject I was analyzed through several aspects as follows. (1) Try aspect: subject I proposed an initial conjecture by directly thinking about combinations that would certainly win, such as Water + Water, Water + Flower, and Flower + Flower, while also considering Water + Tree, which could reach 200 points. This fulfills the inference indicator "proposing a conjecture regarding the solution of the problem" (AI1). Subject I showed the ability to modify an incorrect conjecture. At first, he forgot to count Flower + Flower because he thought it was not enough, but after thinking again, he realized that 100 + 100 = 200 and added it. This is in accordance with the inference indicator "modifying an incorrect conjecture so that it becomes correct" (AI2). (2) Maybe aspect: subject I tested his conjecture by using logic and estimation first, then matching it with the number of possible combinations. This shows the ability to try a conjecture, in accordance with the evaluation indicator "trying the conjecture that has been made to determine whether it can solve the problem" (AE1). (3) Why aspect: subject I chose his approach by selecting combinations that definitely win first and adding several ways to obtain them because, in his view, this approach directly led to the answer. This shows a logical reason behind his choice, in accordance with the evaluation indicator "having logical reasons for accepting or rejecting a conjecture" (AE2). Subject I explained his solution steps systematically: looking at card pairs whose values were ≥ 200, counting how many there were, and comparing them with all possible two-card draws. This shows the explanation indicator "convincing others through a systematic solution orally or in writing" (AP1).

Review Stage

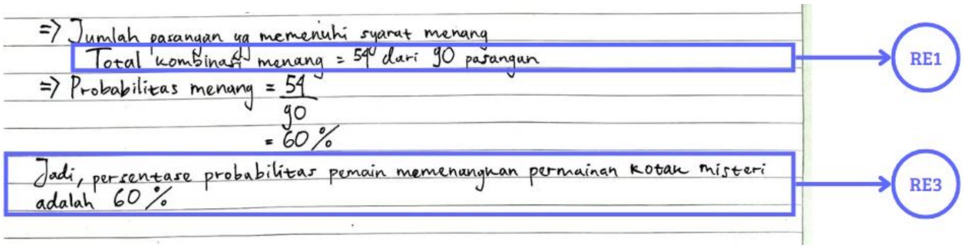

Figure 6. Answer of Subject I in the Review Stage

Figure 6 above is a fragment of subject I's work in solving the problem at the review stage. The following is an excerpt from the interview with subject I at the review stage.

P_I-14 : After you obtained the final probability of winning the "Mystery Box" game, how did you make sure that your calculation was correct?

I-14 : I was confident in the result because the total number of winning combinations was quite large and matched the logic of the problem. RE1

P_I-15 : Did you recheck the reasons behind each solution step in the "Mystery Box" problem? Were all of them logical and appropriate to the problem?

I-15 : I thought through the steps again, and all of them seemed reasonable, even though I did not write them one by one. RE2

P_I-16 : Did the final probability solution you obtained fully answer the question in the "Mystery Box" problem? How did you make sure?

I-16 : Yes, my answer was already in percentage form and answered the question in the problem. RE3

P_I-17 : Which part of the "Mystery Box" problem or its solution process did you find most difficult? What did you learn from this difficulty for similar problems in the future?

I-17 : The rather difficult part was making sure that all combinations had been included. From that, I learned that I must think more comprehensively. RR1

P_I-18 : Is there another way that could be used to solve the "Mystery Box" problem besides the method you chose? If yes, please mention or briefly explain it.

I-18 : It could also be solved using a possibility tree visualization or a permutation formula, but I prefer a direct approach. RR2

P_I-19 : Are there other similar problems, perhaps in everyday life, that can be solved using the same method or strategy you used for the "Mystery Box" problem? Give an example if any.

I-19 : Maybe problems such as card games or strategies in games, where the chance of winning can be estimated from the available combinations. RR3

Based on Figure 6 and the interview excerpt above, it can be seen that in the review stage, subject I was analyzed through several aspects as follows. (1) Check aspect: subject I stated that he was confident in the final result because the number of winning combinations was quite large and matched the logic of the problem. This shows that he checked the accuracy of the calculation conceptually, in line with the evaluation indicator "checking the accuracy of the calculation" (RE1). Subject I also rechecked the reasons behind each step and felt that everything was reasonable, although he did not write them one by one. This fulfills the evaluation indicator "checking the accuracy of the reasons in the solution steps" (RE2). Subject I verified that his final answer, in percentage form, already answered the question in the problem. This is in accordance with the evaluation indicator "checking the suitability of the solution steps with the question" (RE3). (2) Reflect aspect: subject I reflected that the most difficult part was ensuring that all combinations had been included, and from that difficulty he learned to think more comprehensively. This is in line with the self-regulation indicator "reflecting on ideas in the solution, identifying difficulties, and identifying learning gained from the solution" (RR1). (3) Extend aspect: subject I was able to show another method to solve the problem, such as a possibility tree visualization or using the permutation formula, although he preferred a direct approach. This shows the ability to seek another solution method, in accordance with the self-regulation indicator "seeking another method of solution" (RR2). He was also able to identify similar problems in everyday life, such as card games or game strategies, where the chance of winning can be estimated from the available combinations. This shows the self-regulation indicator "showing other problems that can be solved in the same way" (RR3).

The following table presents a comparison between students with sensing and intuition learning styles.

Table 4. Comparison of Students with Sensing and Intuition Learning Styles

Stage	Similarities	Differences
Entry	Both subjects understood the problem by reading and examining the information provided.	The sensing subject tended to understand the problem carefully by identifying and recording important information, such as the number and value of Tree, Flower, and Water cards, in detail. In contrast, the intuition subject tended to understand the problem by imagining the situation and directly focusing on card combinations that produced a win.
	Both subjects were able to restate the problem request in their own words.	The sensing subject tended to group and sequence data explicitly and created a combination table to support understanding. In contrast, the intuition subject grouped card points through mental imagery or a small list rather than a formal table.
	Both subjects connected information from the problem with relevant mathematical concepts or material from previous learning.	

Stage	Similarities	Differences
	Both subjects also ensured that all required information was available, grouped information, used symbols or initials to simplify notes, and summarized the known and asked information in the problem.	
Attack	Both subjects showed similarities in proposing an initial conjecture regarding the solution of the problem.	The sensing subject proposed an initial conjecture by first calculating the total combinations (10 x 9 = 90) and then finding combinations that reached at least 200 points. In contrast, the intuition subject proposed an initial conjecture by directly thinking about card combinations that would definitely win, such as Water + Water and Water + Flower.
	Both subjects were able to modify an incorrect conjecture so that it became correct.	The sensing subject tested his conjecture by checking combinations one by one from the table he had made, showing a systematic and data-based approach. In contrast, the intuition subject tested his conjecture using logic and estimation, with an approach that was more direct toward the answer.
	Both subjects tested their conjectures to see whether they could solve the problem and had logical reasons for choosing their approaches or solution steps.	
	Both subjects were able to explain their solution steps systematically.	
Review	Both subjects showed the ability to find a solution to the problem and recheck their solution steps and reasons.	The sensing subject ensured that his calculation was correct by recounting the number of winning pairs and ensuring that no combination was missed. In contrast, the intuition subject ensured the accuracy of the calculation based on the logic of the problem, which he considered consistent with the result.
	Both subjects reflected on the most difficult part of the solution process and stated the learning gained from that difficulty.	The sensing subject reflected on the difficulty of counting combinations without replacement, which made him learn to be more careful. In contrast, the intuition subject indicated other solution methods such as possibility tree visualization or the permutation formula, although he preferred a direct approach.
	Both subjects could show alternative solution methods and identify similar problems in everyday life that could be solved using the same method or strategy.	

4. CONCLUSION

Based on the data analysis and discussion presented above, it can be concluded that in solving contextual probability problems, students with a sensing learning style tend to show a concrete, systematic, and structured thinking process, as reflected in detailed solution patterns based on factual data. Students with a sensing learning style also carried out the entry, attack, and review stages clearly. In contrast, students with an intuition learning style in solving contextual probability problems tend to show an abstract, conceptual, and reflective thinking process, as indicated by their tendency to understand information comprehensively without requiring written notes or visual aids. Students with an intuition learning style also carried out the entry, attack, and review stages clearly.

5. ACKNOWLEDGMENTS

The authors would like to express sincere gratitude to the Mathematics Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, for the academic support provided during this research. The authors also thank the supervising lecturer, the mathematics teacher, and the students of SMAS Hang Tuah 4 Surabaya who provided assistance and participated in the data collection process.

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