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LEVELING CREATIVE THINKING ABILITY OF PROSPECTIVE MATHEMATICS TEACHERS IN SOLVING MATHEMATICS PROBLEM

Ratri Candra Hastari[1,2], Tatag Yuli Eko Siswono[1], Abadi[1]

[1]Universitas Negeri Surabaya, Department of Mathematics Education, Surabaya, Indonesia

[2]Universitas Bhinneka PGRI, Department of Mathematics Education, Tulungagung, Indonesia

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ABSTRACT

Mathematical creative thinking is an important skill that a person must have in order to process the information given in solving a problem. Prospective mathematics teachers who have an understanding of creative thinking will later, when they become teachers, be able to apply or design creative learning in the classroom. However, several studies have revealed that prospective mathematics teacher students are not yet able to think creatively in solving a given problem. The purpose of this study is to describe the problem solving of prospective mathematics teachers in solving creative thinking problems in terms of their level of creative thinking ability. The research approach used is a qualitative research approach. Data collection methods included tests and semi-structured interviews. The results showed that "very creative" subjects were able to meet the indicators of fluency, flexibility, and novelty in problem solving. 'Creative' subjects were able to meet the indicators of fluency and flexibility. "Less creative" subjects met the indicator of fluency. The "not creative" subjects did not meet all the indicators of creative thinking.

KEYWORDS: creative thinking, prospective mathematics teachers

INTRODUCTION

Twenty-first century skills are categorized into three major domains: learning and innovation skills, life and career skills, and information, media, and technology skills (Anagün, 2018). The domain of learning and innovation includes competencies in critical thinking and problem solving, communication, collaboration, creativity, and innovation. Among these, creativity or creative thinking has become a central focus, as it represents a key competency for students to effectively adapt to complex life challenges and dynamic work environments (Anagün, 2018). In the context of mathematics, creative thinking is a fundamental skill that enables individuals to process available information and develop innovative solutions to problems (Fauzi et al., 2019).

According to Sternberg and Lubart (Sternberg, 2003), creative thinking is defined as thinking that is novel and produces valuable ideas. Through education and learning processes, creative thinking skills can be further developed and enhanced (Maskur et al., 2020). One of the key aims of education is to enable individuals to think creatively; therefore, teachers should facilitate and encourage students' creative ways of thinking (Bayindir & Inan, 2008). Classroom learning activities should be designed to support students in developing their mathematical creative thinking skills (Purwosetiyono et al., 2018). When pre-service mathematics teachers possess an understanding of creative thinking, they will be able to implement or design creative learning environments in their future classrooms (Çenberci & Yavuz, 2018). Munandar (1997) emphasized that educators play a crucial role in fostering an environment that stimulates creative thinking, which includes promoting fluency, flexibility, originality, and elaboration.

Munandar (Lince, 2016), the characteristics of creative thinking skills include fluency, flexibility, and originality. Fluency refers to the ability to generate ideas, solve problems, and provide responses to given situations. Flexibility involves the ability to seek and apply alternative solutions to problems. Originality, or novelty, reflects the capacity to produce unique, unusual, or innovative expressions and ideas. However, several studies have revealed that pre-service mathematics teachers often struggle to demonstrate creative thinking when solving mathematical problems, particularly in the aspects of flexibility and originality (Umar & Ahmad, 2019).

Fluency, flexibility, and originality or novelty are the three core dimensions underlying creative thinking. The levels or categories of creative thinking ability for pre-service mathematics teachers are adapted from (Siswono, 2011). A **"very creative"** level is characterized by the ability to demonstrate fluency, flexibility, and originality in problem solving. A **"creative"** level is indicated when pre-service teachers display originality and fluency or flexibility and fluency. A **"moderately creative"** level is reflected in the ability to demonstrate either flexibility or originality. A **"less creative"** level is identified when pre-service teachers show only fluency in solving problems. Finally, a **"non-creative"** level is determined when individuals are unable to demonstrate any of the three indicators of creative thinking.

Based on the aforementioned background, the purpose of this study is to describe how pre-service mathematics teachers solve mathematical creative thinking problems in relation to their levels of creative thinking ability.

METHOD

This study employed a qualitative research approach, which requires a detailed understanding of the problem being investigated (Creswell, 2015). One of the main characteristics of qualitative research is its naturalistic setting (Sugiyono, 2013). This research adopted a case study design, which is commonly categorized as a qualitative approach, particularly in educational research (Siswono, 2019). Merriam (Siswono, 2019), a case study is a type of research aimed at obtaining an in-depth understanding of a phenomenon through intensive description and analysis.

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Data Collection Methods and instrument

Data were collected through tests and semi-structured interviews. This type of interview falls under the category of in-depth interviews and allows greater flexibility compared to structured interviews. During the interview sessions, the researcher carefully listened to and recorded the participants' responses (Sugiyono, 2022).

The instruments used in this study consisted of a primary and supporting instrument. The primary instrument was the researcher, while the supporting instruments included problem-solving test items and an interview guide. Both the problem-solving test and the interview guide were validated by experts in mathematics education and declared valid, thereby confirming their suitability for data collection.

Trustworthiness of the Data

Lincoln and Guba (Siswono, 2019), the quality or trustworthiness of qualitative research is established through four criteria: credibility, transferability, dependability, and confirmability. Credibility refers to the accuracy or truth of the findings as perceived by the participants and within the discipline itself (Siswono, 2019). One way to ensure credibility is through triangulation. Triangulation involves examining data from various sources, using multiple methods, and collecting data at different times. In this study, methodological triangulation was employed to ensure data validity. This was carried out by cross-checking data from the same participants using different techniques, namely problem-solving tests and interviews.

Data Analysis

Miles and Huberman (Sugiyono, 2022), data analysis in qualitative research consists of several stages.

1. **Data Reduction,** this stage involves selecting the most essential information, the analysis focused on key aspects of the data and involved identifying emerging themes and recurring patterns. The reduced data will provide a clearer picture of the findings overview of the phenomenon being studied and help the researcher conduct subsequent data collection more effectively.
2. **Data Display**, the data may be displayed through concise descriptions, tables, or flow diagrams. Presenting data in this manner facilitates a clearer understanding of the phenomena under study and helps the researcher plan subsequent actions based on that understanding.
3. **Conclusion Drawing and Verification**, in qualitative research, conclusions represent original interpretations or findings that have not been previously revealed through other studies. These findings may take the form of descriptions or explanations that provide greater clarity regarding a phenomenon or object that was initially unclear prior to the study.

RESULTS AND DISCUSSION

Twenty-one pre-service mathematics teachers were given a creative thinking test to measure their levels of creative thinking ability and to determine the research subjects. The following data were obtained after the creative thinking test was administered:

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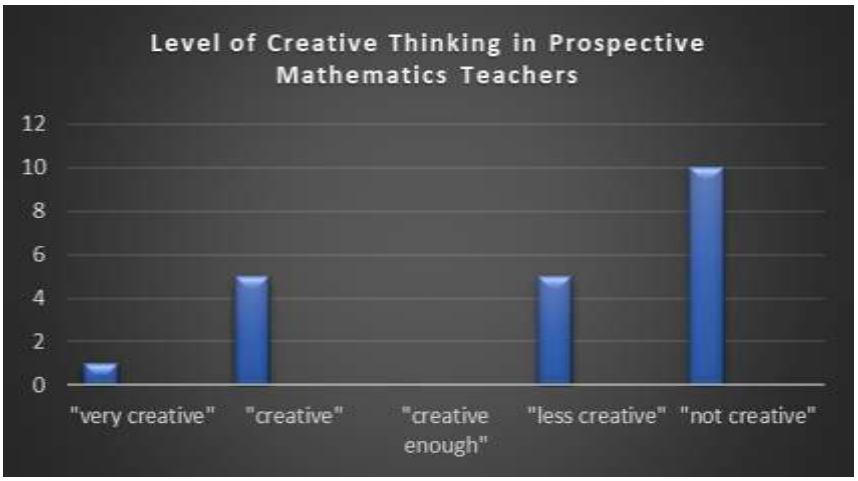

Figure 1. Percentage of Creative Thinking Levels of Prospective Mathematics Teacher Students

Based on the figure above, one pre-service mathematics teacher was categorized at the *"very creative"* level, five at the *"creative"* level, five at the *"less creative"* level, and ten at the *"non-creative"* level. There were no participants categorized as *"moderately creative"*. The research subjects for the interview were selected based on their willingness to cooperate and their ability to communicate effectively, allowing the researcher to obtain in-depth information about their creative thinking skills in problem solving. The selected participants were MZ, representing the *"very creative"* level; IC, representing the *"creative"* level; CE, representing the *"less creative"* level; and RM, representing the *"non-creative"* level.

1. Problem Solving of the Creative Thinking Task by Subject MZ (*"Very Creative"*)

Problem:

Given a line with the equation $\frac{x}{2} + \frac{y}{3} = 1$

a) Determine the equation of a line parallel to the given line, and explain the method used to obtain the equation of that parallel line.

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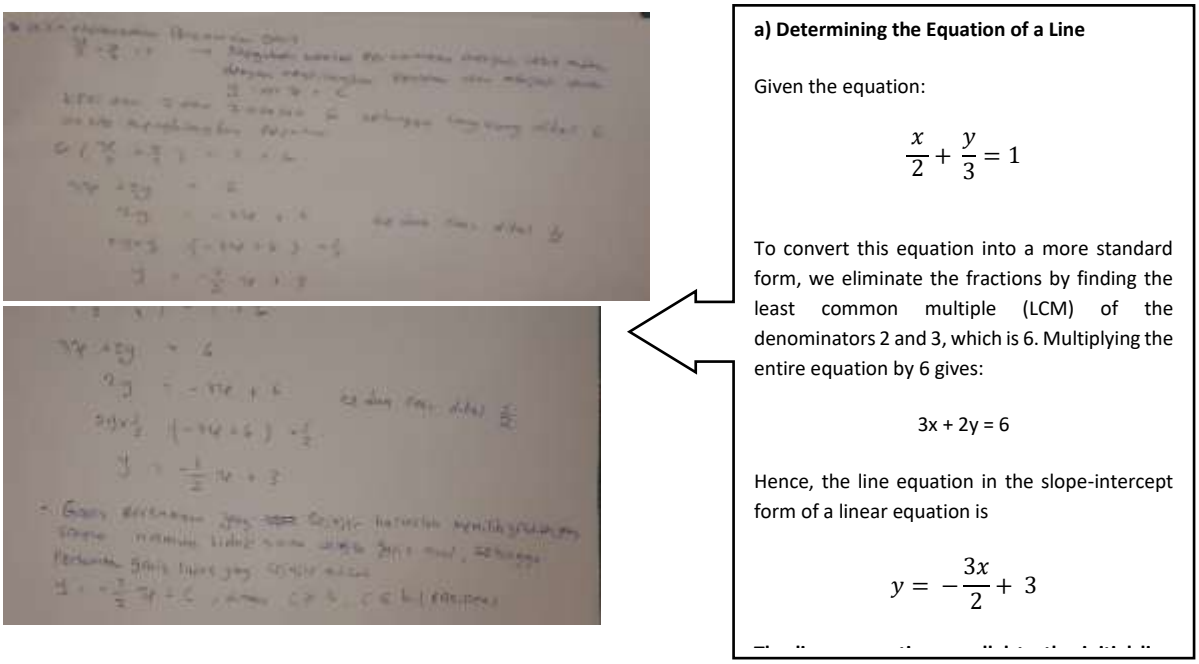

Figure 2. Problem Solving Picture of Subject MZ for Problem a)

The subject correctly determined the equation of a line parallel to $\frac{x}{2} + \frac{y}{3} = 1$ and was able to clearly explain the method used to obtain the equation of that parallel line.

b) Are there any other lines parallel to the given line? If so, write them down.

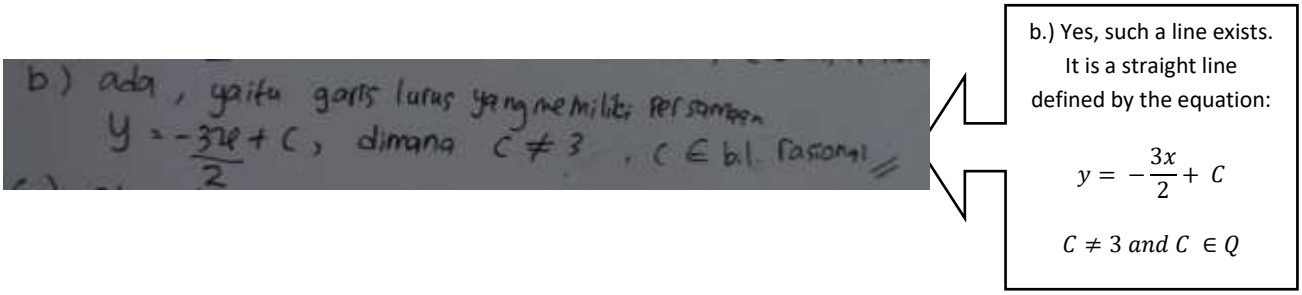

Figure 3. Problem Solving Picture of Subject MZ for Problem b)

For question (b), the subject's response demonstrated **fluency** in thinking. MZ stated that there are other lines that are parallel or more than one line parallel to the given line.

Researcher (R): Are there any other lines parallel to the given line?
MZ: Yes, there are, Ma'am.

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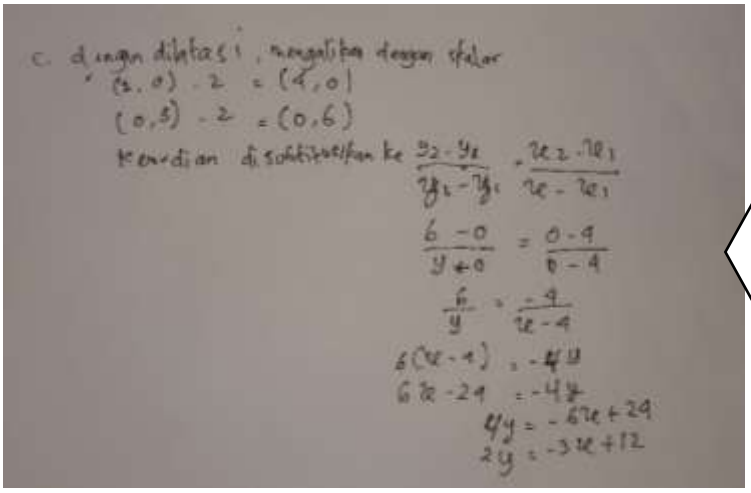
MZ added that there are many lines parallel to the given line. These lines satisfy the equation $y = \frac{-3x}{2} + c, c \neq 3$. The subject explained that if $c = 3$, the line would coincide with the original line.

Based on the interview excerpt above, the subject was able to state that there is more than one line parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$. This indicates that the subject demonstrated **fluency** in answering the problem-solving question.

(c) Are there any alternative methods that can be used to obtain the equation of the parallel line? If so, write them down.



The process begins with a **dilation** (scaling) transformation by multiplying the original points (intercepts of the initial line) by a scalar of **2**

The two new points (4, 0) and (0, 6). are then substituted into the two-point form of a straight line quation: $\frac{y_2-y_1}{y-y_1} = \frac{x_2-x_1}{x-x_1}$.

The resulting equation of the line after the dilation with a scale factor of 2 is

Figure 4. Problem Solving Picture of Subject MZ for Problem c)

or question (c), the subject stated that there is an alternative method that can be used to determine the equation of a parallel line, namely by using **dilation** or by multiplying the points on the given line $\frac{x}{2} + \frac{y}{3} = 1$by a scalar factor. Based on this response, the subject demonstrated the **flexibility** indicator of creative thinking.

Researcher (R): Are there any alternative ways to determine the equation of a line parallel to another line than using the slope?

MZ: Yes, there are, Ma'am. I will first draw the given line, which passes through the points (2, 0) and (0, 3). Then, I multiply the coordinates by a scalar, similar to a dilation, resulting in the points (4, 0) and (0, 6). Next, I substitute these points into the equation $\frac{y_2-y_1}{y-y_1} = \frac{x_2-x_1}{x-x_1}$

R: Okay.

Based on the interview, the subject demonstrated an alternative method (**flexibility**) in determining the equation of a parallel line, other than using the slope method.

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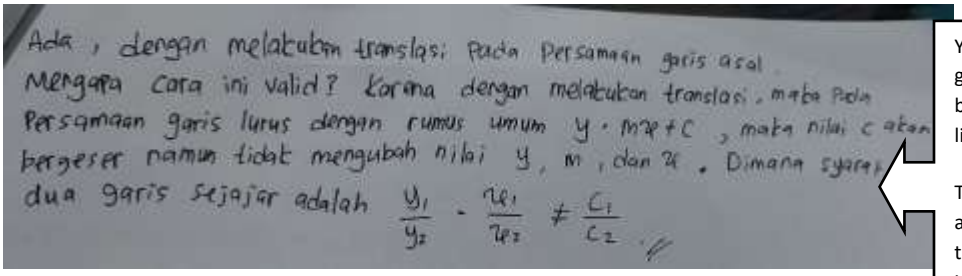
(d) Are there any other methods that are considered *uncommon* or *unusual* for determining the equation of a parallel line? If so, please describe them and explain why such methods are valid to use.



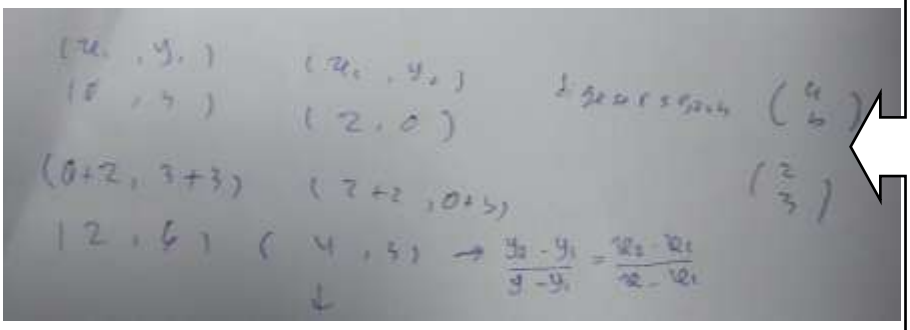
Yes, a parallel line can be generated by applying a rigid body translation to the original line equation.

This method is valid because applying a **translation** (a slide) to the straight-line equation, which is generally expressed as y=mx+C, only shifts the value of the **y-intercept (C)**. The coordinates

Figure 5. Problem Solving Picture of Subject MZ for Problem d)

The subject stated that there is another *uncommon* or *unusual* method that can be used to determine the equation of a parallel line, namely by using **translation**, as shown in the subject's written response in the figure above. However, the subject did not provide a clear or detailed explanation of this method.
Researcher (R): Are there any other methods that you think are uncommon for determining the equation of a parallel line?

MZ: Yes, there are, Ma'am, by using translation, as shown below.



By shifting the line by a vector (a,b), for example $\binom{2}{3}$, and adding this vector to each of the points through which the line passes, namely (2, 0) and (0, 3) obtain new points as a result of the translation.

$\binom{2}{0} + \binom{2}{3} = \binom{4}{3}$ *and* $\binom{0}{3} + \binom{2}{3} = \binom{2}{6}$

the new points (4, 3) and (2, 6) are

Figure 6. MZ Subject Problem Solving for Problem d)

MZ: By shifting the line by a vector (a,b), for example $\binom{2}{3}$, and adding this vector to each of the points through which the line passes, namely (2, 0) and (0, 3), we can obtain new points as a result of the translation.

$$\binom{2}{0} + \binom{2}{3} = \binom{4}{3} \text{ and } \binom{0}{3} + \binom{2}{3} = \binom{2}{6}$$

After that, the new points (4, 3) and (2, 6) are substituted into the equation

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$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1}$$

Based on the interview excerpt above, the subject was able to describe an *uncommon* method for determining a parallel line. The method involved **shifting** or **translating** the line through two known points by adding each point with a translation vector (a,b). This response demonstrates the **novelty (Originality)** aspect of the subject's creative thinking.

Table 1. Triangulation table of subject MZ for creative thinking questions

Indicator of Creative Thinking	Creative Thinking Test	Interview
Fluency	The subject demonstrated fluency in solving the problem.	The subject stated that there is more than one line parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$, indicating fluency in responding to the problem-solving question.
Flexibility	The subject wrote that there is an alternative method to determine the equation of a parallel line, namely by dilation or multiplying the coordinates of the points on the line by a scalar.	The subject demonstrated a different approach (**flexibility**) in determining the equation of a parallel line.
Novelty (Originality)	The subject showed that there is another *uncommon* or *unusual* method to determine the equation of a parallel line, namely by using translation.	The subject was able to describe a method that is not commonly used to determine the equation of a parallel line, demonstrating **originality**.

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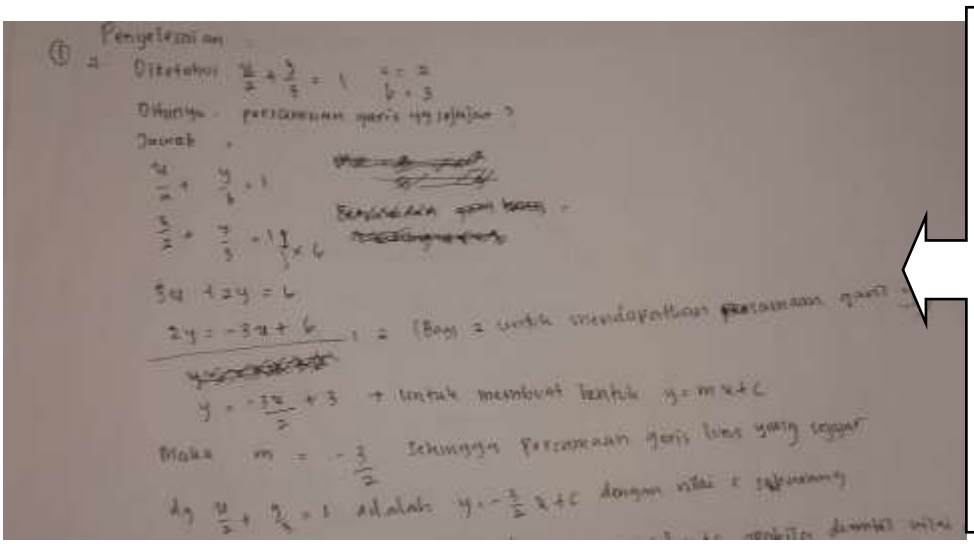
Siswono (2011) suggests that highly creative individuals are capable of tackling problems through multiple approaches, with the use of a novel method reflecting their capacity to generate original and unconventional solutions.

2. Problem Solving on Creative Thinking Task: Subject IC ("Creative")

Problem: Consider the line represented by the equation $\frac{x}{2} + \frac{y}{3} = 1$.

a) Determine the equation representing a line that runs parallel to this line and provide a detailed explanation of the method used to derive the parallel line equation.



The process begins with the line equation expressed in the intercept form $\frac{x}{2} + \frac{y}{3} = 1$.

Multiply the entire equation by the least common multiple, which is 6: 3x+2y=6

Rearrange the equation to solve for y:

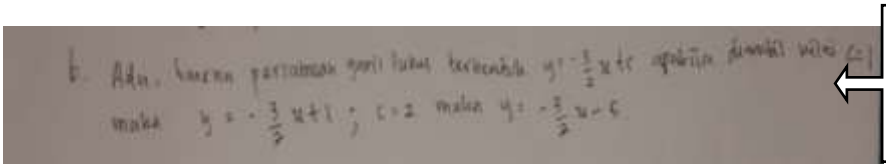
2y=−3x+6

Divide both sides by 2:

Figure 7. Problem Solving Picture of Subject IC for Problem a)

The subject accurately identified the equation of the parallel line and provided a clear, coherent explanation of the method employed to obtain it.

b) Are there any other lines that are parallel to the given line? If so, please write them down.



Yes, there are. There is a parallel line expressed as $y = \frac{-3x}{2} + c, c =$

Figure 8. Problem Solving Picture of Subject IC for Problem b)

The subject demonstrated fluency on item b) by indicating that there are other lines parallel to the given line, or that more than one parallel line exists.

R: Are there any other parallel lines?

IC: Yes, there are. There is a parallel line expressed as $y = \frac{-3x}{2} + c, c = 1 \; or \; c = 2$.

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Based on the analysis of interview data excerpt above, the participant was able to state that multiple lines are parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$, which demonstrates the subject's fluency.

c) Are there an alternative method that can be used to find the equation of the parallel line? If so, please describe it.

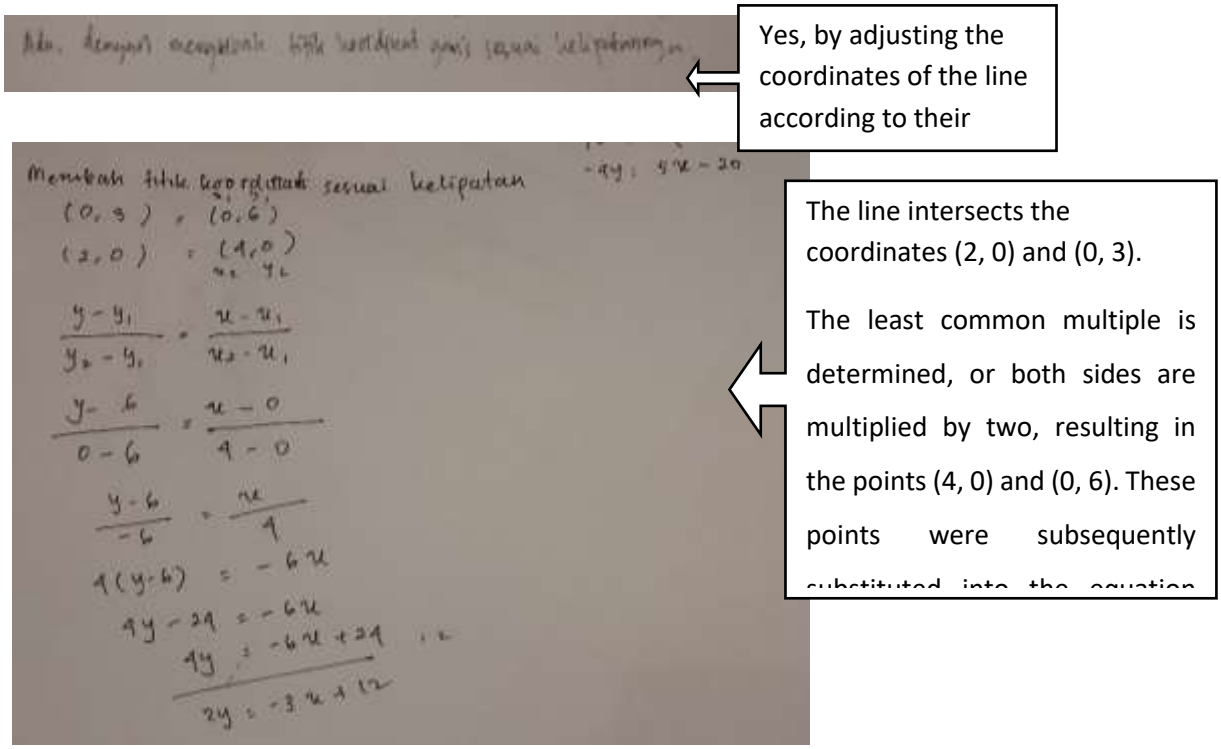

Figure 9. Problem Solving Picture of Subject IC for Problem c)

The subject indicated that there are various methods to determine the linear equation representing a line parallel to a specified line, either by identifying multiples of the points through which the line passes or by applying a scalar multiplication to the points on the line $\frac{x}{2} + \frac{y}{3} = 1$.

R: "Is there a different method to find the equation of a line that is parallel to the given line?"
IC: "Yes, ma'am. The line can be defined by the coordinates (2, 0) and (0, 3). I then found their multiples by multiplying by two, resulting in the points (4, 0) and (0, 6). These points were subsequently substituted into the equation $\frac{y_2-y_1}{y-y_1} = \frac{x_2-x_1}{x-x_1}$

The interview revealed that the subject employed an alternative method to determine the equation of a parallel line by dilating or applying scalar multiplication to the points on the line, which were then substituted into the equation $\frac{y_2-y_1}{y-y_1} = \frac{x_2-x_1}{x-x_1}$.

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d) Are there any other methods that you consider unconventional for determining the equation of a parallel line? If so, please describe the method and justify its validity.

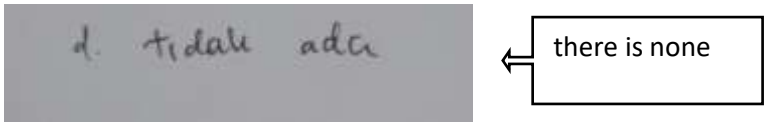

Figure 10. Problem Solving Picture of Subject IC for Problem d)

The subject stated that there is no unconventional method for determining the equation of a parallel line.

R: "Are there any other methods that you consider unconventional for determining the equation of a parallel line?'

IC: "Not yet, ma'am; there aren't any".

R: "Please think again; are there any unconventional methods for determining the equation of a parallel line?".

IC: "In my opinion, there aren't any, ma'am".

Based on this interview excerpt, the subject was unable to demonstrate any unconventional method for determining the equation of a parallel line, indicating a lack of novelty in the problem-solving task.

Table 2. Triangulation table of subject IC for creative thinking questions

Creative Thinking Indicator	Creative Thinking Test	Interview
Fluency	The subject demonstrated fluency on item b) by stating that there are other lines parallel to the given line, or more than one parallel line.	The subject was able to answer that more than one line is parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$, indicating fluency.
Flexibility	The subject answered that different methods can be used to determine the equation of a parallel line, namely by finding multiples of the points through which the line passes or by multiplying by a scalar of the points on the line.	The subject demonstrated different approaches to determining the equation of a parallel line.

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Creative Thinking Indicator	Creative Thinking Test	Interview
Novelty (Originality)	The subject was unable to demonstrate originality in the problem-solving test.	The subject was unable to show any unconventional or uncommon method for determining the equation of a parallel line.

Creative thinking is the ability to solve problems by utilizing available data and information while considering various alternative solutions. In this process, aspects of originality, flexibility, and fluency are reflected in the outcomes expressed. Fluency refers to the ability to present an idea convincingly to make it appear valid, while flexibility pertains to the skill of viewing a problem from multiple perspectives. Meanwhile, originality is the ability to generate ideas that are different, unique, and not merely following common opinions or other sources (Rizal et al., 2020). Subjects at the 'creative' level demonstrate fluency and flexibility, or fluency and originality, in solving mathematical problems (Siswono et al., 2019).

3. Problem-Solving on the Creative Thinking Task by Subject CE ("Less Creative")
Consider the line defined by the equation $\frac{x}{2} + \frac{y}{3} = 1$

a). Determine the equation of a line that is parallel to the given line and provide a detailed explanation of the method employed to derive the equation representing a line that runs parallel to.

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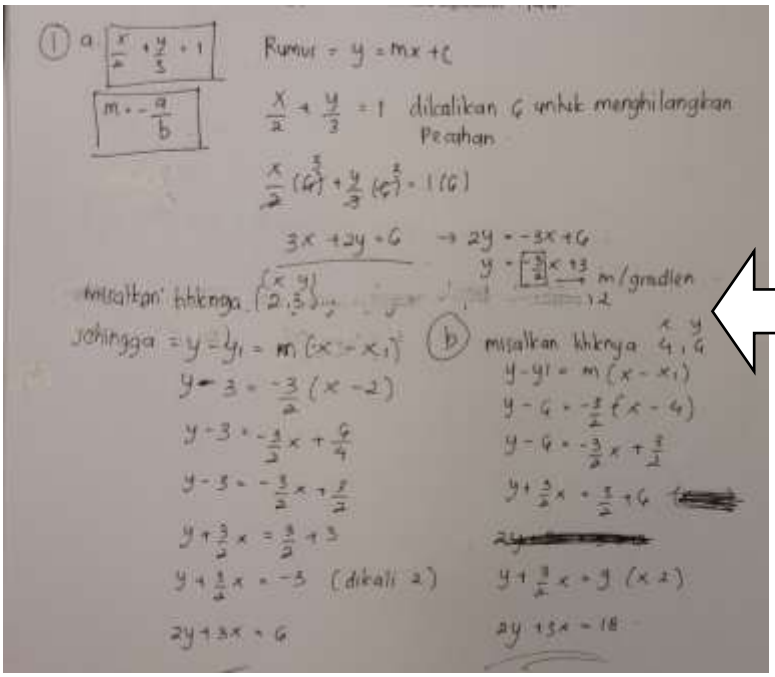


In order to eliminate the fractional terms, both sides of the equation are multiplied by the least common multiple of 2 and 3, which is 6

$$6(\frac{x}{2}+\frac{y}{3}=1)$$

3x + 2y = 6,

Rearranging for y, Thus, the gradient (slope) of the line is m = $\frac{-3}{2}$

Assume the point (2, 3). Then the linear equation representing a line

Figure 11. Problem Solving Picture of Subject CE for Problem a)

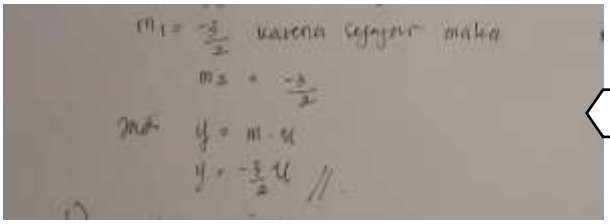
The subject's response to the above creative thinking task was correct in determining the slope but remained incorrect in identifying a parallel line. To further investigate the subject's approach, the researcher conducted an interview to clarify how the subject determined the equation of the parallel line. The following is an excerpt from the interview with the subject.

R (Researcher): "Please explain the method you used to obtain the equation of a line parallel to the given one".

CE: "a line that is parallel is a line that has the same slope, ma'am. That is, a line with a slope of $\frac{-3}{2}$".

R: "What you wrote is the same as the equation given in the problem. Could you provide an example of a parallel line?"

CE: "For example, like this, ma'am".



$m_1 = \frac{-3}{2}$ since the lines are parallel, it follows that $m_2 = \frac{-3}{2}$

Therefore, the line's equation is $y = mx, y =$ 3

Figure 12. Problem Solving Picture of Subject CE for Problem a)

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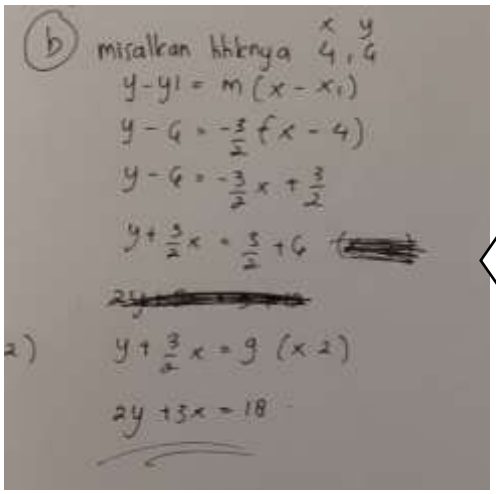
CE: For example, the line $y = \frac{-3}{2}\ x$.

R: Alright.

Based on the interview excerpt above, the subject was able to explain the method for formulating the equation of a line that maintains parallelism with the given line $\frac{x}{2} + \frac{y}{3} = 1$.

b) Are there any other lines that are parallel to the given line? If so, please provide them.



Assume the point (4, 6). Then the equation of a line that passes through that point is:

$$y - y_1 = m(x - x_1)$$

with the slope m replaced by $\frac{-3}{2}$.

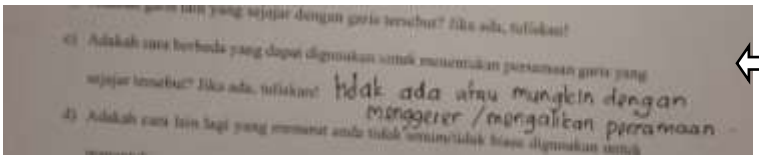
Figure 13. Problem Solving Picture of Subject CE for Problem b)

The subject demonstrated fluency in question (b), indicating that there are other lines parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$.

R (Researcher): "Are there any other lines parallel to the line $\frac{x}{2} + \frac{y}{3} = 1$?"

CE: Yes, ma'am. As I have done, for example, if the line passes through the point (4, 6), it is then substituted into the equation $y - y_1 = m(x - x_1)$, with the slope m replaced by $\frac{-3}{2}$. Thus, the equation of the line is $2y + 3x = 18$

c) Is there an alternative method that can be used to determine the equation of a line parallel to the given line? If so, please describe it.



There is none, or it might be done by shifting or multiplying the equation

Figure 14. Problem Solving Picture of Subject CE for Problem c)

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In solving the above creative thinking task, the subject did not explain how to shift or scale the equation. The researcher subsequently conducted an interview with the subject to clarify the meaning of the response provided. The following is an excerpt from the interview with the subject.

R: "Could you explain the answer you wrote on the response sheet for the question, "Is there an alternative method to determine the equation of a parallel line?"
CE: "Perhaps by shifting it, ma'am".
R: "What do you mean by shifting? Do you mean like a translation?".
CE: "Yes, perhaps, ma'am. I am still confused and uncertain about my answer.
R: "Would you like to draw it and try to recall and explain if there is another method to determine the equation of a parallel line?"
CE: "I don't think I am confident about my answer, ma'am. I am still confused".
R: Alright.

Based on the interview, the subject was unable to demonstrate an alternative method or flexibility in determining the equation of a parallel line.

d) Is there another method that you consider uncommon or unconventional for determining the derived equation of a line parallel to the given line? If so, please describe it and explain why this method is valid.

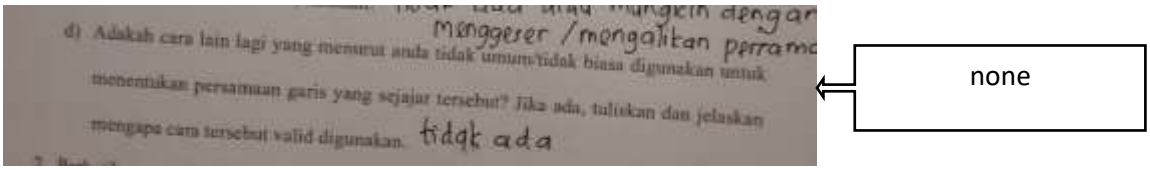

Figure 15. Problem Solving Picture of Subject CE for Problem d)

The subject indicated that there is no uncommon or unconventional method to obtain the parallel line equation.

P: Is there any other method that you consider unconventional for determining the equation of a parallel line?

CE: "No, ma'am".

R: "Try to think again. Is there any method that is uncommon or unconventional for determining the equation of a parallel line?"

CE: In my opinion, there is none, ma'am.

Based on the interview excerpt above, the subject was unable to demonstrate an unconventional method for determining the equation of a parallel line. Consequently, the subject did not exhibit originality in the creative thinking task.

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Table 3. Triangulation table of subject CE for creative thinking questions

Creative Thinking Indicator	Creative Thinking Test	Interview
Fluency	The subject demonstrated fluency in question (b), indicating that there are other lines parallel to the given line.	The subject was able to answer that there are other lines parallel to $\frac{x}{2} + \frac{y}{3} = 1$, which demonstrates fluency.
Flexibility	The subject was still uncertain in completing the problem-solving task and did not explain an alternative method.	The subject was unable to demonstrate an alternative method or flexibility in determining the equation of a parallel line.
Originality	The subject wrote that there is no uncommon or unconventional method for determining the equation of a parallel line. The subject was unable to demonstrate originality in the problem-solving task.	The subject was unable to demonstrate an unconventional method for determining the equation of a parallel line and did not exhibit originality in the problem-solving task.

Subject CE was able to demonstrate only the fluency indicator in completing the creative thinking task. According to (Handayani et al., 2021), an individual's creative thinking ability is considered "less creative" if they can exhibit only one of the four indicators of creative thinking when solving a mathematical problem. Munandar (Lince, 2016) explains that fluency, as a key characteristic of creative thinking, involves the ability to solve problems, provide solutions, and generate multiple examples or statements related to a concept within a given context.

4. Problem-Solving on the Creative Thinking Task by Subject RM ("Not Creative")

a). Given the line with the equation $\frac{x}{2} + \frac{y}{3} = 1$. Find the equation of a line that is parallel to the given line and explain the method used to derive the equation of the parallel line.

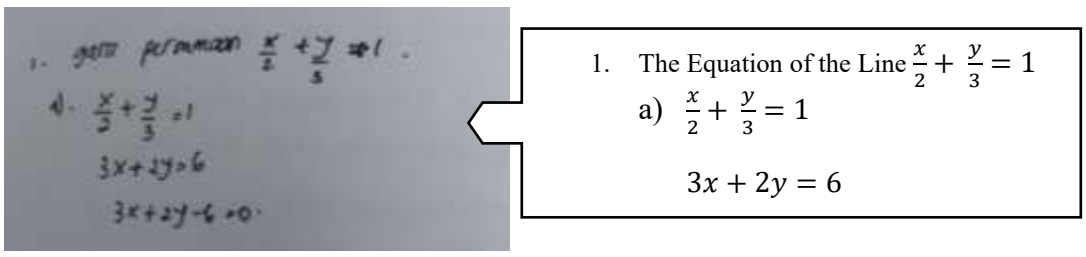

Figure 16. Problem Solving Picture of RM Subject for Problem a)

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The subject did not write the equation of a line that is parallel nor explain the method used to determine it.

R: Could you explain how to find the equation of a line that is parallel for this problem?
RM: First, I multiplied both sides by six, ma'am, and obtained the equation $3x + 2y = 6$

R: What about after that? How would you determine the equation of a parallel line?
RM: I'm still confused, ma'am. I'm sorry, I don't know.
R: That's alright.

Based on the interview excerpt above, the subject was unable to explain the method for deriving the linear equation of a line parallel to the given one $\frac{x}{2} + \frac{y}{3} = 1$.

b) Are there any other lines parallel to the given line? If so, please provide them.

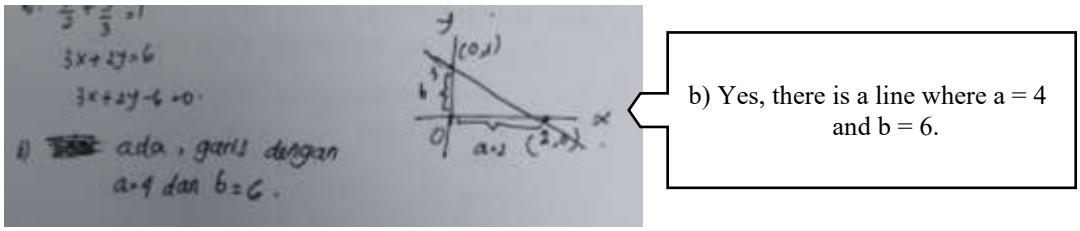

Figure 17. Figure RM Subject Problem Solving for Problem b)

The subject did not write the equation of any other line parallel to $\frac{x}{2} + \frac{y}{3} = 1$.

R: Could you explain what you wrote in your solution for the problem?
RM: Yes, ma'am. I wrote that if *a = 4 and b = 6*, I looked at what my friend did. I'm confused, ma'am, and don't know what to do next.

R: Do you think there is a line parallel to $\frac{x}{2} + \frac{y}{3} = 1$?
RM: I think there is, ma'am, but I am still confused about how to find the parallel line.
R: Alright.

Based on the interview excerpt above, the subject believes that a line parallel to $\frac{x}{2} + \frac{y}{3} = 1$ exists; however, the subject was unable to determine the equation of the parallel line.

c) Is there an alternative method that can be used to determine the equation of a line parallel to the given line? If so, please describe it.

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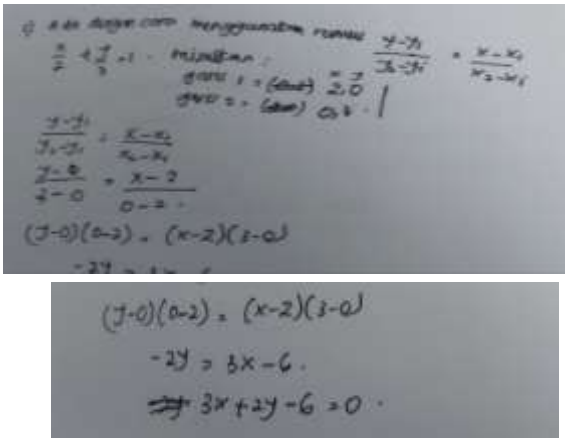


Yes, it can be done by using a equation

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1}$$

Line 1: 2, 0

Line 2: 0. 3

Figure 18. Problem Solving Picture of RM Subject for Problem c)

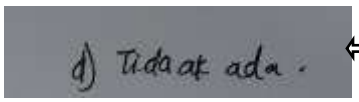
In the creative thinking task above, the subject did not demonstrate an alternative method for solving the problem. The researcher subsequently conducted an interview to clarify the solution provided by the subject. The following is an excerpt from the interview:

R: "Could you explain your answer on the response sheet for the question, "Is there an alternative method that can be used to find the parallel line's equation?"
RM: "By finding a point the line passes through and then substituting it into the equation, ma'am".
R: What do you mean by that? Are you referring to the original line given in the problem?
RM: Yes, ma'am, that is how I worked on it

R: What would an alternative method look like?
RM: I'm not sure, ma'am.
R: Alright.

Based on the interview above, the subject was unable to demonstrate an alternative method or flexibility in determining the equation of a parallel line.

d) Is there another method that you consider uncommon or unconventional for determining the linear equation representing a line parallel to the given line? If so, please describe it and explain why this method is valid.



none

Figure 19. Problem Solving Picture of RM Subject for Problem d)

On the response sheet, the subject wrote that there is no unconventional method for determining the equation of a parallel line.

R: Is there any method that you consider unconventional for determining the equation of a parallel line?

RM: In my opinion, there isn't, ma'am.
R: Try to recall and think again. Is there any method for determining the equation of a parallel line that is unconventional?
RM: There isn't, ma'am.

Based on the interview excerpt, the subject was unable to demonstrate an unconventional method for determining the equation of a parallel line and did not exhibit originality in the problem-solving task.

Table 4. Triangulation table of RM subject for creative thinking questions

Creative Thinking Indicator	Creative Thinking Test	Interview
Fluency	The subject was unable to formulate the equation of another line parallel to the given line.	subject believed that a line parallel to $\frac{x}{2}+\frac{y}{3}=1$ exists, but could not determine its equation, and thus could not complete or answer the problem.
Flexibility	In the problem-solving task, the subject did not demonstrate an alternative method for solving the problem.	The subject was unable to demonstrate an alternative method or flexibility in determining the equation of a parallel line.
Originality	The subject wrote that there is no uncommon method for determining the equation of a parallel line.	The subject did not demonstrate originality in the problem-solving task.

CONCLUSION

The findings of this study indicate that subjects categorized as "highly creative" were able to fulfill all indicators of creative thinking, namely fluency, flexibility, and originality in problem-solving. Subjects with a "creative" level of ability demonstrated fluency and flexibility but were not yet able to exhibit originality. Those classified as "less creative" only met the fluency indicator, without showing flexibility or originality. In contrast, "non-creative" subjects did not meet any of the creative thinking indicators.

For future research, in addition to employing methodological triangulation, researchers may also consider time or source triangulation. Furthermore, it is recommended to include research subjects with a "moderately creative" level of creative thinking ability.

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