Creative Mathematical Reasoning Process of Climber Students in Solving Higher Order Thinking Skills Geometry Problems

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***Abstract* – This study aims to explore the creative mathematical reasoning process of climber students in solving Higher Order Thinking Skills geometry problems. The results showed that the climber students met the criteria for basic mathematical creative reasoning in solving problems, namely the plausible and novelty criteria. However, there are times when climber students do not meet the requirements for novelty because their accuracy and creative mathematical reasoning thinking have not been used to solve problems, even though climber students tend to like challenges and do not give up on solving problems.**

***Keywords* – creative mathematical reasoning, climber students, geometry problem, higher order thinking skill.**

1. Introduction

Mathematical reasoning is a cognitive process of identifying problems, solving the reasons logically, and providing conclusions.

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Mathematical reasoning is the process of drawing conclusions and giving reasons in problem-solving [1], [2], [3], [4]. Mathematical reasoning is a logical statement of propositions, creating and examining conjectures in some cases and drawing conclusions [5], [6], [7], [8]. Mathematical reasoning really requires creative ability in the reasoning process.

Creative reasoning is a type of reasoning to find solutions by prioritizing the process of solving problems. [5], [9] state that creative mathematical reasoning is problem-solving with criteria that include novelty, plausible, and mathematically based.

The results of research [9], [10] show that creative reasoning is essential when getting used to reasoning creatively to make logical conclusions. [11], [12], [13] suggest that creative reasoning is appropriate in problematic situations, where opportunities are given and may be forced to complete certain tasks. Creative reasoning has an important function and role in solving problems [14], [15]. Creative mathematical reasoning in this study represents the ability to solve problems by completing new steps or strategies that can be accepted logically through the linkage of the provided information with the criteria of mathematical foundation, plausibility, and novelty. Creative mathematical reasoning plays an important role in solving problems.

Problem-solving is an ability that must be possessed to solve mathematical problems. [16], [17], [18], [19] revealed that solve problems with knowledge, skills, and understanding is an effort to problem-solving. [19], [20], [21], [22], [23] state that solving problems is carried out by understanding problems, making problem plans, implementing problem plans, as well as examining the problem-solving results. The process of solving problems requires creative mathematical reasoning skills, especially for problems related to Higher Order Thinking Skills.

Higher Order Thinking Skills (HOTS) are essential in solving mathematical problems. [20], [24], [25] stated that HOTS is essential in mathematics and is a new challenge for mathematical problems. Some supporting research results [26], [27], [28] show that HOTS is the ability to analyze, evaluate, create, logic & reason, and solve problems. One of the constraint factors in solving HOTS problems is the ability to face challenges and obstacles in dealing with various difficulties in solving HOTS problems, namely with Adversity Quotient (AQ).

Adversity Quotient (AQ) is necessary for creative mathematical reasoning in solving HOTS problems as it helps students to survive and not give up quickly so that they can turn various difficulties they face into opportunities for progress. The ability possessed by a person to process and change problems with his inner intelligence so that it becomes a challenge to be solved is known as Adversity Quotient (AQ) [29]. Adversity Quotient (AQ) has three types: climbers, campers, and quitters. Someone with the climber type always tries to reach the pinnacle of success and has a strong desire always to try and motivate himself to solve the problems he faces. To measure a person's response to the difficulties encountered in solving problems and facing challenges with the Adversity Quotient (AQ) questionnaire using the Adversity Response Profile (ARP), the theory of Paul G. Stoltz can be adapted [29]

The supporting research that has described HOTS has not investigated the procedure of solving HOTS problems on geometric materials and creative mathematical reasoning. [30] explains that aspects of skills include having high order thinking skills (HOTS). This aspect becomes the gap and urgency in the research field because creative mathematical reasoning is a necessary cognitive process in solving HOTS problems, especially geometry. Geometry is one of the materials with basic concepts that students must master. Geometry helps the reasoning process in solving problems [31], [32]. HOTS has an important role when solving math problems [24], [25]. The Adversity Quotient (AQ) is one part of the internal factors, positioning AQ as a determining factor for one's learning success [33], [34], [35]. In this regard, this study focuses more on exploring climber students' mathematical creative reasoning process in solving mathematical problems in HOTS geometry.

2. Methods

This study aims to explore the creative mathematical reasoning process of climber students in solving HOTS geometry problems. This type of research was descriptive qualitative because the obtained data were identified, analyzed, studied, and described qualitatively based on actual conditions to obtain an overview of the natural process regarding the creative mathematical reasoning process of climber students in solving mathematical problems in HOTS geometry. Therefore, this research was descriptive exploratory research [36]. The research subjects were students of mathematics education department at one of universities in Malang, Indonesia. Subject selection was carried out by distributing an Adversity Quotient questionnaire using Adversity Response Profile. Two climber students were selected from 27 students as research participants with the specified criteria: having taken or currently taking the course of mathematics development for school, having an Adversity Quotient with the climber type, and being willing to participate during the study as research participants.

The research instruments included an Adversity Quotient questionnaire using Adversity Response Profile, HOTS geometry test questions with creative mathematical reasoning, and interview sheets. The research instrument was validated by two lecturers (who have doctoral education qualifications) in mathematics or mathematics education and have 5 years of teaching experience. Regarding the validation results, it was necessary to make improvements to the content of the research instrument according to the suggestions from the two validators.

The research data included the results of the Adversity Quotient questionnaire using the Adversity Response Profile, the answers to the results of the HOTS geometry test with creative, mathematical creative reasoning, and the results of the interview transcripts on student work. Data analysis was carried out by reducing data, presenting data, coding, checking the validity of data, analyzing data and research findings, and drawing conclusions. The Adversity Quotient questionnaire used the Adversity Response Profile (ARP), which was adapted from the theory of Paul G. Stoltz because ARP was a valid instrument to measure a person's response to adversity. The Higher Order Thinking Skill (HOTS) indicators used in this study are shown in Table 1.

Table 1. Higher Order Thinking Skill (HOTS)

HOTS Level	Description
Analysis	a. Identifying the problem b. Distinguishing between what is logical and relevant and what is not c. Relating the existing knowledge to the problem
Evaluation	a. Checking the work done b. Explaining the reasons for the completion of the work done c. Discussing whether the solution being worked on is consistent
Create	a. Generating ideas b. Planning to solve problems c. Producing new products by writing different ways/steps of completion

The data analysis was completed using creative mathematical reasoning according to the criteria: mathematics foundation, plausible, and novelty, by developing indicators as shown in Table 2.

Table 2. Creative Mathematical Reasoning

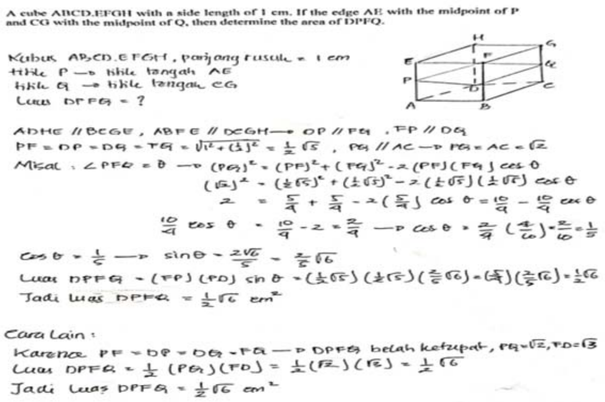
Mathematical Creative Reasoning Criteria and Indicators
Mathematics Foundation
1. Identifying and providing re-explanation related to information that must be resolved with the same understanding in solving problems 2. Identifying what needs to be done and what comes first regarding information to solve the problem 3. Identifying and explaining arithmetic operations and formulas as well as applied concepts and the results obtained in mathematical concepts
Plausible
1. Identifying known information on the problem and providing an explanation of the connectedness process in mathematical concepts 2. Providing an explanation regarding the results of developing strategies or steps that are applied to prove the truth in mathematical concepts 3. Explaining the reasons and suitability in implementing a strategy or step that was developed and would be implemented in a mathematical concept
Novelty
1. Obtaining connectedness of information that is just known in the problem 2. Developing strategies or solving steps to be used in solving problems 3. Implementing developed strategies or steps to solve problems

3. Results and Discussion

The Adversity Quotient questionnaire using the Adversity Response Profile (ARP) showed two students belonging to the climber type, namely SC1 and SC2 students. The following is a description of the climber students' work related to their creative reasoning in solving HOTS geometry problems.

Subject SC1

In solving the HOTS geometry problem at the analysis level, the work of the SC1 subject is shown in Figure 1.



Translate

A cube ABCD.EFGH with a side length of 1 cm.
Point P → midpoint AE
Point Q → midpoint CG
Area of DPFQ =?

ADHE ∥ BCGF, ABFE ∥ DCGH → DP ∥ FR, FP ∥ DQ ,

$PF = DP = DQ = FQ = \sqrt{1^2 + \left(\frac{1^2}{2}\right)} = \frac{1}{2}\sqrt{5}$, PQ ∥ AC $PQ = AC = \sqrt{2}$

Suppose: $\angle PFQ = \theta \rightarrow (PQ)^2 = (PF)^2 + (FQ)^2 - 2(PF)(FQ)\cos\theta$

$$(\sqrt{2})^2 = \left(\frac{1}{2}\sqrt{5}\right)^2 + \left(\frac{1}{2}\sqrt{5}\right)^2 - 2\left(\frac{1}{2}\sqrt{5}\right)\left(\frac{1}{2}\sqrt{5}\right)\cos\theta$$

$$2 = \frac{5}{4} + \frac{5}{4} - 2\left(\frac{1}{2}\sqrt{5}\right)\left(\frac{1}{2}\sqrt{5}\right)\cos\theta = \frac{10}{4} - \frac{10}{4}\cos\theta$$

$$\frac{10}{4}\cos\theta = \frac{10}{4} - 2 = \frac{2}{4} \rightarrow \cos\theta = \frac{2}{4}\left(\frac{4}{10}\right) = \frac{1}{5}$$

$\cos\theta = \frac{1}{5} \rightarrow \sin\theta = \frac{2}{5}\sqrt{6}$

Area of $DPFQ = (FP)(PD)\sin\theta = \left(\frac{1}{2}\sqrt{5}\right)\left(\frac{1}{2}\sqrt{5}\right)\left(\frac{2}{5}\sqrt{6}\right) = \left(\frac{5}{4}\right)\left(\frac{2}{5}\sqrt{6}\right) = \frac{1}{2}\sqrt{6}$

So, the area of DPFQ is $\frac{1}{2}\sqrt{6}$ cm².

Another way:
PF = DP = DQ = FQ → DPFQ is rhombus, $PQ = \sqrt{2}$, $FD = \sqrt{3}$
Area of $DPFQ = \frac{1}{2}(PQ)(FD) = \frac{1}{2}(\sqrt{2})(\sqrt{3}) = \frac{1}{2}\sqrt{6}$
So, the area of DPFQ is $\frac{1}{2}\sqrt{6}$ cm²

Figure 1. Solving the HOTS Problem at the Level of Analysis by SC1Subject

In figure 1, the SC1 subject illustrates the problem by drawing the cube ABCD.EFGH and identifying the given problem, with point P being the midpoint of AE and point Q being the midpoint of CG, the length of the cube's edge is 1 cm with the question area of DPFQ. SC1 subject solves the problem by logically explaining that ADHE is parallel to BCGF, ABFE parallel to DCGH, DP is parallel to FQ, and FP is parallel to DQ, PF = DP = DQ = FQ. Since PQ is parallel to AC, then PQ = AC. Next, SC1 linked what is known to what is being asked by finding the area of DPFQ.

In addition, the SC1 subject can solve the problem in other ways by positioning the quadrilateral DPFQ as a rhombus where DF is the diagonal of the space so that the area of the rectangle DPFQ =1/2 (PQ)(FD).

The following are the results of interview transcripts on SC1 subjects in solving HOTS geometry problems at the analysis level.

P: *How to identify the problem?*
SC1: *Yes, with pictures to make it clearer and understand the problem with the cube.*
P: *What comes to your mind first when solving a problem?*
SC1: *Identify the problem that ADHE is parallel to BCGF, ABFE parallel to DCGH, DP is parallel to FQ, and FP is parallel to DQ, then PQ = AC*
P: *After that, what steps do you think of?*
SC1: *I was still confused at first, ma'am, but I kept remembering to relate it to the concept of sin and cos.*
P: *Do you mean by the concept of trigonometry?*
SC1: *Yes, ma'am.*
P: *If so, how to find the area?*
SC1: *Yes, by finding the area of DPFQ*
P: *Where did you get the idea of finding the area of DPFQ through sin and cos?*
SC1: *From experience, ma'am, suddenly I immediately remembered the concept of sin and cos.*

In solving the HOTS geometry problem at the evaluation level, the work of the SC1 subject is shown in Figure 2.

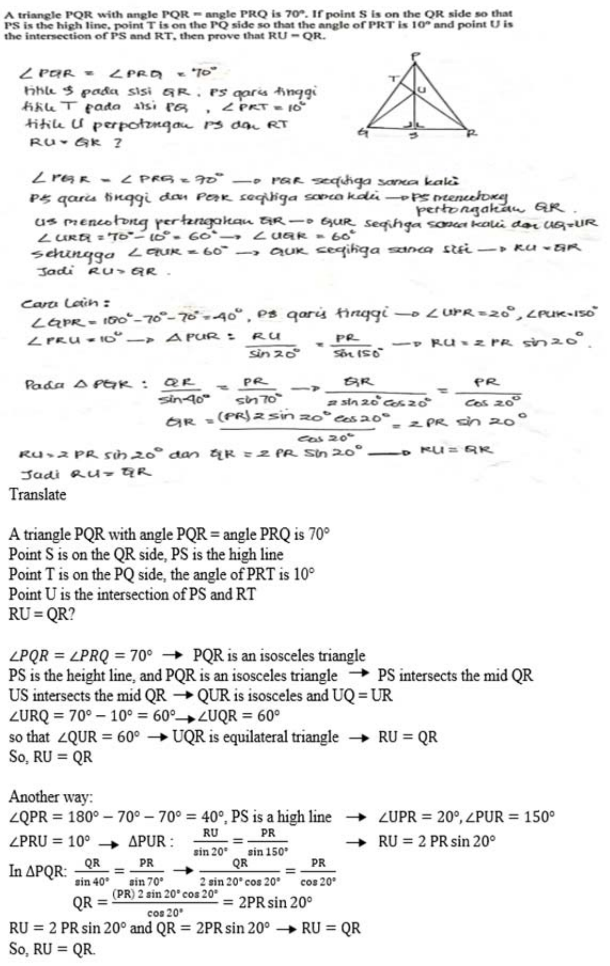


Figure 2. Solving the HOTS Problem at the Evaluation Level by SC1Subject

In Figure 2, the SC1 subject illustrates the problem by drawing a triangle PQR and identifying the given problem, with point S on the QR side, PS on the height line, point T on the PQ side, point U intersects PS and RT, and the other. When asked to show that RU = QR, subject SC1 solves the problem by explaining logically that triangle PQR = triangle PRQ so that PQR is an isosceles triangle. Furthermore, PS is the height line, and PQR is an isosceles triangle, then PS intersects the mid QR, US intersects the mid QR, and US high line QUR then QUR is isosceles and UQ = UR. SC1 subject checks again by triangle URQ, then UQR is equilateral triangle and QUR is equilateral triangle, thus showing that RU = QR. So, RU = QR.

In addition, the SC1 subject uses another method with a high line and checks again that triangle QPR and PS is a high line. Since RU and QR uses the concept of sin, then RU = QR, So, RU = QR

The results of interview transcripts on the SC1 subject in solving HOTS geometry problems at the evaluation level.

P: *How do you identify the problem?*
SC1: *Yes, ma'am, with a triangle picture to quickly answer the question.*
P: *What comes to your mind first when solving a problem?*
SC1: *That the point S is on the QR side, PS is the high line, the point T is on the PQ side, the point U intersects PS and RT.*
P: *After that, what steps do you think of?*
SC1: *What I think is that PQR is an isosceles triangle.*

In solving the HOTS geometry problem at the create level, the work of the SC1 subject is shown in Figure 3.

Translate

A trapezoid → height = 4 cm.
Two diagonals are perpendicular to each other
One diagonal with length = 5 cm
Area of the trapezoid =?

Suppose: $\angle ACD = \theta \rightarrow \angle GOD = \angle CAB = \angle BOF = \theta \rightarrow \sin\theta = \frac{4}{5}, \cos\theta = \frac{3}{5}, \tan\theta = \frac{4}{3}$
Suppose: $CO = x, GO = y$, and because $FG = 4$ cm then $\rightarrow OA = 5 - x, OF = 4 - y$
$GC = CO\cos\theta = \frac{3}{5}x, DG = GO\tan\theta = \frac{4}{3}y \quad DC = DG + GC = \frac{3}{5}x + \frac{4}{3}y$
$AF = OA\cos\theta = (5-x)\frac{3}{5} = 3 - \frac{3}{5}x, FB = OF\tan\theta = (4-y)\frac{4}{3} = \frac{16}{3} - \frac{4}{3}y$
$AB = AF + FB = 3 - \frac{3}{5}x + \frac{16}{3} - \frac{4}{3}y = \frac{25}{3} - \frac{3}{5}x - \frac{4}{3}y$
Area of trapezoid $= \frac{1}{2}(Dc + AB)FG = \frac{1}{2}\left(\frac{3}{5}x + \frac{4}{3}y + \frac{25}{3} - \frac{3}{5}x - \frac{4}{3}y\right)4 = \frac{1}{2}\left(\frac{25}{3}\right)4 = \frac{50}{3}$
So, the area of the trapezoid $\frac{50}{3}$ cm^2

Another way:
Suppose: $OC = x, OD = y, OB = z$
$OA = 5 - x$
ΔAOB is congruent with $\Delta OCD \rightarrow \frac{5-x}{x} = \frac{z}{y}$
$y(5-x) = xz \rightarrow 5y - xy = xz \rightarrow 5y = xz + xy = x(z+y) \rightarrow \frac{y}{x} = \frac{z+y}{5}$
Suppose $\angle ACD = \theta \rightarrow \tan\theta = \frac{4}{3}$
$AC \perp BD \rightarrow \tan\theta = \frac{y}{x} = \frac{4}{3} \rightarrow \frac{y}{x} = \frac{z+y}{5} \rightarrow \frac{4}{3} = \frac{z+y}{5} \rightarrow 3(z+y) = 20 \rightarrow z + y = \frac{20}{3}$
$AC \perp BD \rightarrow$ Area of the trapezoid $= \frac{1}{2}(AC)(BD) = \frac{1}{2}(5)(z+y) = \frac{1}{2}(5)\left(\frac{20}{3}\right) = \frac{50}{3}$
So, the area of the trapezoid is $\frac{50}{3}$ cm^2

Figure 3. Solving HOTS Problems at the Create Level by SC1 Subject

In figure 3, the SC1 subject illustrates the problem by drawing a trapezoid and identifying the problem, with the height of 4cm and the two diagonals are perpendicular to each other, the length of one of the diagonals is 5 cm, and the question is the area of the trapezoid. SC1 subject plans to solve the problem by assuming triangle GOD = triangle GOD = triangle CAB = triangle BOF and the concept with sin and cos. Next, SC1 searches for the area of the trapezoid by coming up with ideas and applying them. Further, the SC1 subject can also solve problems in other ways to find the area of a trapezoid by illustrating through trapezoidal drawings, planning, and solving problems by assuming that OC = x, OD = y, OB = z, and OA = 5 - x

Next, the SC1 subject comes up with an idea and applies it in solving the problem, namely, triangle AOB is congruent with triangle OCD. For AC is perpendicular to BD, the area of the trapezoid = ½ (AC)(BD) = 50/3. So, the area of the trapezoid is 50/3 cm^2.

The following are the results of interview transcripts with SC1 in solving HOTS geometry problems at the create level.

P: *From the obtained information, how did the idea of drawing come up?*
SC1: *Yes, the idea is to draw a trapezoid so that it is easy to understand and work on.*
P: *What comes to your mind first when solving a problem?*
SC1: *Yes, ma'am, by assuming CO = x, and GO = y*
P: *After that, what steps do you think of?*
SC1: *Find the area of the trapezoid with the area of the trapezoid = 1/2 (DC + AB) (FG) = 50/3*
P: *Are you sure that the area of the trapezoid is 50/3 cm^2?*
SC1: *Yes, ma'am, there is another way with triangle AOB is congruent with triangle OCD, we get the same result that the area of the trapezoid is 50/3 cm^2*

Regarding SC1, the research findings focused on the creative reasoning process in mathematics of climber students in solving HOTS geometry problems and the analysis is shown in Table 3.

Table 3. Creative Mathematical Reasoning Process for SC1 Subject

Creative Mathematical Reasoning
HOTS with Analisis Level
Mathematics Foundation 1. Identifying problem information on cube 2. Explaining information obtained by drawing and assuming mathematical concepts, 3. Providing an explanation related to parallel to the side and parallel to the plane Plausible 1. Explaining logically that PQ is parallel to AC 2. Determining the strategy or move with the concept of cos 3. Applying a strategy or step so that sin and cos are obtained correctly Novelty 1. Associating the information that area DFQ 2. Developing a strategy or step in another way, namely that the DPFQ quadrilateral is a rhombus and DF is the diagonal of the space 3. Implementing the strategy or steps that have been developed appropriately
HOTS with Evaluation Level
Mathematics Foundation 1. Identifying the problem information that triangle PQR = triangle PRQ 2. Explaining the information obtained by drawing 3. Explaining the high-line PS and US Plausible 1. Logically explaining that triangle PQR = triangle PRQ 2. Determining strategies or steps related to isosceles triangles and equilateral triangles 3. Applying strategies or steps related to isosceles triangles and equilateral triangles correctly Novelty 1. Relating the information that the area of triangle UQR = triangle QUR 2. Developing a strategy or step in another way, namely sin and cos in triangle PUR in triangle PQR 3. Implement the strategy or steps that have been developed appropriately
HOTS with Create Level
Mathematics Foundation 1. Identifying problem information on the trapezoid 2. Explaining the obtained information by drawing 3. Explaining sin and cos in triangles related to trapezoids Plausible 1. Explaining logically that the concept of sin, cos, and tan 2. Determining a strategy or step related to high FG 3. Applying strategies or steps related to sin and cos in

the right triangle
Novelty 1. Relating the information that DC = DG +GC, and AB = AF + FB with the concept of sin, cos, and tan 2. Developing a strategy or step in another way, namely with triangle AOB congruent with triangle OCD and trapezoidal area = ½ (AC)(BD) correctly 3. Implementing the strategy or steps that have been developed appropriately

In short, the creative reasoning process in mathematics of SC1 climber students in solving HOTS geometry problems consists of 1) SC1 subject has a character who likes challenges and always have various ways of solving HOTS geometry problems correctly at the level of analysis, evaluation, and creation; 2) SC1 subject tend to solve HOTS geometry problems at the level of analysis, evaluation, and creation by drawing based on the information obtained and experience in order to solve the problems given easily; 3) when solving problems, SC1 subject is able to work on HOTS geometry at the level of analysis, evaluation and creation correctly, and meet the mathematics foundation, plausible, and novelty criteria; 4) his difficulty is feeling hesitant in solving HOTS geometry problems at the level of analysis, evaluation, and creation, but he can overcome the problems and determine the right strategy or step when solving problems; 5) in answering interview questions in solving HOTS geometry problems at the level of analysis, evaluation, and creation, the SC1 subject is able to answer logically, and coherently thus the SC1 subject has good creative reasoning thoughts.

SC2 Subject

In solving the HOTS geometry problem at the analysis level, the work of the SC2 subject is shown in Figure 4.

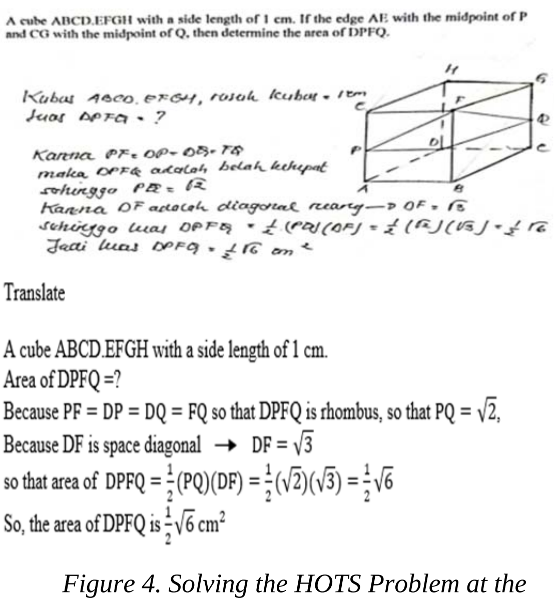


Figure 4. Solving the HOTS Problem at the Level of Analysis by SC2 Subject

In figure 4, the SC2 subject identifies the problem by drawing the cube ABCD.EFGH with the edge length of the cube is 1 cm, representing the area of the DPFQ in question. Subject SC2 solves the problem by logically explaining that since PF = DP = DQ = FQ, so DPFQ is a rhombus. Further, SC2 relates the information that because DF is a diagonal of space, then the area of the rectangle is DPFQ = 1/2 (PQ)(DF)

The following are the results of interview transcripts on SC2 subject in solving HOTS geometry problems at the analysis level:

P: *How do you identify the problem?*
SC2: *Yes, ma'am, drawing is more straightforward and easier to understand.*
P: *What comes to your mind first when solving a problem?*
SC2: *At first, I was hesitant, ma'am, with DPFQ being a rhombus and a diagonal of the space is DF.*
P: *Where did you get the idea of finding the area of DPFQ through the diagonal of the space?*
SC2: *I once knew ma'am, even though I was hesitant and confused, but I was able to find the results, ma'am.*
P: *Are you sure you give the correct answers and steps to find the area of DPFQ?*
SC2: *Yes, ma'am, because DPFQ = 1/2 (PQ)(DF)*

This shows that the SC2 subject can solve HOTS geometry problems at the analytical level precisely and adequately. Besides, SC2 even solves problems with up to two solutions with different strategies or steps from the first solution.

In solving the HOTS geometry problem at the evaluation level, the work of the SC2 subject is shown in Figure 5.

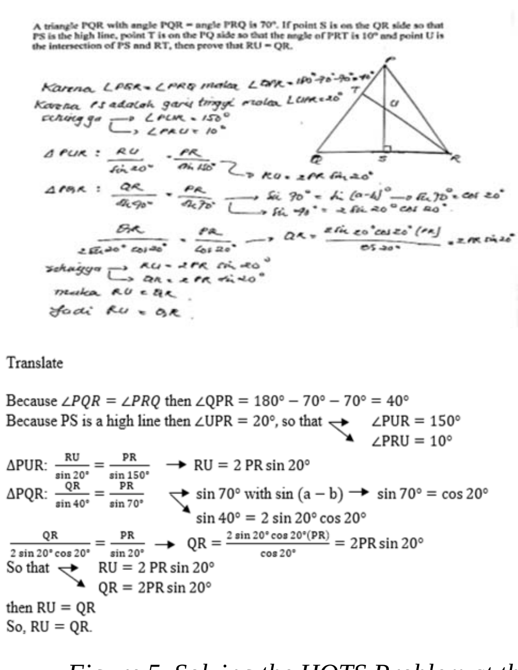


Figure 5. Solving the HOTS Problem at the Evaluation Level by SC2 Subject

In figure 5, the SC2 subject solves the problem by drawing a triangle according to the problem, namely the PQR triangle, identifying the problem that triangle PQR = triangle PRQ. SC2 checks again that PS is a high line. Furthermore, the SC2 explains that in triangle PUR with the concept of sin and cos.

The following are the results of interview transcripts on SC2 in solving HOTS geometry problems at the evaluation level.

P: How do you identify the problem?
SC2: Yes, ma'am, by drawing a triangle to answer the question easily.
P: What comes to your mind first when solving a problem?
SC2: What I think is that because triangle PQR = triangle PRQ, then PQR is an isosceles triangle.
P: Are you sure that concept sin?
SC2: Yes, ma'am, with the concept that sin (a - b), and the result is the same that RU = QR.

In solving the HOTS geometry problem at the create level, the work of the SC2 subject is shown in Figure 6.

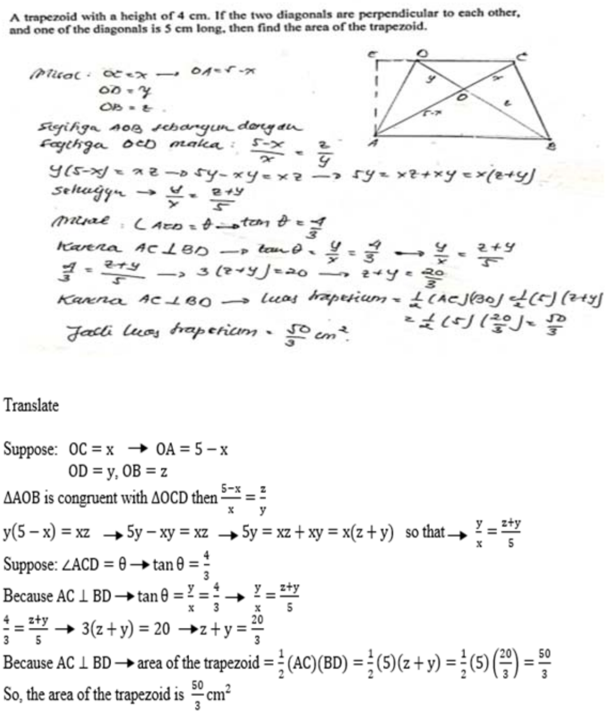


Figure 6. Solving HOTS Problems at the Create Level by Subject SC2

In figure 6, the SC2 subject solves the problem by drawing a trapezoid by assuming OC = x, OA = 5 – x, OD = y, and OB = z. Since triangle AOB is congruent with triangle OCD, and AC is perpendicular to BD, we can find the area of the trapezoid = ½ (AC)(BD) = 50/3. So, the area of the trapezoid is 50/3 cm^2.

The following is the interview transcript with SC2 in solving the HOTS geometry problem at the create level.

P: From the obtained information, how did the idea of drawing come up?
SC2: The idea came up to draw a trapezoid to make it easier to calculate, ma'am.
P: What comes to your mind first when solving a problem?
SC2: Yes, ma'am, by assuming that OC = x, OA = 5 – x, OD = y, and OB = z.
P: After that, what steps do you think of?
SC2: Since triangle AOB is congruent with triangle OCD, I get (5-x)/x = z/y
P: Are you sure that the area of the trapezoid is 50/3 cm^2?
SC2: Yes, ma'am, there is another way with triangle AOB is congruent with triangle OCD, and AC is perpendicular to BD, we can find the area of the trapezoid = ½ (AC)(BD) = 50/3. So, the area of the trapezoid is 50/3 cm^2

Regarding the SC2 subject, the analysis of the SC2's creative mathematical reasoning process of climber students in solving HOTS geometry problems is shown in Table 4.

Table 4. Creative Mathematical Reasoning Process for SC2 Subject

Creative Mathematical Reasoning
HOTS with Analisis Level
Mathematics Foundation 1. Identifying problem information on cube 2. Explaining by drawing a cube 3. Explaining the DPFQ rhombus Plausible 1. Explaining information logically 2. Determining the strategy 3. Implementing strategies or steps so that the DPFQ area is obtained correctly Novelty 1. Relating the information that DPFQ is a rhombus 2. There is no strategy development or other steps yet 3. No strategy or steps have been developed yet
HOTS with Evaluation Level
Mathematics Foundation 1. Identifying problem information that triangle PQR = triangle PRQ 2. Explaining the obtained information by drawing 3. Describing the PS height line Plausible 1. Explaining logically that triangle PUR and triangle PQR 2. Defining strategies 3. Implementing strategies or steps related to sin and cos in PUR and on triangle PQR Novelty 1. Relating the information tha AC is perpendicular to BD 2. There is no strategy development or other steps, yet 3. No strategy or steps have been developed yet
HOTS with Create Level
Mathematics Foundation 1. Identifying problem information regarding trapezoid

2. Explaining the obtained information by drawing
3. Explaining triangle AOB which is congruent with triangle OCD

Plausible
1. Explaining information logically
2. Determine the strategy
3. Implementing the right strategy or step

Novelty
1. Relating the information
2. There is no strategy development or other steps yet
3. No strategy or steps have been developed yet

The mathematical creative reasoning process of SC2 climber students in solving HOTS geometry problems included 1) SC2 subjects like challenges and try to solve HOTS geometry problems at the level of analysis, evaluation, and creation correctly; 2) SC2 subjects tend to solve HOTS geometry problems at the level of analysis, evaluation, and creation by drawing based on the obtained information and experience to attain easier procedure to solve the problems given; 3) when solving problems, SC2 is able to work on HOTS geometry at the level of analysis, evaluation, and creation correctly and meet the criteria in the mathematics foundation, plausible and novelty aspects, but only one solution solves the problem because SC2 is unfamiliar with HOTS geometry problems; 4) SC2's difficulty is feeling hesitant in solving HOTS geometry problems at the level of analysis, evaluation, and creation, but SC2 has not been able to overcome and determine the right strategy or steps in solving problems; 5) in answering interview questions about solving HOTS geometry problems at the level of analysis, evaluation, and creation, SC2 subject can answer logically and coherently but does not yet have other solutions that different from creative reasoning thinking that has not been maximized.

Our research findings showed that SC1 climber could identify problem information, provide explanations of obtained information by drawing and assuming mathematical concepts, and provide explanations related to the provided information regarding the creative mathematical reasoning process in solving HOTS geometry problems at the level of analysis, evaluation, and creation. This shows that climber students always make every effort to solve problems. If there are doubts, they have a high desire to solve problems correctly, so it can be said that students have mathematics foundation abilities. Furthermore, when answering interview questions, climber students can immediately answer in clear sentences with coherent and precise reasoning. This is in line with the opinion [37], [38], [39], [40] that climber students can convey information in mathematical concepts.

Climber students can explain logically, determine strategies or steps, and appropriately apply those strategies or measures. During the reasoning process and answering interview questions, the climber students can convey acceptable reasons coherently and clearly until the end of the conclusion, so it can be considered plausible. This is in accordance with the opinion [41], [42], [43], [44], [45] that students who have plausible criteria in themselves can convey reasons or arguments clearly and precisely. Climber students can also relate information, develop strategies or steps in other ways, and apply the developed strategies or steps appropriately. During the reasoning process, climber students can master concepts and develop different problem solving to have novelty. This is in line with the opinion [17], [46], [47], [48] that students who can relate information and mathematical concepts can provide solutions with different solutions to the same concept.

4. Conclusion

Our findings related to the creative reasoning process in solving Higher Order Thinking Skill (HOTS) geometry problems at the levels of analysis, evaluation, and creation suggested that climber students can meet the criteria of mathematics foundation, plausibility, and novelty. Climber students love challenges, do not give up easily, always try to apply strategies or steps in solving problems mathematically, and can meet the criteria of the mathematics foundation. Climber students can present logically acceptable reasons for solving problems and meet plausible criteria. Besides, climber students can develop and apply strategies or steps to solve problems with new and different solutions and meet the novelty criteria. However, there are times when climber students do not meet the criteria for novelty aspects due to a lack of thoroughness and creative mathematical reasoning thinking. Also, climber students are still not used to solving problems, especially Higher Order Thinking Skill (HOTS) geometry problems, even though climber students have characteristics who tend to like challenges and do not give up on solving problems.

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