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Exploring the influence of Sternberg's thinking styles on students' mathematical creative problem-solving

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Abstract:
Creative thinking is an essential skill for students in the 21st century, especially in mathematics, requiring problem-solving and analytical abilities. This study aims to analyze the creative thinking abilities of high school students in solving mathematical problems, analyzed through Sternberg's legislative, executive, and judicial thinking styles. A mixed method approach was employed, combining quantitative analysis of thinking style questionnaires and mathematics ability tests with qualitative examination of students' creative thinking task responses and interview data. Nine students were purposively selected from the 37 participants for in-depth analysis based on their dominant thinking styles and mathematical ability levels. These students were analyzed further through their written responses and semi-structured interviews to gain deeper insights into their mathematical creative thinking processes. Students completed a mathematical creative thinking task, evaluated on four indicators: fluency, flexibility, originality, and elaboration. Findings revealed that all students were categorized at MCT Level 2 (*Quite Creative*), demonstrating only partial fluency and elaboration. No subject fulfilled flexibility or originality criteria, indicating limited strategic and novel thinking across styles. Interestingly, students with low mathematical ability also reached MCT Level 2, suggesting that creative thinking can be independent of academic performance. Legislative students lacked strategic variation despite their preference for autonomy, executive students relied strictly on procedural methods, and judicial students remained evaluative but unoriginal. Future research should involve a larger and more diverse sample to explore broader dimensions of students' cognitive processes in mathematical learning. These findings imply that differentiated instruction based on thinking styles may be key to cultivating creativity in mathematics classrooms. The study underscores the need for instructional approaches emphasizing divergent thinking and creative exploration to align with diverse cognitive styles and enhance students' mathematical creativity.

Keywords: Creative Thinking; High School Student; Sternberg's Thinking Styles; Thinking Styles.

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Introduction

In the era of the 21st century and the demands of Society 5.0, the ability to think creatively has become one of the most crucial competencies for students. Creative thinking allows individuals to generate new ideas, adapt to complex problems, and explore innovative solutions (Heard et al., 2025). Mathematics, a discipline emphasizing logical reasoning and problem-solving, is significant in cultivating students' creative potential. However, creative thinking is not a standalone skill; it is influenced by various factors such as cognitive styles, motivation, personality, and, especially, thinking styles. Every student has their way of thinking. Many factors influence how someone chooses to optimize their thinking abilities. Sternberg explained that not everyone is equally fluent in creating and manipulating mental imagery because definitions, tasks, experiences, interactions, and individual factors influence it. Individual factors are also influenced by various elements, such as learning style, personality, or even thinking style (Sternberg, 2006). Thinking style is how a person employs and demonstrates skills (Sternberg, 2006). Different ways of thinking determine how individuals arrange or weigh their responses to constructive processes. Crucially, thinking styles relate to how people select their concepts rather than the abilities they employ, like intelligence level. Thinking style analysis also looks at how individuals react, or decide to react, to a certain situation (Kim & Song, 2012; Sahatcija et al., 2017; Shadrina et al., 2023).

According to this viewpoint, thinking style refers to an individual's method of demonstrating their abilities. As proposed by Grigorenko and Sternberg, the theory of thinking styles categorizes thinking into distinct styles that reflect how individuals prefer to process information and solve problems (Grigorenko & Sternberg, 1997). These styles are grouped into five dimensions; functions, forms, levels, scopes, and leanings. The legislative, executive, and judicial styles are part of the functions dimension, each representing a unique approach to thinking and problem-solving. The legislative style is characterized by autonomy and creativity, allowing individuals to devise their own methods for completing tasks. The executive style involves adherence to rules and established procedures, while the judicial style focuses on evaluating and critiquing based on established criteria. These styles have been linked to various cognitive abilities and academic outcomes, providing a framework for understanding individual differences in thinking (Aljojo, 2017; Grigorenko & Sternberg, 1997; Sternberg, 2005). The form dimension describes how individuals manage tasks; monarchic thinkers focus on one task at a time, hierarchic thinkers prioritize and manage multiple tasks, *oligarchic* thinkers address several tasks without clear prioritization, and anarchic thinkers prefer unstructured and flexible approaches. The level dimension distinguishes between global thinkers, who see the big picture, and local thinkers, who focus on details. The scope dimension identifies whether a person is more internal, preferring to work independently and develop personal ideas, or external, favoring collaborative work and group settings. Lastly, the leaning dimension reflects a preference for either liberal thinking, which is open to novelty and change, or conservative thinking, which emphasizes structure, tradition, and proven methods. These dimensions help explain individual differences in learning, problem-solving, and decision-making preferences (Sternberg, 1997, 2005).

Mathematics has a role in students' success in completing their education level and helps students improve their thinking skills. Creative thinking is one of the thinking skills that students must have to face competition in the era of Society 5.0 (Smuts & Van der Merwe, 2022). Creativity is a person's ability to produce new things through thoughts and actual work by emphasizing ability and combining solutions or answers (Ellamil et al., 2012; Hakim, 2020). Creative thinking is not an organized process but rather a habit of the mind that is trained by paying attention to intuition, activating the imagination, revealing new possibilities, opening up surprising points of view, and generating unexpected ideas (Heard et al., 2025; PISA, 2024; Wathoni & Negara, 2024). It means that to develop students' creative thinking abilities, continuous practice, perseverance, self-discipline, and full attention are needed, which includes mental activities such as asking questions; establishing links, especially between different things; connecting things freely; applying imagination to each situation to produce something new and different; and listening to intuition (Hulinggato et al., 2024; Lambertus, 2010; Pang, 2024).

The cognitive aspects of creativity are fluency, flexibility, originality, and elaboration (Guilford, 1966, 1967). Fluency is a person's ability to quickly generate relevant ideas, answers, and problem-solving (Anderson & Graham, 2021; Fatmawati et al., 2022). Fluency is a person's ability to quickly and precisely relate one concept to another quickly and precisely (Trianggono, 2017). Flexibility is the ability to produce varied ideas, answers, or questions, see a problem from different points of view, look for many alternatives or different directions, and change approaches or ways of thinking (Hendriyana et al., 2018). Originality is the ability to generate new and unique ideas, think of unconventional ways to express oneself, and create unusual combinations (Munandar, 2012; Tohir, 2019). Elaboration is a person's ability to explain a simple thing into a broader definition (Prasetiyo & Mubarokah, 2014).

There is a close relationship between intellectual capacity, knowledge, thinking style, personality, motivation, environment, and creative thinking capacity (Ho & Kozhevnikov, 2023; Lin et al., 2024; Sternberg, 2006). In addition, there is a connection between a person's thinking style and their capacity for creative thinking (Chegeni et al., 2016). Research indicates that students exhibit different thinking styles, such as legislative, executive, and judicial, influencing their analogical reasoning in solving mathematical problems. These styles affect how students process information and apply known solutions to new problems, suggesting a potential link to creative thinking in mathematics (Mulyani et al., 2024). Education professionals should consider the kinds of thinking styles that younger generations' creativity needs to be developed and maintained (Zhu & Zhang, 2011). Integrating Sternberg's thinking styles with creative thinking could address the gap between cognitive styles and creativity research. By understanding how different thinking styles contribute to various stages of the creative process, educators can develop more tailored approaches to fostering creativity in diverse learners (Allen et al., 2019). This explanation leads one to conclude that a person's thinking style and creativity are related. In this research, the Sternberg thinking style is based on legislative, executive, and judicial functions.

To address the study's objectives, the following research questions are proposed; how do students with different thinking styles (legislative, executive, and judicial) demonstrate creative thinking in solving mathematical problems across various levels of mathematical ability (high, medium, and low)? This study analyzes how students with different thinking styles demonstrate creative thinking in mathematics. This study presents a novel approach by combining Sternberg's thinking styles with creative thinking indicators in a mathematical problem-solving context. The research highlights how students' creative thinking profiles differ across legislative, executive, and judicial thinking styles while considering variations in their mathematical ability levels. By doing so, this study provides a unique contribution to mathematics education, offering insights for educators to develop more personalized teaching strategies based on students' thinking style preferences.

Research Methods

This research employed a mixed method approach, integrating both quantitative and qualitative methods to provide a comprehensive understanding of students' mathematical creative thinking in relation to their thinking styles. The quantitative phase was used to analyze the instruments' properties and categorize students by their thinking style and mathematical ability. For the quantitative phase, the data were analyzed using IBM SPSS Statistics 22. The qualitative phase explored students' written responses and interview reflections to interpret their creative thinking processes in problem-solving contexts.

To measure students' thinking styles, a 15-item instrument was adapted from the Thinking Styles Inventory developed by (Gafoor & P., 2016) grounded in Sternberg's theory. Each item offered three response options, each corresponding to one of the three styles: legislative, executive, or judicial. Aiken's V index was employed to assess the instrument's content validity, measuring students' thinking styles. The content validation was conducted by two experts who rated the relevance of each item using a 4-point scale. Based on the experts' ratings, each item's Aiken's V value was calculated using SPSS. For the reliability of the questionnaire, the researcher used inter-rater reliability using ICC (Intraclass Correlation Coefficient). The intraclass correlation coefficient (ICC) was employed to evaluate the consistency of ratings provided by different raters across multiple items. The ICC can vary from 0 to 1, where values closer to 1 indicate higher reliability (McGraw & Wong, 1996).

Table 1. Thinking Styles Inventory *(Adapted from* (Gafoor & P., 2016) *based on Sternberg's Thinking Styles Theory)*

No.	Question Statement
1.	When solving a problem, you tend to: a. Make your own decision based on what you believe is right b. Make a decision based on the advice of older individuals or others c. Make a decision after analyzing other people's opinions
2.	When you have to present an assignment in class, you prefer to: a. Present the material suggested by the teacher b. Present material you have chosen yourself c. Present the material by considering it from multiple perspectives
3.	When you are drawing, you usually: a. Draw based on your imagination b. Draw while looking at a model or example c. Draw various forms based on images you've seen before

No.	Question Statement
4.	If you had the opportunity to work at a media or news broadcasting company, you would prefer to: a. Discover new sources of news b. Explore the details of reported news c. Prepare reports based on the newsworthiness of the story
5.	After reading an interesting book or article, you usually: a. Try to remember the summary and main points of the story b. Evaluate the characters and events in the story c. Have new ideas come to your mind
6.	When your teacher assigns you a practical task or experiment, you will: a. Complete it according to the teacher's instructions b. Do it after observing others and improving on their methods c. Do it on your own using the method you believe is correct
7.	If there were a drama performance at your school, the role you would choose is: a. Director b. Actor/Actress c. Stage crew or set decorator
8.	If you are experimenting in the school laboratory, you will: a. Follow the method or steps as explained b. Be excited to try different methods or steps to see what will happen c. Follow steps created by others if they make sense to you
9.	In an art exhibition held by your school, which of the following would you most likely do: a. Plan several activities and create rules for how they will be carried out b. Carry out the activities according to the rules and schedule c. First, consider the activities and artworks that will be displayed
10.	Which of the following opinions do you prefer when your parents get involved in solving your problems: a. A person should try their best to follow their advice b. Older people should give more freedom to the younger ones c. A person should act after considering or listening to the opinions of the elders
11.	When working on a math assignment, you will: a. Use the usual method that you often use b. Use the method taught by your teacher c. Try using several different methods to solve it
12.	In a group discussion or when presenting an idea, you prefer to: a. Use existing ideas b. Use ideas that have been discussed with your friends c. Use new ideas of your own

No.	Question Statement
13.	When you need more information, you prefer to: a. Ask the teacher b. Search for it yourself c. Discuss with your friends
14.	Your character or way of solving a problem is most influenced by: a. Yourself b. Other people c. Experience
15.	When you buy clothes, you will: a. Follow your parents' taste b. Follow current fashion trends c. Follow your taste

The creative thinking ability test used in this research consists of one problem representing creative thinking indicators. The creative thinking indicators used in this research are shown in Table 2 (Guilford, 1966).

Table 2. Description of Creative Thinking Indicators

No.	Indicators	Criteria
1	*Fluency*	a. Students can understand the information in the questions with various interpretations; b. Students can identify what is known and unknown about the problem; c. Students can explore and translate problem information in their language; d. Students can propose several solution strategies; e. Students can provide several alternative answer solutions.
2	*Flexibility*	a. Students can offer various solution strategies, different from the strategies usually used; b. Students can research several solution methods or answers and then create different solutions correctly.
3	*Originality*	a. Students can produce ideas that are not common so that students' answers are not tied to the material explained by the teacher and the student handbook.
4	*Elaboration*	a. Students can develop mathematical ideas in solving mathematical problems in detail; b. Students can explain the reasons for solving the problem and conclude correctly.

The mathematical creative thinking ability test used in this research is shown in Table 3. The content validity of the mathematical creative thinking test was evaluated by two experts using Aiken's V index (Aiken, 1980), with values ≥ 0.60 considered acceptable for small expert panels. Inter-rater reliability for scoring students' creative thinking responses was analyzed using Gregory's Agreement, which recommends ≥ 75% agreement as acceptable (Gregory, 2004). Descriptive statistics (mean, standard deviation, minimum, maximum) were computed to summarize students' thinking style scores and mathematical performance (Fraenkel et al., 1993).

Table 3. The mathematical creative thinking test

No.	Question
1	A tree that is 20 meters high grows at a slope of 30° from the vertical so that the tree does not fall; a piece of wood is propped up in the middle of the tree so that it is 45° from the ground. The length of the supporting wood is..... a. Write what you know about the problem above! b. Draw an illustration of the question above! c. Make comparisons or trigonometry rules that can be used from the problem above! d. Determine the length of the supporting wood (use the method you understand)!

A cross-tabulation analysis (crosstabs) (Field, 2013) was also conducted using SPSS to examine the relationship between students' dominant thinking styles, which were classified based on the highest subscale score and their categorized mathematical ability levels. The students' mathematical ability scores from the initial test are presented in Table 4 to support the grouping process.

Table 4. Students' Mathematical Ability Scores from the Initial Test

Score	Mathematics Ability Test Criteria
0 – 7	Low
8 – 14	Medium
15 – 21	High

The level of creative thinking uses the levels of creative thinking according to (Siswono, 2006) modified by researchers as shown in Table 5.

Table 5. Description of Levels in Mathematical Creative Thinking (MCT)

Level of creative thinking ability (MCT)	Characteristics of Creative Thinking Levels
MCT 4 (Very Creative)	Students can show four indicators of creative thinking (Fluency, Flexibility, Originality, and Elaboration)
MCT 3 (Creative)	Students can demonstrate three of the four indicators of creative thinking
MCT 2 (Quite Creative)	Students can show two of the four indicators of creative thinking
MCT 1 (Not Creative Enough)	Students can show one indicator of creative thinking
MCT 0 (Not Creative)	Students are unable to demonstrate the four indicators of creative thinking, which include (Fluency, Flexibility, Originality, and Elaboration)

The initial sample consisted of 37 students from a grade XI science class at a senior high school in Central Aceh. All students completed two instruments: (1) a thinking style questionnaire adapted from the Sternberg-based Thinking Styles Inventory by Gafoor & P. (2016) and (2) a mathematical ability test consisting of six national exam-based essay items. Based on the results of these two instruments, a purposive sampling technique was used to select 9 representative students. These students were grouped according to their dominant thinking style (legislative, executive, or judicial) and stratified by mathematical ability level (high, medium, or low). It ensured that each combination of style and ability was equally represented, enabling in-depth qualitative analysis of variations in creative mathematical thinking.

The qualitative data were analyzed using the interactive model by Miles and Huberman, which consists of three main steps; data reduction, data display, and drawing conclusions (Miles & Huberman, 2014). These steps were applied systematically to the data collected from the thinking style questionnaire, mathematics ability test, creative thinking test, and interviews. During the data reduction phase, the researcher applied a coding system to categorize and interpret the data. The indicators of creative thinking were coded as follows; K1 (Fluency), K2 (Flexibility), K3 (Originality), and K4 (Elaboration). In addition to coding the creative thinking indicators, the level of creative thinking was categorized using the code MCT, which ranges from MCT 0 until MCT 5. Students were also assigned a code reflecting their thinking style and mathematical ability level. Legislative thinking style with high (S1-LH), medium (S2-LM), and low math ability (S3-LL); Executive thinking style with high (S4-EH), medium (S5-EM), and low math ability (S6-EL); Judicial thinking style with high (S7-JH), medium (S8-JM), and low math ability (S9-JL). This coding system facilitated a structured analysis and comparison of students' creative thinking profiles across different cognitive styles and academic ability levels. To ensure validity, triangulation was conducted by cross-referencing test results, questionnaire data, and interview responses, allowing for deeper insights into how thinking styles and math proficiency influence creative thinking performance.

Results and Discussions

The results of this mixed-method study are presented in two main phases: quantitative and qualitative. The quantitative phase reports on (1) the content validity (Aiken's V) and inter-rater reliability (Intraclass Correlation Coefficient) of the thinking style questionnaire, the validity and reliability of mathematical creative thinking test, including the content validity (Aiken's V) and inter-rater reliability (Gregory's Agreement), (2) the descriptive statistics of students' thinking style scores and mathematical ability levels; and (3) the crosstabulation analysis examining the relationship between dominant thinking styles and mathematical performance. The qualitative phase focuses on (1) students' written responses to open-ended mathematical creative-thinking tasks, analyzed across the four creativity indicators (fluency, flexibility, originality, and elaboration), and (2) interview findings that provide deeper insight into how students with different thinking styles approached and reasoned through creative problem-solving situations. The qualitative findings were triangulated with data from semi-structured interviews to provide deeper insights into students' mathematical creative thinking. The excerpts presented below serve to complement and validate the written test responses. Each excerpt is followed by the researcher's interpretation to comprehensively understand students' thought processes in solving the creative task.

Two expert validators evaluated the relevance of each item on a 4-point scale, and their ratings were analyzed using SPSS to calculate Aiken's V coefficients. The results revealed that Aiken's V values ranged from 0.67 to 1.00. The analysis revealed that items 2, 3, 6, and 7 achieved perfect scores of 1.00 (indicating perfect agreement), and item 15 also demonstrated good validity with a score of 0.83. However, several items had the lowest acceptable score of 0.67. Since all items scored above the recommended minimum threshold of 0.60 for two raters, it can be concluded that the instrument possesses acceptable to excellent content validity, confirming its appropriateness for measuring students' thinking styles according to Sternberg's framework.

Descriptive Statistics

	N	Minimum	Maximum	Mean
aiken_v	15	.67	1.00	.7667
Valid N (listwise)	15			

Case Processing Summary[a]

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Item	15	100.0%	0	0.0%	15	100.0%
aiken_v	15	100.0%	0	0.0%	15	100.0%

a. Limited to first 100 cases.

Case Summaries[a]

		Item	aiken_v
1		1	.67
2		2	1.00
3		3	1.00
4		4	.67
5		5	.67
6		6	1.00
7		7	1.00
8		8	.67
9		9	.67
10		10	.67
11		11	.67
12		12	.67
13		13	.67
14		14	.67
15		15	.83
Total	N	15	15

a. Limited to first 100 cases.

Picture 1. Aiken's V Coefficients for Thinking Style Questionnaire

The reliability analysis results using the Intraclass Correlation Coefficient (ICC) indicated high consistency among raters. The ICC for single measures was calculated to be 0.851, with a 95% confidence interval ranging from 0.613 to 0.947. It suggests a substantial agreement among individual raters, albeit with some variability, as indicated by the confidence interval. Furthermore, the average measures ICC, which provides a more stable estimate of reliability by averaging the ratings of all raters, was found to be even higher at 0.920, with a 95% confidence interval from 0.760 to 0.973. This high value underscores the excellent reliability of the ratings across raters, confirming that the average ratings are consistent and reliable. The statistical significance of these ICC values was confirmed by an F-test, yielding an F-value of 12.429 with degrees of freedom df1 = 14 and df2 = 14 and a p-value of less than 0.001. This significant result indicates that the observed reliability is statistically reliable and not due to random chance.

Reliability Statistics

Cronbach's Alpha	N of Items
.920	2

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.851[a]	.613	.947	12.429	14	14	.000
Average Measures	.920[c]	.760	.973	12.429	14	14	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Picture 2. Intraclass Correlation Coefficient for Thinking Style Questionnaire

Content validity for the mathematical creative thinking test was evaluated using Aiken's V with two expert raters. The V values for all four indicators were above the minimum accepted threshold (0.60), ranging from 0.67 (Flexibility) to 1.00 (Originality), confirming strong expert agreement on the item's relevance.

Case Processing Summary[a]

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Indikator	4	100.0%	0	0.0%	4	100.0%
aiken_v	4	100.0%	0	0.0%	4	100.0%

a. Limited to first 100 cases.

Case Summaries[a]

		Indikator	aiken_v
1		Fluency	.83
2		Flexibility	.67
3		Originality	1.00
4		Elaboration	.83
Total	N	4	4

a. Limited to first 100 cases.

Picture 3. Aiken's V Coefficients for Creative Thinking Indicators

Inter-rater reliability was assessed using Gregory's agreement coefficient, showing that 83.3% of the scores between the two raters agreed across the four indicators.

Despite students' limited performance in the originality and flexibility indicators, the high percentage indicated a reliable scoring process.

Statistics

Gregory_Agreement

N	Valid	36
	Missing	0

Gregory_Agreement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	6	16.7	16.7	16.7
	1.00	30	83.3	83.3	100.0
	Total	36	100.0	100.0	

Picture 4. Gregory Inter-Rater Agreement

To provide a clearer overview of students' profiles, Table 6 summarizes the individual scores obtained by 37 participants across the three thinking style dimensions (Legislative, Executive, and Judicial) and their total scores on the mathematical test. Students were grouped into categories of high, medium, or low math ability based on their total scores. The dominant thinking style for each student was identified by selecting the highest score among the three dimensions. The cross-tabulation analysis further used this classification to explore potential relationships between thinking styles and mathematical performance (Table 6).

Table 6. Individual Student Scores on Thinking Style Dimensions and Mathematical Ability Categories

Subject	Legislative	Executive	Judicial	Math Score	Math Category	Dominant Thinking Style
Subject_1	10	11	11	2	Low	Executive
Subject_2	7	6	13	1	Low	Judicial
Subject_3	11	8	12	3	Low	Judicial
Subject_4	8	13	12	4	Low	Executive
Subject_5	10	6	4	6	Low	Legislative
Subject_6	13	14	12	6	Low	Executive
Subject_7	6	13	10	13	Medium	Executive
Subject_8	10	14	12	10	Medium	Executive
Subject_9	11	9	11	5	Low	Legislative
Subject_10	8	6	4	6	Low	Legislative
Subject_11	7	8	11	4	Low	Judicial
Subject_12	11	11	11	8	Medium	Executive
Subject_13	11	12	6	19	High	Executive
Subject_14	6	7	4	16	High	Executive
Subject_15	9	5	11	10	Medium	Judicial
Subject_16	8	8	6	21	High	Executive
Subject_17	5	6	6	3	Low	Executive

Subject	Legislative	Executive	Judicial	Math Score	Math Category	Dominant Thinking Style
Subject_18	11	12	4	4	Low	Executive
Subject_19	9	8	8	10	Medium	Legislative
Subject_20	5	6	13	14	Medium	Judicial
Subject_21	8	10	10	6	Low	Executive
Subject_22	4	10	13	14	Medium	Judicial
Subject_23	13	14	12	12	Medium	Executive
Subject_24	9	8	10	15	High	Judicial
Subject_25	12	10	12	8	Medium	Legislative
Subject_26	4	6	11	18	High	Judicial
Subject_27	13	14	5	14	Medium	Executive
Subject_28	6	6	4	10	Medium	Executive
Subject_29	10	14	10	3	Low	Executive
Subject_30	7	8	10	19	High	Judicial
Subject_31	12	12	11	12	Medium	Executive
Subject_32	6	11	8	6	Low	Executive
Subject_33	8	13	6	18	High	Executive
Subject_34	6	12	11	21	High	Executive
Subject_35	10	9	9	14	Medium	Legislative
Subject_36	8	6	6	21	High	Legislative
Subject_37	12	9	4	16	High	Legislative

The analysis of students' thinking styles was initially performed using descriptive statistics to obtain an overview of the score distributions across the three dimensions: legislative, executive, and judicial. Picture 5 shows that the executive thinking style scored the highest on average (M = 9.59, SD = 2.93), indicating a strong preference among students for structured, rule-based problem-solving and task completion. It was followed by the judicial thinking style, which had a mean score of 9.00 (SD = 3.13), reflecting a tendency among students to analyze, evaluate, and justify information before forming conclusions. The legislative style recorded the lowest mean score (M=8.76, SD=2.60), suggesting a lesser inclination among students to engage in creative autonomy or generate their solutions. These results indicate a predominant preference among students for structured, rule-following, and instruction-oriented approaches, consistent with the characteristics of executive thinking.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Legislative	37	4	13	8.76	2.597
Executive	37	5	14	9.59	2.929
Judicial	37	4	13	9.00	3.127
Math_Score	37	1	21	10.59	6.080
Valid N (listwise)	37				

Picture 5. Descriptive Statistics of Thinking Styles

To further explore the relationship between students' thinking styles and their mathematical performance, a cross-tabulation analysis was conducted between dominant thinking style categories and students' mathematical ability levels (High, Medium, Low). As shown in Picture 6, the majority of students were categorized as having an executive thinking style (n = 20), followed by judicial (n = 9) and legislative (n = 8). Regarding mathematical ability, 27.0 % of students fell into the high-ability group, 37.8 % into the low, and 35.1 % into the medium. Within the executive group, 25.0 % demonstrated high mathematical ability, 40.0 % low, and 35.0 % medium. The judicial thinkers were evenly distributed across all three levels (33.3 % high, low, and medium each). Legislative thinkers showed 25.0 % in the high category, 37.5 % in the low category, and 37.5 % in the medium.

Dominant_Thinking_Style * Math_Category Crosstabulation

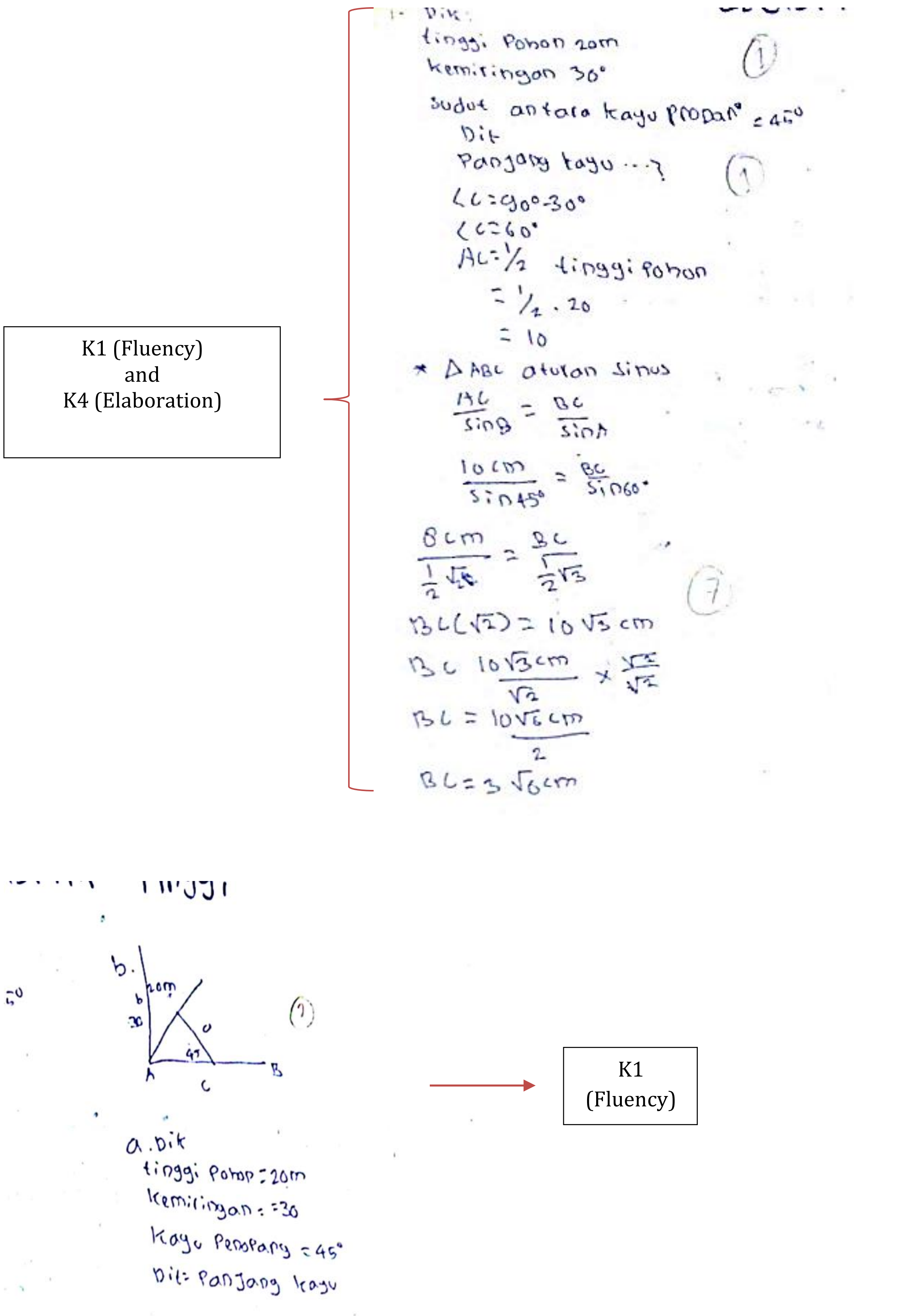
			Math_Category			Total
			High	Low	Medium	
Dominant_Thinking_Style	Executive	Count	5	8	7	20
		% within Dominant_Thinking_Style	25.0%	40.0%	35.0%	100.0%
	Judicial	Count	3	3	3	9
		% within Dominant_Thinking_Style	33.3%	33.3%	33.3%	100.0%
	Legislative	Count	2	3	3	8
		% within Dominant_Thinking_Style	25.0%	37.5%	37.5%	100.0%
Total		Count	10	14	13	37
		% within Dominant_Thinking_Style	27.0%	37.8%	35.1%	100.0%

Picture 6. Crosstab of Thinking Style and Mathematical Ability

Nine students were purposefully selected from the larger sample for in-depth qualitative analysis to explore how students' dominant thinking styles relate to their mathematical creative thinking. Specifically, three students were chosen from the dominant thinking style categories; legislative, executive, and judicial. Within each group, one student was selected to represent each level of mathematical ability: high, medium, and low. The following section elaborates on the creative thinking profiles of students grouped by thinking style and mathematical ability. The analysis integrates test results and interview responses through triangulation to comprehensively understand each student's cognitive performance.

a. Legislative subject creative thinking profile on high mathematical ability (S1-LH)

The student coded S1-LH, identified as having a legislative thinking style and high mathematical ability, was given a creative thinking task. The student's written response to the task is presented in Picture 7.



Picture 7. The results of S1-LH students' work

S1-LH's written work began with a clear listing of all given data, the tree's height of 20 m, its 30° tilt from the vertical, and the supporting wood at 45° from the ground. Below the data, S1-LH sketched a well-proportioned Picture, a vertical line (the tree if upright), an inclined line at 30° from that vertical (*the actual tree*), and a second line at 45° from the horizontal (*the supporting wood*). Points A (*ground pivot*), B (*top of the tree*), and C (ground end of the support) were labeled, as were angles of 30° and 45°. For the calculations, S1-LH decomposed the problem by focusing on the midpoint of the tree, calculating both the horizontal and vertical components using trigonometric ratios. The following is an excerpt from the interview with S1-LH.

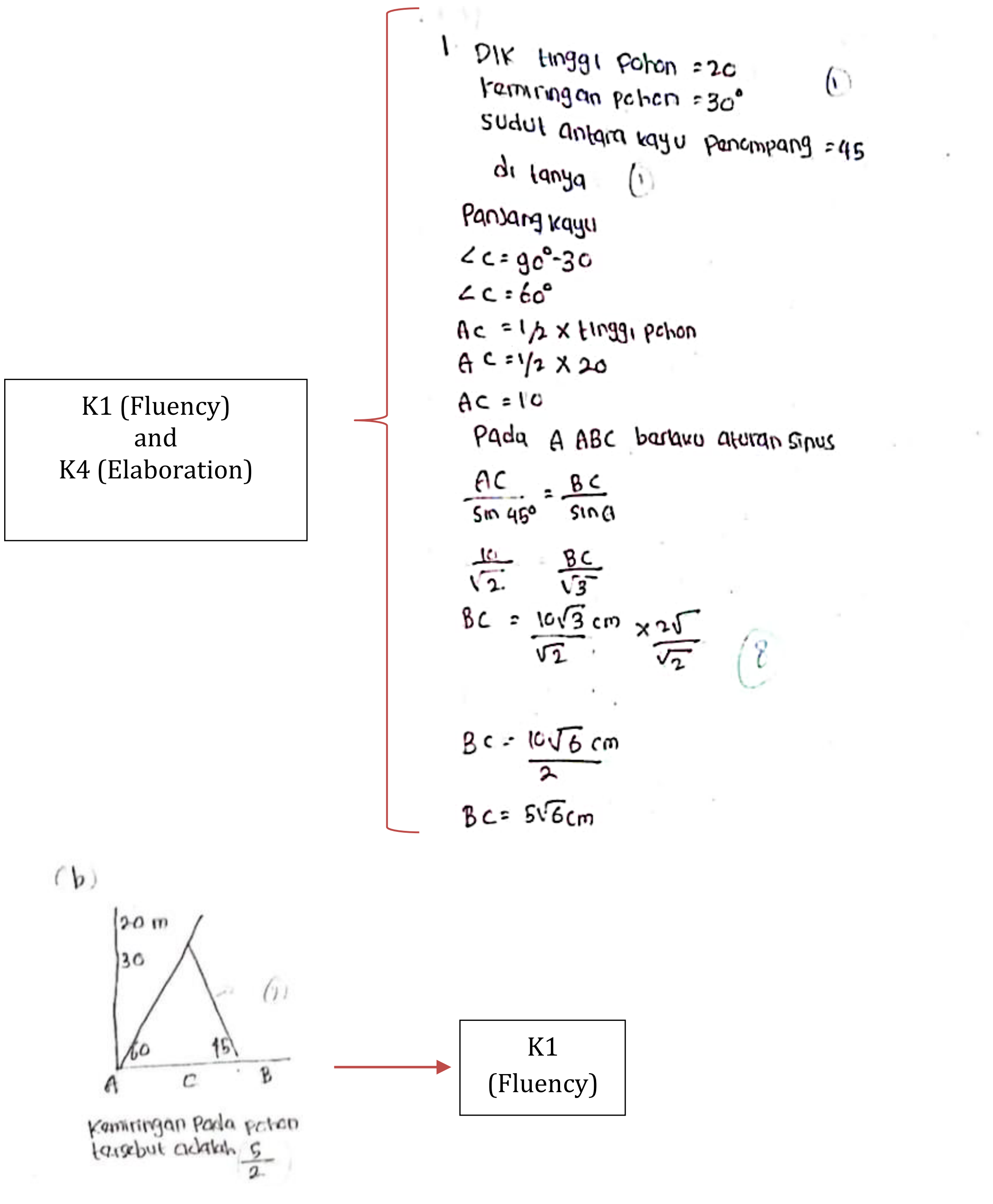
R	:	*Did you understand the problem?*
S1-LH	:	*Yes, I understood it. It was similar to a problem we had worked on in class.*
R	:	*What did you understand from the problem?*
S1-LH	:	*The tree was 20 meters tall, tilted at 30°, and the support angle was 45°*
R	:	*In your opinion, how many ways could the problem be solved?*
S1-LH	:	*Maybe this problem could have been solved using another method, too, but I felt more confident using Sine.*
R	:	*How did you solve the problem?*
S1-LH	:	*I drew the triangle first and then used the sine formula.*
R	:	*Could you combine your method with any other?*
S1-LH	:	*Hmm, I think no.*
R	:	*Have you ever solved a problem like this before?*
S1-LH	:	*Yes, I had done a similar one in class.*
R	:	*Did you think your answer was correct?*
S1-LH	:	*InshaAllah, it was. I checked my steps again to be sure.*
R	:	*Did you face any difficulties while solving it?*
S1-LH	:	*Just a bit at the beginning, but the rest went smoothly*

Based on S1-LH's written work and interview responses, the subject demonstrated strong fluency in mathematical creative thinking. S1-LH clearly understood the problem, identified known and unknown elements, and translated the information into their own words. However, S1-LH only used one strategy (sine rule) and did not propose alternative methods, so fluency is only partially fulfilled. Regarding flexibility, S1-LH did not explore or attempt different solution strategies. Although S1-LH acknowledged that other methods might exist, they chose to stick with the familiar approach, indicating that this indicator is not fulfilled.

Regarding originality, S1-LH followed a standard method taught in class, showing no unique or uncommon ideas. Thus, this aspect is also not met. For elaboration, S1-LH explained their steps briefly and double-checked their work, showing some reflection. However, their reasoning remained procedural with limited depth, meaning elaboration is partially fulfilled. In summary, S1-LH showed strengths in fluency and some elaboration but lacked flexibility and originality in problem-solving.

b. Legislative subject creative thinking profile on medium mathematical ability (S2-LM)

The student coded as S2-LM, identified as having a legislative thinking style and moderate mathematical ability, was given a creative thinking task. The student's written response to the task is presented in Picture 8.



Picture 8. The results of S2-LM students' work

At the top, S2-LM listed all known information from the problem, including the height of the tree (*20 meters*), the angle of the tree's tilt (*30° from the vertical*), and the angle of the supporting wood (*45° from the ground*). Below this, the subject drew a triangle to illustrate the scenario, clearly labeled the relevant angles, and marked the midpoint of the tree where the supporting wood was attached. S2-LM wrote out the trigonometric formulas needed to solve the problem, such as sine, and applied them to the labeled sides and angles in the Picture. S2-LM calculated the horizontal and vertical components from the midpoint of the tree and then used these values to determine the length of the supporting wood. Each calculation step was written in sequence, leading to a final answer for the length of the supporting wood, which was indicated at the end of the solution. The following is an excerpt from the interview with S2-LM.

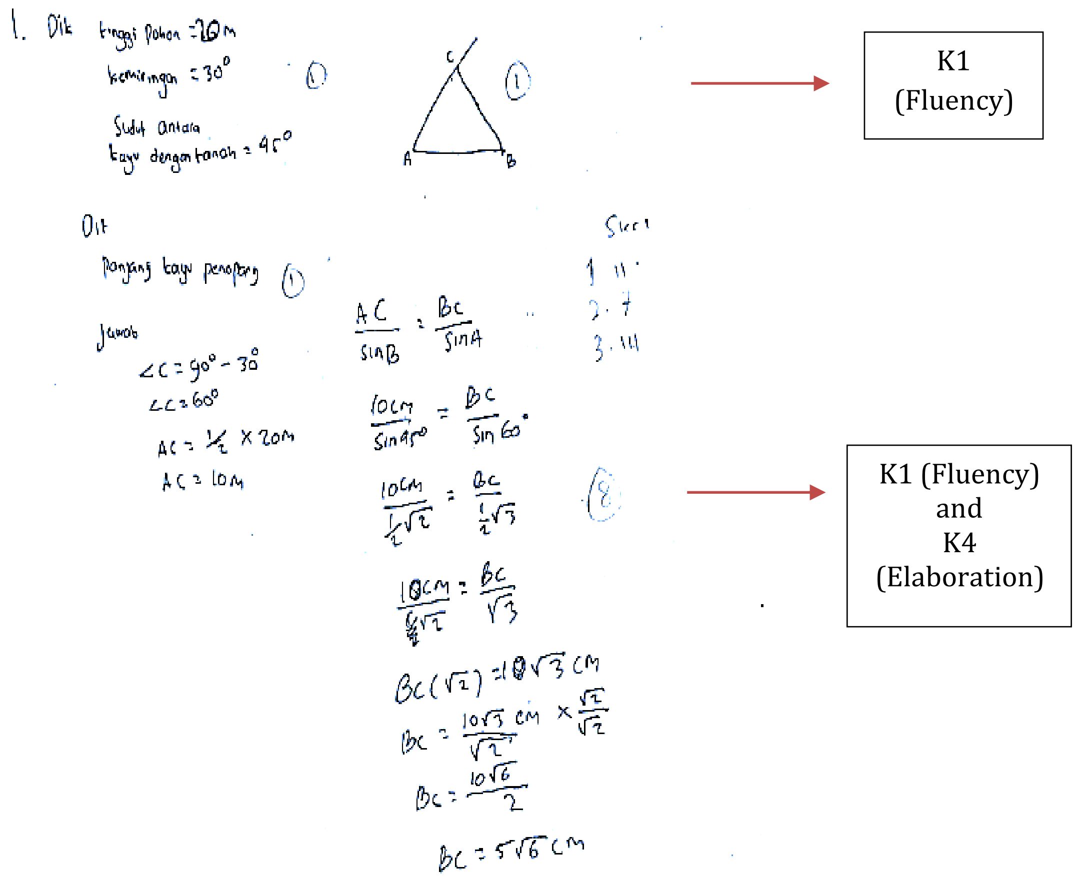
R	:	*Did you understand the problem?*
S2-LM	:	*Yes, I understood it.*
R	:	*What did you understand from the problem?*
S2-LM	:	*The tree was 20 meters tall, tilted 30°, and had a 45° support angle.*
R	:	*In your opinion, how many ways could the problem be solved?*
S2-LM	:	*I thought there may be two ways, but I just used what I remembered.*
R	:	*How did you solve the problem?*
S2-LM	:	*I drew the triangle first, labeled the sides and angles, and then used the sine rule as we were taught.*
R	:	*Could you combine your method with any other?*
S2-LM	:	*Hmm, I wasn’t sure how to do it.*
R	:	*Have you ever solved a problem like this before?*
S2-LM	:	*It's not exactly like this, but something close during practice.*
R	:	*Did you think your answer was correct?*
S2-LM	:	*I hoped it was. I checked it again, just in case.*
R	:	*Did you face any difficulties while solving it?*
S2-LM	:	*A little, especially at the beginning, I tried sticking with what we learned.*

Based on S2-LM’s written solution and interview responses, S2-LM showed adequate fluency. S2-LM understood the key information from the problem (*tree height, tilt, support angle*), labeled the triangle correctly, and used the sine rule as taught. While S2-LM mentioned the possibility of two methods, S2-LM only used one and did not present multiple strategies or alternative answers. Thus, fluency is partially met. In terms of flexibility, S2-LM showed limited exploration. Although S2-LM considered there might be another way, S2-LM lacked confidence and did not attempt or combine different strategies. As a result, flexibility is not fulfilled. For originality, S2-LM followed a conventional method exactly as taught, without introducing novel ideas or approaches. This indicator is not met.

Regarding elaboration, S2-LM explained their process briefly and rechecked their work for correctness, showing some attention to detail. However, their reasoning remained procedural without deeper mathematical insight. Therefore, elaboration is partially fulfilled. S2-LM demonstrated partial fluency and elaboration but lacked flexibility and originality in their problem-solving approach.

c. Legislative subject creative thinking profile on low mathematical ability (S3-LL)

The student coded as S3-LL, identified as having a legislative thinking style and low mathematical ability, was given a creative thinking task. The student's written response to the task is presented in Picture 9.



Picture 9. The results of S3-LL students' work

S3-LL's answer to the tree problem, as seen in the image, revealed several important aspects of their mathematical thinking process. S3-LL began by listing the known information: the height of the tree (20 meters), the tilt angle (30°), and the angle of the supporting wood (45°). The Picture provided by S3-LL was very basic and lacked clear labels or structure. There was no indication of the midpoint of the tree, the ground line, or the specific points relevant to the problem. It made it difficult to follow the student's reasoning or to see how the Picture supported their calculations. The interview results with subject S3-LL supported it.

R	:	*Did you understand the problem?*
S3-LL	:	*I understood a little, like the numbers and angles.*
R	:	*What did you understand from the problem?*
S3-LL	:	*The tree was 20 meters, the tilt was 30°, and the angle was 45°.*
R	:	*In your opinion, how many ways could the problem be solved?*
S3-LL	:	*I wasn't sure; maybe it was just one way.*

R : *How did you solve the problem?*

S3-LL : *I drew the triangle and used the sine formula because that's what we learned.*

R : *Could you combine your method with any other?*

S3-LL : *I didn't know how to do that.*

R : *Have you ever solved a problem like this before?*

S3-LL : *Not yet, I think.*

R : *Did you think your answer was correct?*

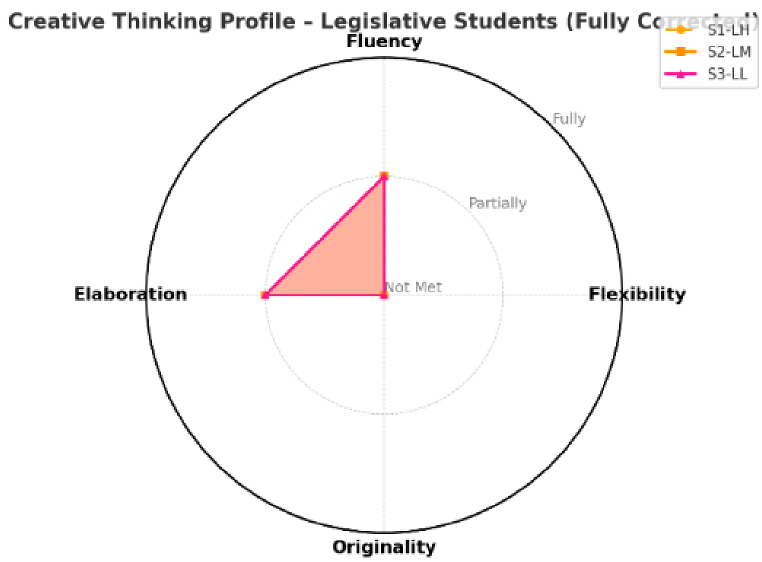
S3-LL : *I wasn't sure, but I followed the steps we were taught.*

R : *Did you face any difficulties while solving it?*

S3-LL : *Yes, I thought it was quite hard, especially the calculation part.*

Based on S3-LL's written work and interview, S3-LL demonstrated limited fluency. While S3-LL recognized the key numbers and angles in the problem, their explanation showed only partial understanding. S3-LL followed a single strategy, the sine rule, as taught, without proposing or attempting alternative approaches. Fluency is, therefore, partially met, mostly at a basic level. In terms of flexibility, S3-LL did not explore or consider other methods. When asked, S3-LL was unsure if multiple strategies were possible and could not combine or vary their approach. Thus, flexibility is not fulfilled.

Regarding originality, S3-LL relied fully on the standard classroom-taught method and displayed no signs of generating novel ideas or unique strategies. Therefore, originality was also not met. As for elaboration, their written steps were basic and mostly followed procedural instructions without detailed explanation. S3-LL admitted struggling with calculations and uncertainty about the correctness of the answer, suggesting limited confidence in their reasoning. Consequently, elaboration is minimally fulfilled. The results from the three legislative subjects were visualized in the radar chart below.

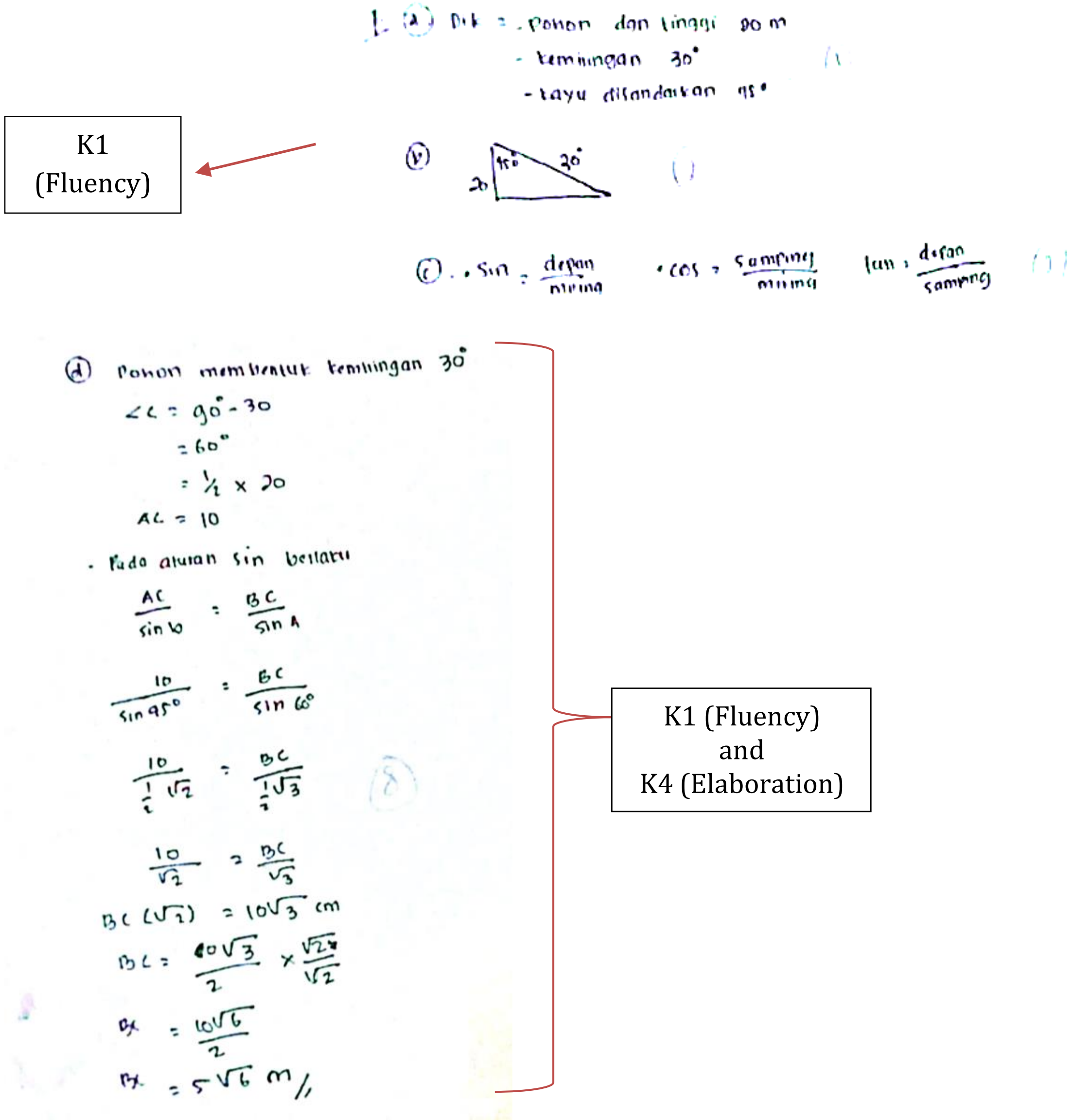


Picture 10. The radar chart showed creative thinking profiles of students with a legislative thinking style.

The radar chart for the legislative students, S1-LH, S2-LM, and S3-LL, showed that all three subjects demonstrated partial fluency, as they understood the problem well but did not propose or attempt alternative strategies. Neither student met the indicators of flexibility and originality since each relied solely on the sine rule without exploring other methods or introducing unique ideas. Regarding elaboration, all three students showed partial fulfillment, providing procedural explanations with limited conceptual depth or reflective reasoning.

d. Executive subject creative thinking profile on high mathematical ability (S4-EH)

To examine the creative thinking profile of a student with an executive thinking style and high mathematical ability, the subject coded as S4-EH was selected. The student's response to the creative thinking task is shown in Picture 11 and serves as the basis for evaluating performance across the four creative thinking indicators.



Picture 11. The results of S4-EH students' work

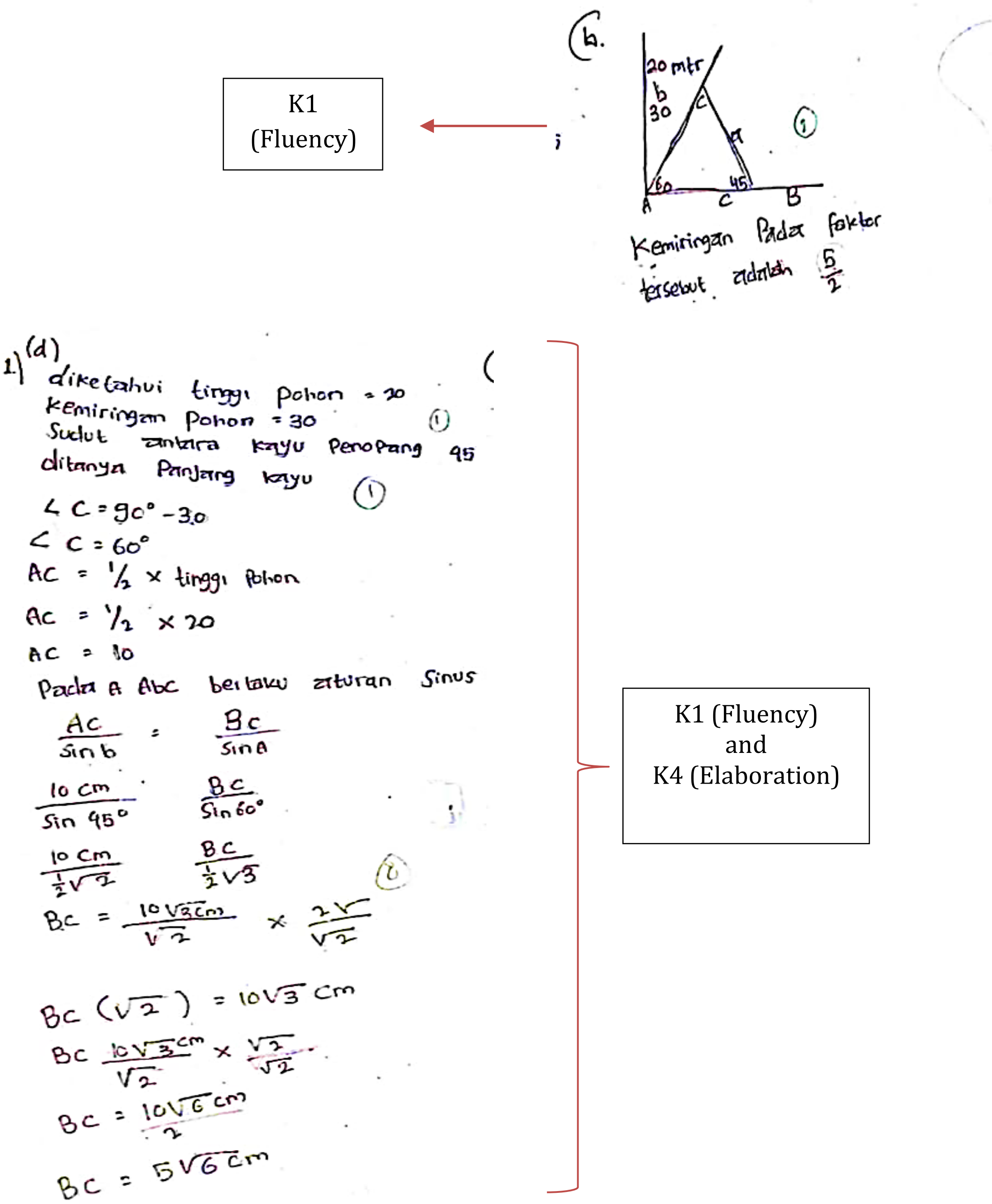
S4-EH's answer to the tree problem was a solid example of clear and structured mathematical thinking. S4-EH began by restating the problem and listing all the information, which showed strong fluency. The Picture included was simple but effective, helping to clarify the relationships between the tree, the ground, and the supporting wood. S4-EH solved the problem using standard trigonometric methods, breaking the scenario into triangles and applying sine rules as typically taught in class. Here is an excerpt from the interview with subject S4-EH.

R	:	*Did you understand the problem?*
S4-EH	:	*Yes, I understood it clearly.*
R	:	*What did you understand from the problem?*
S4-EH	:	*It involved a tree 20 meters tall, a 30° tilt, and a 45° support angle. It formed a triangle; we were supposed to find the side using trigonometry.*
R	:	*In your opinion, how many ways could the problem be solved?*
S4-EH	:	*I believed there were several ways, but I followed the sine rule.*
R	:	*How did you solve the problem?*
S4-EH	:	*I drew the triangle, labeled the sides and angles, and then applied the sine formula to calculate the unknown side.*
R	:	*Could you combine your method with any other?*
S4-EH	:	*I only knew how to use the sine rule, so I used that to solve the problem.*
R	:	*Have you ever solved a problem like this before?*
S4-EH	:	*Yes, during class practice and in exercises at home.*
R	:	*Did you think your answer was correct?*
S4-EH	:	*Yes, I was confident. I also double-checked the steps to be sure.*
R	:	*Did you face any difficulties while solving it?*
S4-EH	:	*Not really. I just needed to be careful with the angles and units.*

S4-EH demonstrated a strong creative thinking profile in terms of fluency and elaboration. S4-EH clearly understood the problem, identified all relevant elements such as the tree height, tilt, and support angle, and rephrased the situation as a trigonometric triangle task. Their explanation and written solution are coherent and structured, indicating partial achievement of the fluency indicator. Additionally, S4-EH showed strong elaboration skills by confidently applying the sine rule, carefully labeling the Picture, and double-checking their calculations for accuracy. However, despite recognizing the possibility of multiple solution methods, the student chose to rely solely on the sine rule without exploring or integrating other approaches. As a result, the flexibility indicator was not met. Similarly, the approach was entirely conventional, showing no unique strategies or ideas beyond what was taught in class, meaning that originality was also not fulfilled.

e. Executive subject creative thinking profile on medium mathematical ability (S5-EM)

To examine the creative thinking profile of a student with an executive thinking style and moderate mathematical ability, the subject coded as S5-EM was selected. The student's response to the creative thinking task is shown in Picture 12 and serves as the basis for evaluating performance across the four creative thinking indicators.



Picture 12. The results of S5-EM students' work

S5-EM's written response to the tree problem demonstrated a basic but organized structure. The student began by listing the known values from the question: the tree's height (20 meters), the tilt angle (30°), and the supporting wood angle (45°). The triangle sketch was simple yet complete, with clear labels for angles and lengths, including a proper marking of the midpoint of the tree where the supporting wood is attached. The triangle also included standard notation, such as points and angle indicators, helping to visualize the elements' relationship. S5-EM applied the sine rule in a conventional step-by-step format for the calculations. However, the method remained procedural and did not explore alternative approaches. The interview results with subject S5-EM supported this.

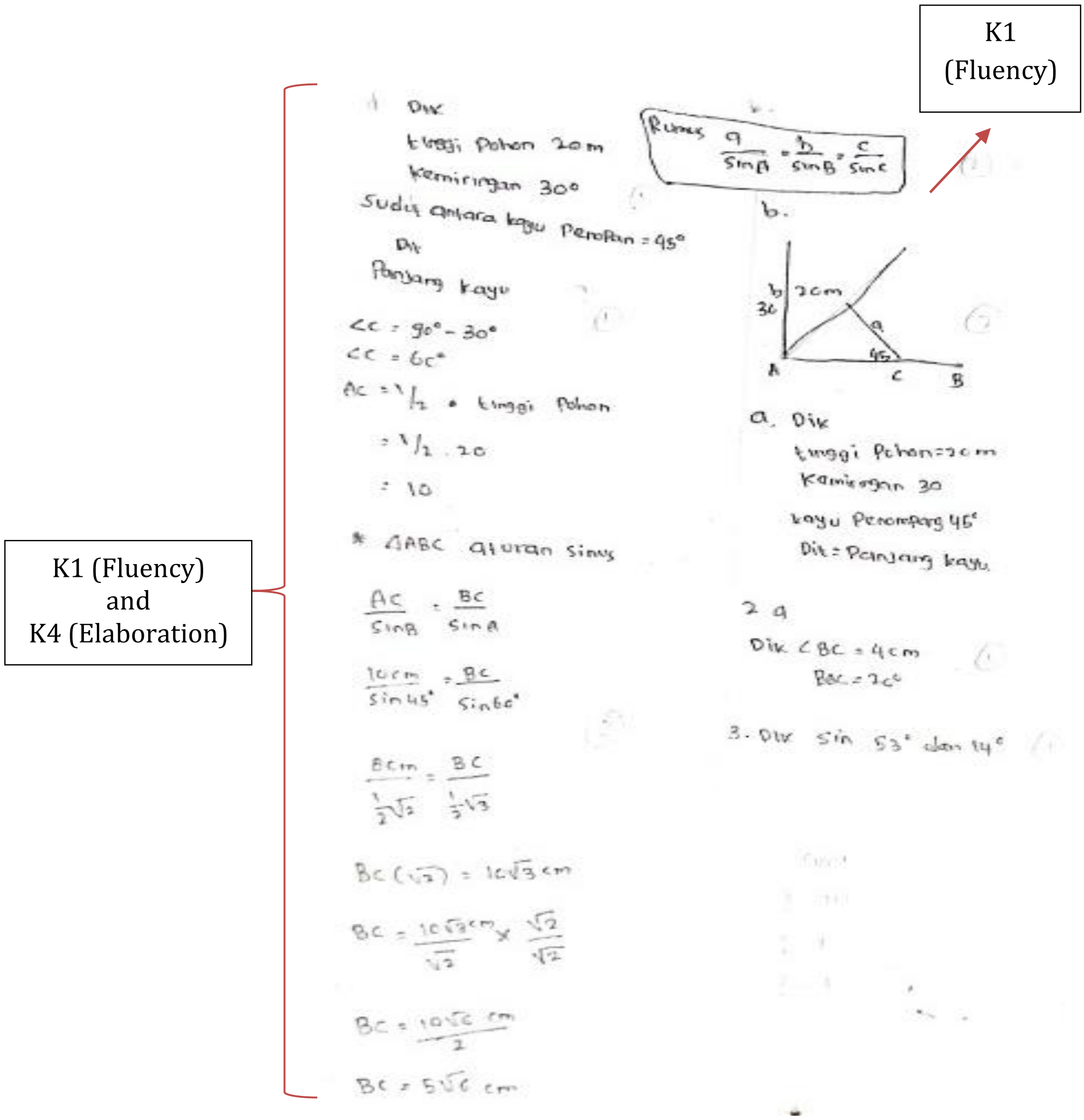
R	:	*Did you understand the problem?*
S5-EM	:	*Yes, I understood it.*
R	:	*What did you understand from the problem?*
S5-EM	:	*The tree was 20 meters high, tilted at 30°, and there was a 45° angle with the support.*
R	:	*In your opinion, how many ways could the problem be solved?*
S5-EM	:	*I didn't think of other ways. I just used the sine formula.*
R	:	*How did you solve the problem?*
S5-EM	:	*I drew a triangle, wrote down the values, and used the sine rule to find the side.*
R	:	*Could you combine your method with any other?*
S5-EM	:	*I only knew how to use the sine rule, so I just used that.*
R	:	*Have you ever solved a problem like this before?*
S5-EM	:	*I think so, but not exactly like this one.*
R	:	*Did you think your answer was correct?*
S5-EM	:	*I hoped it was correct. I checked the steps again to make sure.*
R	:	*Did you face any difficulties while solving it?*
S5-EM	:	*Yes, a bit in the middle steps, but I just followed what we learned.*

S5-EM showed adequate performance in terms of fluency and elaboration, although with some limitations. S5-EM understood the basic structure of the problem, including the given angles and the tree's height, and correctly interpreted it as a trigonometry-based question. S5-EM's solution followed the standard sine rule, with a properly drawn triangle and clear labeling, indicating that fluency was partially fulfilled. However, S5-EM did not consider or explore other solution strategies, admitting that they only used the sine rule because it was the only method they were familiar with. It reflects a lack of flexibility, as S5-EM has neither attempted to vary its approach nor combined it with alternative methods.

Regarding originality, S5-EM did not display any unique or uncommon thinking; their work followed a conventional classroom procedure, and this indicator was not met. Meanwhile, elaboration was partially met. S5-EM described their process and took care to check their work, but their explanation remained procedural and lacked deeper reasoning.

f. Executive subject creative thinking profile on low mathematical ability (S6-EL)

The subject coded as SER was selected to examine the creative thinking profile of a student with an executive thinking style and low mathematical ability. The student's response to the creative thinking task is shown in Picture 13.



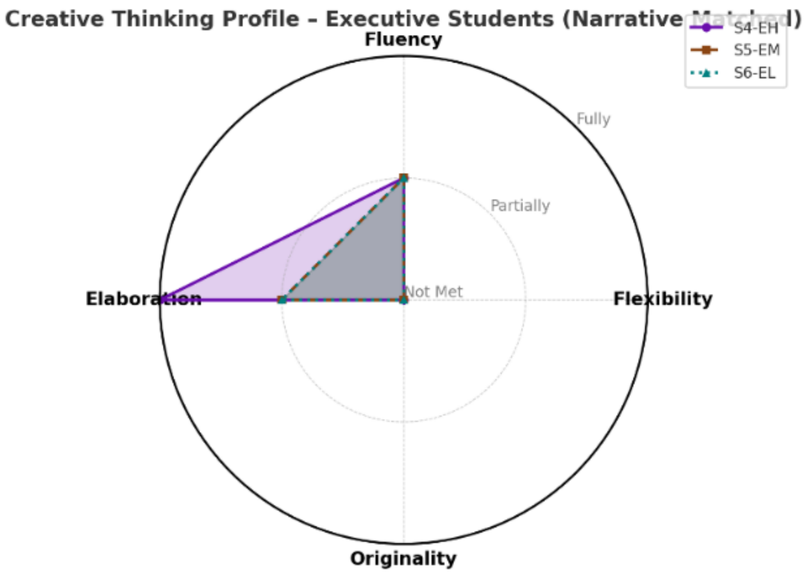
Picture 13. The results of S6-EL students' work

S6-EL's answer to the slanted tree problem began by listing the information and drawing a triangle Picture to represent the scenario. The student identified the relevant triangle and applied the sine formula. The approach was straightforward, relying on a standard trigonometric method without exploring alternative strategies or verifying the result using a different approach. The interview results with subject S6-EL supported this.

R	:	*Did you understand the problem?*
S6-EL	:	*Yes, I think I understood it.*
R	:	*What did you understand from the problem?*
S6-EL	:	*It had something to do with angles and the tree's height, and we had to find the side.*
R	:	*In your opinion, how many ways could the problem be solved?*

S6-EL	*:*	*I only knew one way, using the sine formula.*
R	*:*	*How did you solve the problem?*
S6-EL	*:*	*I just used the sine formula and followed the numbers step by step.*
R	*:*	*Could you combine your method with any other?*
S6-EL	*:*	*No, I just used what we were taught.*
R	*:*	*Have you ever solved a problem like this before?*
S6-EL	*:*	*I don't think so.*
R	*:*	*Did you think your answer was correct?*
S6-EL	*:*	*I wasn't sure, but I finished the steps.*
R	*:*	*Did you face any difficulties while solving it?*
S6-EL	*:*	*Yes, a bit with the square root part.*

The student S6-EL showed a basic and procedural approach, demonstrating partial fluency by recognizing key elements but relying solely on the sine rule without deeper interpretation. S6-EL did not explore alternative methods, indicating a lack of flexibility, and their solution followed standard procedures with no originality. While the steps were completed, the explanation lacked clarity and confidence, so elaboration was only partially met. Overall, S6-EL displayed basic understanding but limited creative or strategic thinking. The results from the three executive subjects were visualized in the radar chart below.

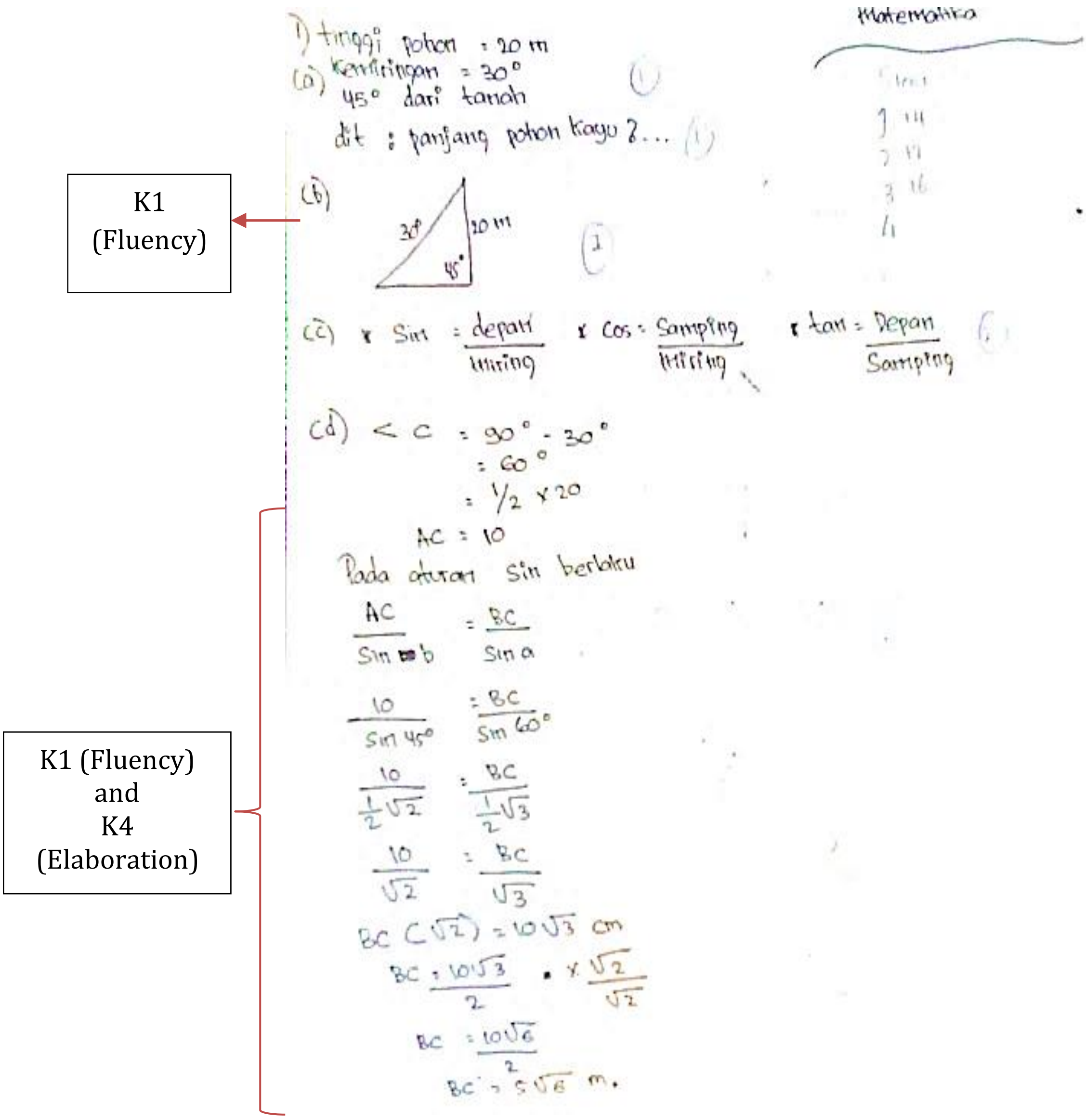


Picture 14. The radar chart shows the creative thinking profiles of students with an executive thinking style.

The radar chart for the executive students (S4-EH, S5-EM, and S6-EL) reflected their creative thinking profiles based on the narrative descriptions. All three students demonstrated partial fluency, as they understood the problem well but relied solely on the sine rule without considering other strategies. None of the students met the flexibility and originality indicators since none explored alternative methods or introduced novel ideas. Regarding elaboration, S4-EH fully met the criteria by providing detailed reasoning and careful verification of their work, whereas S5-EM and S6-EL only partially fulfilled this indicator, offering procedural explanations with limited depth.

g. Judicial subject creative thinking profile on high mathematical ability (S7-JH)

The student coded S7-JH, identified with a judicial thinking style and high mathematical ability, was assigned a creative thinking problem. The student's written solution is presented in Picture 15 and further analyzed based on the indicators of creative thinking.



Picture 15. The results of S7-JH students' work

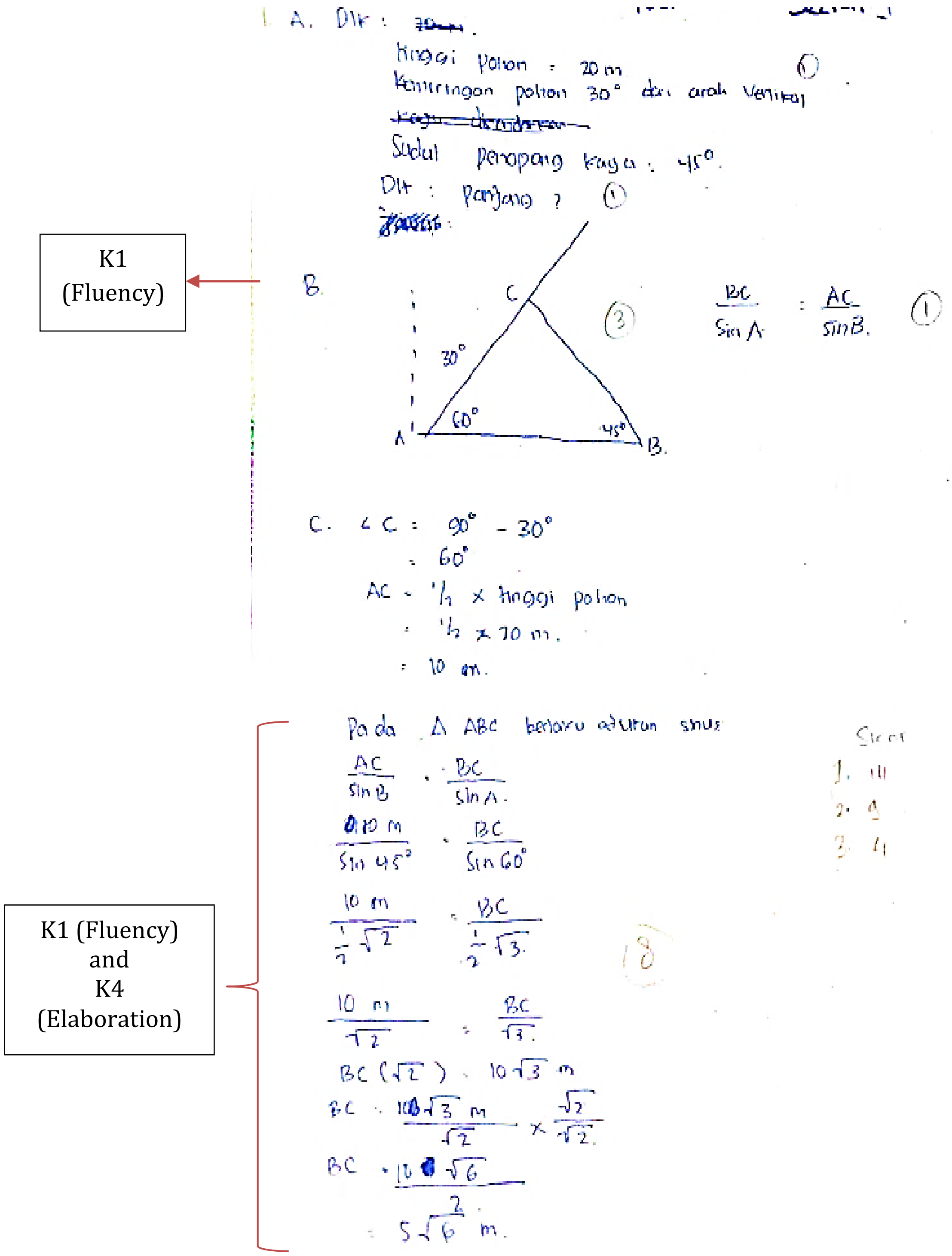
The S7-JH answer began with a clear listing of all the given information, such as the tree's height, the angle of inclination, and the length of the supporting wood. A well-labeled right-triangle Picture was included, making the relationships between the elements easy to follow. S7-JH applied the sine ratio and solved for the unknown side. The algebraic manipulation was accurate, and the denominator was rationalized to present the answer in a standard form. Each step was annotated with brief justifications, such as indicating which trigonometric ratio was used and why. The final answer was boxed and included the correct units. The interview results with subject S7-JH supported this.

R	:	*Did you understand the problem?*
S7-JH	:	*Yes, I understood it well. It had to do with angles and triangle sides.*
R	:	*What did you understand from the problem?*
S7-JH	:	*The tree was 20 meters tall, tilted at 30°, and the support formed a 45° angle. We were asked to find the length of the support.*
R	:	*In your opinion, how many ways could the problem be solved?*
S7-JH	:	*I believed there were several ways, but I used the sine rule because it matched the known values.*
R	:	*How did you solve the problem?*
S7-JH	:	*I drew the triangle, labeled the parts, and used the sine formula. Then, I rationalized the denominator to simplify the final answer.*
R	:	*Could you combine your method with any other?*
S7-JH	:	*No, I chose the sine rule because it was the most straightforward based on what was given.*
R	:	*Have you ever solved a problem like this before?*
S7-JH	:	*Yes, I had practiced problems like this in class.*
R	:	*Did you think your answer was correct?*
S7-JH	:	*Yes, I was confident. I also checked the unit and calculation at the end.*
R	:	*Did you face any difficulties while solving it?*
S7-JH	:	*Not really, just needed to be careful with the algebra part.*

S7-JH demonstrated a structured and accurate approach, showing partial fluency. S7-JH correctly identified and interpreted key elements of the problem and translated them into a labeled triangle, applying the sine rule confidently. However, although S7-JH acknowledged the possibility of multiple strategies, they did not explore or specify any beyond the one used. It indicates that while the student understood the problem well, their fluency remained procedural and lacked strategic variation. Flexibility and originality were also not met, as the student relied on standard methods without attempting novel approaches or combinations. For elaboration, S7-JH showed confidence in their reasoning, checked units, and simplified the final expression, reflecting partial fulfillment.

h. Judicial subject creative thinking profile on medium mathematical ability (S8-JM)

The student coded as S8-JM, identified with a judicial thinking style and moderate mathematical ability, was assigned a creative thinking problem. The student's written solution is presented in Picture 16 and further analyzed based on the indicators of creative thinking.



Picture 16. The results of S8-JM students' work

S8-JM began by listing all the known values: the tree's height, the supporting wood's length, and the angle of inclination. S8-JM drew a clear triangle Picture, labeled the vertices, and marked the relevant angles, which helped clarify the problem’s structure. S8-JM applied the sine formula, substituted the correct values, performed the algebraic manipulations, rationalized the denominator, and arrived at a final answer. Each calculation step was detailed, and the process was carried out accurately and efficiently, demonstrating a strong command of the necessary mathematical procedures.

S8-JM recognized that the wood was attached at the midpoint, which appropriately split the angle and applied the sine formula. The interview results with subject S8-JM supported this.

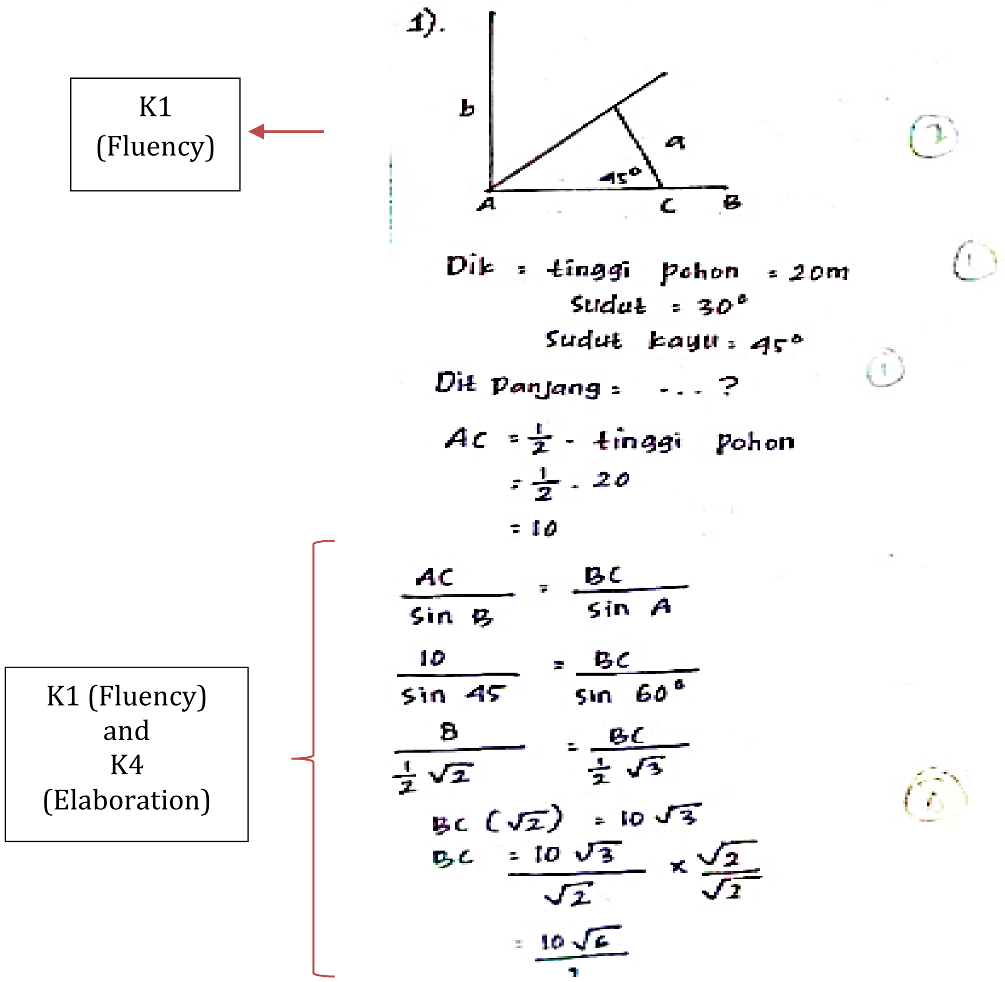
R	:	*Did you understand the problem?*
S8-JM	:	*Yes, I did. I understood what was given and what to find.*
R	:	*What did you understand from the problem?*
S8-JM	:	*The tree was 20 meters high, tilted 30°, and had a 45° support angle. I needed to find the length of the support.*
R	:	*In your opinion, how many ways could the problem be solved?*
S8-JM	:	*I thought there might be another way, but I only remembered the sine rule.*
R	:	*How did you solve the problem?*
S8-JM	:	*I drew the triangle and applied the sine formula based on what I learned in class.*
R	:	*Could you combine your method with any other?*
S8-JM	:	*I didn't think about other methods, so I just used sine.*
R	:	*Have you ever solved a problem like this before?*
S8-JM	:	*Yes, I had practiced problems like this in class.*
R	:	*Did you think your answer was correct?*
S8-JM	:	*I hoped it was. I checked the steps again just to be sure.*
R	:	*Did you face any difficulties while solving it?*
S8-JM	:	*A little, especially when calculating the last part with the square roots.*

S8-JM showed a straightforward and structured approach to solving the problem, indicating partial fluency. S8-JM understood what was given and what needed to be solved, correctly identifying the tree height, angles, and the missing side. S8-JM represented the problem with a Picture and solved it using the sine rule, as taught in class. However, S8-JM did not propose or attempt any alternative strategies despite briefly mentioning the possibility of other methods; this means flexibility was not fulfilled. Similarly, S8-JM's solution followed a conventional method with no unique or original ideas, so originality was also not met.

Regarding elaboration, S8-JM explained their process step by step and rechecked their answer, though they mentioned difficulty simplifying square roots. It suggests that elaboration was partially fulfilled. Overall, S8-JM demonstrated basic procedural competence but showed limited creative thinking or strategic variation in problem-solving.

i. Judicial subject creative thinking profile on low mathematical ability (S9-JL)

The student coded as S9-JL, identified with a judicial thinking style and low mathematical ability, was assigned a creative thinking problem. The student's written solution is presented in Picture 17 and further analyzed based on the indicators of creative thinking.



Picture 17. The results of S9-JL students' work

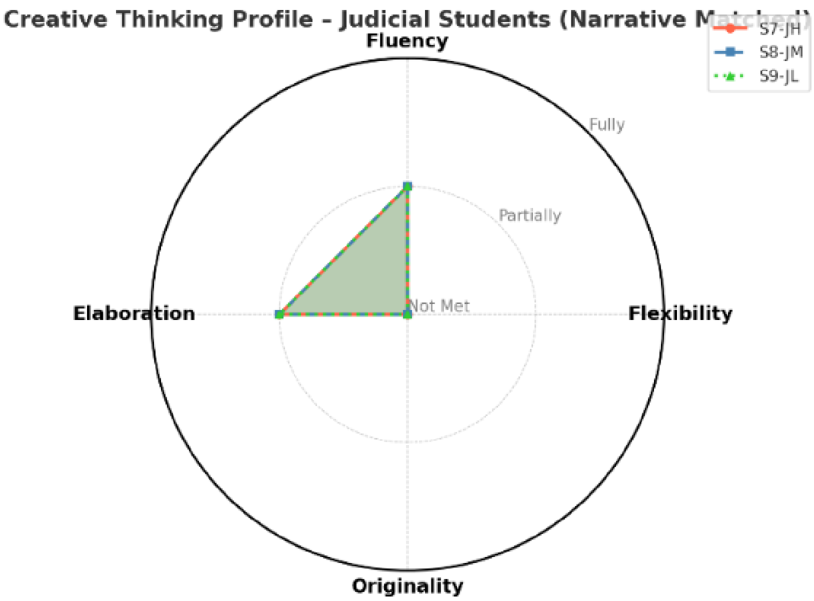
S9-JL started by listing all the given information, such as the tree's height, the wood's length, and the base angle. S9-JL drew a triangle Picture and labeled the points and angles, which helped clarify the structure of the problem. The interview results with subject S9-JL supported this.

R	:	*Did you understand the problem?*
S9-JL	:	*Yes, I tried to understand it. I got the part about the height and angles.*
R	:	*What did you understand from the problem?*
S9-JL	:	*The tree was 20 meters tall, the angle of tilt was 30°, and the from the ground made a 45° angle. I had to find the length.*
R	:	*In your opinion, how many ways could the problem be solved?*
S9-JL	:	*I didn't know. I only remembered one way—using the sine formula.*
R	:	*How did you solve the problem?*
S9-JL	:	*I divided the height first, then used the sine formula step by step.*
R	:	*Could you combine your method with any other?*
S9-JL	:	*I didn't know any other way, so I just used what I had learned.*

R	*:*	*Have you ever solved a problem like this before?*
S9-JL	*:*	*Not really. I just remembered the formula from class.*
R	*:*	*Did you think your answer was correct?*
S9-JL	*:*	*I hoped so. I tried to follow the steps correctly and checked it once.*
R	*:*	*Did you face any difficulties while solving it?*
S9-JL	*:*	*Yes, especially with the square root part, but I finished it.*

S9-JL demonstrated a procedural approach to solving the problem, indicating partial fluency. S9-JL identified the tree height and angles correctly and understood that the goal was to find the length of the support. The problem was solved using the sine rule, which S9-JL recalled from class. Although the steps were followed in a structured way, there was no exploration of alternative strategies, and the subject stated that S9-JL only knew one method; this reflects that flexibility was not met. Likewise, originality was not demonstrated, as the solution followed the standard classroom-taught procedure without any creative variation.

Regarding elaboration, S9-JL showed an effort to work step-by-step and checked S9-JL's answer once, but S9-JL expressed uncertainty and faced difficulty simplifying square roots, suggesting elaboration was only partially fulfilled. Overall, S9-JL showed basic procedural understanding but limited strategic or creative depth. The results from the three judicial subjects were visualized in the radar chart below.



Picture 18. The radar chart shows the creative thinking profiles of students with a judicial thinking style.

The radar chart for the judicial students (S7-JH, S8-JM, and S9-JL) reflected their creative thinking profiles as described in the narratives. All three students demonstrated partial fluency, as they understood the key elements of the problem but did not formulate or attempt alternative solution strategies. The indicators of flexibility and originality were not met, as each student relied solely on the sine rule taught in class without exploring other methods or generating novel ideas. In terms of elaboration, all three students provided procedural explanations, but their reasoning lacked depth and reflection, indicating partial fulfillment of this indicator. The research results of the nine subjects can be seen in Table 7.

Table 7. Summary of Creative Thinking Indicators and MCT Levels Across All Subjects

Subject	Fluency	Flexibility	Originality	Elaboration	Indicators Met	MCT Level	Description
S1-LH	✓	✗	✗	✓	2	**MCT 2**	Understood the problem and explained steps; no alternative strategies.
S2-LM	✓	✗	✗	✓	2	**MCT 2**	Recognized key elements and rechecked; lacked method variation.
S3-LL	✓	✗	✗	✓	2	**MCT 2**	Basic understanding and process; limited confidence.
S4-EH	✓	✗	✗	✓✓	2	**MCT 2**	Clear reasoning, labeled Picture, strong elaboration.
S5-EM	✓	✗	✗	✓	2	**MCT 2**	Solved procedurally, checked work; no strategic variation.
S6-EL	✓	✗	✗	✓	2	**MCT 2**	Recognized elements and completed steps; lacked depth.
S7-JH	✓	✗	✗	✓	2	**MCT 2**	Structured and confident; did not vary the approach.
S8-JM	✓	✗	✗	✓	2	**MCT 2**	Solved with sine rule, rechecked; faced calculation difficulty.
S9-JL	✓	✗	✗	✓	2	**MCT 2**	Procedural and uncertain; followed one known method.

All nine subjects (S1 to S9) were classified at Level MCT 2 (Quite Creative) based on analyzing the four creative thinking indicators: fluency, flexibility, originality, and elaboration. This level was assigned because each student fulfilled two out of four indicators, specifically fluency, and elaboration, although only to a partial extent. None of the students demonstrated flexibility in their solution strategies or originality in their thinking, as all relied on the sine rule without attempting alternative or unique approaches. Interestingly, high, moderate, and low students across different mathematical ability groups achieved the same MCT level. It indicates that a student's academic mathematical performance does not strictly determine creative mathematical thinking but how they engage with the problem, structure their reasoning, and reflect on their process. No student fell into MCT Level 1 or Level 0, suggesting that even basic procedural understanding can reflect a degree of creativity when supported by clear problem comprehension and explanation. These findings suggest that thinking style and mathematical ability shape how students express creative thinking in mathematics (Putri et al., 2024; Safaria & Agus, 2024).

Legislative students (S1-LH, S2-LM, S3-LL), who typically prefer to generate their own rules and ideas, were expected to show more flexible or original thinking. However, the results did not align with this assumption. Although they showed solid fluency and were comfortable structuring their approach, they did not attempt alternative methods or demonstrate divergent thinking. It suggests that a learning environment that favors procedural conformity may hinder their legislative inclination. Legislative thinkers enjoy creating, planning, and solving problems in self-initiated ways. They prefer freedom and innovation, often deviating from rigid instructions (Grigorenko & Sternberg, 1997). However, in this study, the three legislative-style students showed no fulfillment of flexibility or originality. Their responses were procedurally correct but lacked strategic variety. It may suggest a mismatch between cognitive preference and classroom practice; that is, while they might prefer creative freedom, the structure of mathematics instruction (which heavily emphasizes correctness and formulaic answers) may inhibit their exploration. This result may indicate a suppression of legislative students' cognitive preferences due to external classroom expectations. As noted by previous research, instructors' teaching practices and classroom structure significantly influence how students engage cognitively. When classroom practices are rigid or assessment-driven, students may suppress their natural inclinations for creativity or divergent thinking in favor of meeting expected standards (Barlow & Brown, 2020). The structured nature of mathematics instruction, which emphasizes correctness and formulaic answers, may not provide the freedom necessary for legislative thinkers to explore alternative methods (Hage, 2015).

Students with executive thinking styles (S4-EH, S5-EM, S6-EL), who are usually task-oriented and prefer to follow given rules, perform as predicted, rely entirely on standard strategies (sine rule), and focus on accurate execution. S4-EH stood out slightly in elaboration, possibly due to higher confidence and procedural fluency, but still lacked in the flexibility and originality domains. Executive thinkers prefer structured environments and are most comfortable following rules and expectations (Sternberg, 2006). As anticipated, these students consistently applied the sine rule as taught without deviation. Their performance reflects task fidelity, not creative variation. However, S4-EH demonstrated stronger elaboration, suggesting that executive thinkers may excel in depth rather than breadth, especially when confident in their approach. It aligns with findings by (Zhang & Sternberg, 2005), who noted that executive-style students perform well under rule-based systems but often underperform in open-ended or ambiguous tasks. This pattern aligns with previous studies showing that executive thinkers often underperform in creative tasks that require unconventional or adaptive thinking (Chegeni et al., 2016; Güner & Erbay, 2021). Additionally, (L. B. Lestari & Budiarto, 2018) emphasize that students with executive thinking styles prefer structured and rule-based environments, which may limit their ability to explore novel or intuitive strategies in mathematical problem-solving. Thus, their creative thinking tends to emerge within the boundaries of known procedures rather than through exploratory or intuitive reasoning.

Judicial students (S7-JH, S8-JM, S9-JL), who often prefer to evaluate and critique others' ideas, showed no significant creative advantage. While they demonstrated careful reasoning and rechecking, their thinking remained procedural. This suggests that, though reflective, judicial thinkers may need more explicit encouragement to explore alternative strategies rather than critically adhere to standard solutions. Judicial thinkers are critical, evaluative, and analytical. They tend to assess ideas' logic or correctness rather than generate new ones (Sternberg, 1997). The students with this style in the study demonstrated accurate but conservative strategies. They rechecked units, simplified answers, and followed a rational path but did not explore beyond what was instructed. Their creative profile was evaluative rather than generative, suggesting that judicial thinkers may thrive in proof-based or argumentative mathematical tasks but not necessarily in tasks requiring novel generation (Treffinger et al., 2002).

Across all thinking styles and mathematical ability levels, the indicators of originality and flexibility were the most underdeveloped. This finding echoes concerns in existing literature that school mathematics tends to emphasize single-solution problems and accuracy over idea generation (Munandar, 2012; Pang, 2024). In such environments, students are rarely encouraged or allowed to think divergently or pursue alternative solutions. Most students were taught in structured, teacher-centered environments, which limited their opportunity to try alternative strategies or generate original ideas (R. Lestari & Lingga, 2024). As a result, they relied on familiar methods like the sine rule and avoided non-routine thinking (Kadir et al., 2022). This tendency was reinforced by low confidence, limited exposure to open-ended tasks, and a lack of collaborative learning opportunities (Primadoni & Muslim, 2023; Wahyu et al., 2024). These factors constrained both flexibility and originality, suggesting that the absence of these indicators reflects not a lack of ability but rather instructional practices that do not promote creative mathematical thinking.

In contrast to the consistently absent indicators of originality and flexibility, fluency and elaboration were the most frequently demonstrated among all students. Although both were partially fulfilled, their presence highlights the types of creative thinking most accessible within structured mathematics instruction. Students generally understood the problem context, identified key elements, and explained their reasoning sequentially, indicating that their cognitive engagement remained procedural but clear. These findings align with research suggesting that fluency and elaboration are more naturally supported in teacher-centered classrooms, where tasks emphasize comprehension and procedural justification rather than idea generation (Elsayed, 2015). Similarly, (Sajedi, 2018) found that students with legislative and judicial thinking styles often excel in elaboration and fluency due to their preference for planning, evaluation, and structured expression. According to (Wardani et al., 2019), elaboration is perceived as a low-risk dimension of creativity, requiring less divergence and more explanation, thus making it more approachable for students. These patterns suggest students may lack the freedom or confidence to generate novel ideas or strategies. However, they can still engage with mathematical tasks through structured understanding and verbal or written explanations. Fluency and elaboration thus represent the “entry points” for creative thinking in environments that have not yet embraced open-ended or student-driven approaches.

This study is limited by its small sample size and context-specific setting, which may affect the generalizability of the findings. Using a single mathematical problem and relying on self-reported questionnaires for identifying thinking styles may not fully capture the complexity of students' creative thinking abilities. Additionally, the focus was only on one dimension of Sternberg's thinking styles (functions), leaving other dimensions unexplored. Future research is encouraged to include larger and more diverse samples, multiple problem types, and a broader exploration of thinking style dimensions to enhance the richness and applicability of the findings.

Conclusions and Suggestions

This study analyzed students' mathematical creative thinking through the lens of Sternberg's legislative, executive, and judicial thinking styles. It revealed that fluency and elaboration were the most consistently demonstrated indicators, whereas flexibility and originality remained absent across all profiles. Despite variations in thinking styles and mathematical abilities, all nine students were categorized at MCT Level 2, indicating partial creativity. Interestingly, even students with low mathematical ability could demonstrate creative elements, suggesting that creative thinking is not solely dependent on content mastery but also on how students process and express their reasoning. Legislative students, who ideally thrive on autonomy, failed to exhibit flexibility or originality, likely due to rigid instructional norms. Executive students performed as expected, structured and accurate, yet lacked innovation. Judicial students demonstrated evaluative tendencies but did not deviate from standard procedures. These findings highlight the critical need for mathematics instruction that supports creative exploration through open-ended tasks, multiple-solution approaches, and collaborative problem-solving. A more adaptive classroom structure could better align with diverse thinking styles and foster holistic creative growth in students.

These findings highlight the need to consider students' thinking styles when designing mathematics instruction. Tailoring learning environments to cognitive preferences can enhance engagement and creativity. For example, legislative thinkers benefit from open-ended tasks, executive thinkers from structured scaffolding, and judicial thinkers from encouragement to shift from evaluation to idea generation. Teachers should integrate divergent tasks, such as those with multiple solutions or creative strategy options and value originality alongside accuracy in assessment to foster a more creativity-supportive classroom culture. Future research should involve larger and more diverse samples and explore various creative tasks across mathematical topics. Investigating additional dimensions of thinking styles and conducting longitudinal studies may offer deeper insight into how cognitive preferences interact with the development of creative mathematical thinking over time.

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