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How Do Students Thinking Processes in Solving Originality and Elaboration Problems of Mathematical Creative Thinking Based on Brain Domination?

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abstract

Thought processes and brain dominance can be applied in the field of education because of the linkages between neuroscience, psychology, and education. The thinking process of students can assist teachers in planning the learning process, while brain dominance is an important factor in student performance so it is important to know students' thinking processes based on brain dominance in the learning process. This research aims to describe students' thinking processes in solving originality and elaboration problems on mathematical creative thinking based on brain dominance. The research method used is qualitative with a descriptive exploratory approach. The instrument used is a matter of mathematical creative thinking that meet the indicators of originality and elaboration, brain dominance tests, and unstructured interviews. The Subject selected research was 3 subjects, namely 1 subject dominated by the left brain, 1 subject dominated by a balanced brain, and 1 subject dominated by the right brain. The subject is a class IX student of SMPN 1 Kota Tasikmalaya. The result of the research is that the thinking process of students in solving originality and elaboration questions creative thinking mathematically based on brain dominance in solving problems cannot be separated from the function of the right and left hemispheres. The thinking process of students in solving problems shows that students use the characteristics of the function of the hemispheres of the brain according to the dominance of the student's brain.

Keywords:
Thought Process; Originality; Elaboration; Mathematical Creative Thinking; Brain Domination.

INTRODUCTION

Researchers directly conduct preliminary studies at SMPN 1 Tasikmalaya to find information and initial data in the field before conducting further research. The researcher gave a question about a flat-sided solid figure. Researchers took several answers that had different answers as material for analysis in this preliminary study. Student answers were taken, namely student 1 answers (JS1), student 2 answers (JS2), and student 3 answers (JS3). Students JS1 and JS3 solve solid figure problems using the volume cube formula, while students JS2 use the volume cuboid formula. Based on the answers of students JS1 and JS3 it also proved that the thinking processes of students JS1 and JS3 were different even though both of them used the volume cube formula. Student JS1 solves the problem by calculating the overall volume, while student JS3 first calculates the volume of the cube. Based on the explanation of the preliminary study, it proves that students' thinking processes are different. This is supported by the results of research conducted by Yohanes (2013) which aims to determine the thinking processes of junior high school students in solving math problems. The study's results concluded that the students' thinking processes showed different thought processes (Yohanes, 2013).
The different thinking processes of students prove that what is thought and how the students' thought processes are different. Different thought processes allow teachers to make certain judgments about what is thought and how thoughts are generated (Shadrikov et al., 2016). The teacher assesses what and how students think resulting in the teacher being able to recognize what students think in solving problems. Teachers know what students think can maximize the learning process.

Teaching affects achievement through students' thinking processes, and vice versa (Clark, 1984). The thinking process of students can assist teachers in planning the learning process so that the teaching that the teacher plans can maximize the potential of students. Teachers can make learning designs that are by students' thinking processes by knowing the students' creative thinking processes (Wulandari, 2014). The thinking process does not explain how a person's creative thinking ability, but the thinking process explains how the process or way of thinking creatively in solving problems.

Problem-solving plays an important role, especially so that learning can run flexibly (Mulyasa, 2010). Problem-solving has been the interest of mathematics education researchers as long as the field exists (Liljedahl et al., 2016). This is because problem-solving has special needs in the study of mathematics. Problem-solving is an attempt to find a solution to a difficulty (Polya, 1981). Problem-solving is the condition of a person using knowledge and reasoning to solve problems (Haylock & Thangata, 2007). It can be concluded that problem-solving is a process by which someone to find solutions in solving problems using knowledge and reasoning. Problem-solving in this study focuses on solving originality questions and elaborating mathematical creative thinking.

Musbikin (Hendriana et al., 2017) Explains creative thinking is an activity or mental activity to start ideas, see new relationships or previously unexpected things, compile concepts that are not rote, find new answers to old problems, and ask new questions. Creative thinking is a way of thinking that produces new ideas as a result of the thinking process (Sekar & Sarining, 2017). Signs of the emergence of creative thinking are the emergence of new ideas generated. The thought process is a mental activity used to formulate and solve problems, make decisions and understand problems (Subanji, 2007). From the description above, it can be concluded that the process of creative thinking is an activity to develop a systematic thinking process that involves cognitive structures to solve a problem to produce new things or new perspectives from previously acquired knowledge. The process of creative thinking is a real illustration of how creativity occurs (Oktaviani et al., 2018). The process of mathematical creative thinking is a process of a creative thinking mental activity that is developed in mathematics.

The mathematical creative thinking process developed in mathematics emphasizes four aspects, namely fluency, flexibility, originality, and elaboration. Creative thinking contains four components, namely fluency with students expressing many ideas to solve problems, flexibility by modifying information to find ideas, originality by developing ideas, and elaboration by linking results with theory (Susantini et al., 2016). Creative thinking is a process that involves elements of originality, fluency, flexibility, and elaboration (Torrance, 1990). Munandar (2014) also revealed that indicators of creative thinking include fluency, flexibility, originality, and elaboration. This research only uses two indicators of creative thinking, namely: (1) Originality includes: a) being able to generate new and unique expressions, b) thinking of unusual ways, c) being able to make unusual combinations of its parts, (2) Elaboration includes: a) being able to enrich and develop an idea or product, b) adding or detailing details of an object, idea, or situation so that it becomes more interesting (Munandar, 2014).

Originality is an aspect that has new ideas to solve problems (Kaufman & Sternberg, 2010). The aspect of originality that makes a person get unique new ideas from a given problem and combine them (Saida et al., 2021). Originality is the ability to generate extraordinary ideas that are not common (Nurdayanti et al., 2020). Originality has an important role in the process of creative thinking (Wang & Hou, 2018). Originality is a component of creativity that everyone agrees (Wilson et al., 1953). This description concludes that originality is the ability to generate new ideas that are unique and unusual. This explanation also shows the importance of the originality aspect in the creative thinking process.

Elaboration is another important aspect besides originality. Elaboration is the ability to develop ideas to multiply the initial response (Torrance, 1990). Elaboration leads to many ideas, perceptions, or correct answers with detailed steps to solve problems (Treffinger et al., 2002). Elaboration refers to the degree to which an idea is detailed, embellished, or explained (Guilford, 1967). New ideas (originality) must be in line with the ability to explain these ideas (elaboration) to optimize one's creative potential (Simonton, 1997). In the context of education, elaboration is a source of aspects that have long been considered worthy of research in creativity research (Mottweiler & Taylor, 2014). It can be concluded that elaboration is the ability to detail, develop, or explain ideas to solve problems. As with originality, the elaboration aspect is also important in the process of creative thinking.

The Wallas stage model approach can be used to see how a person's creative thinking works (Sriraman, 2004). The model that can be used to see students' creative thinking processes is the model put forward by Graham Wallas (Savic, 2016). This model is known as the Wallas stage. Strenberg (Sriraman, 2004) emphasized that the idea of a creative thinking process can arise by going through a process of tension between conscious and unconscious reality. Wallas' stages are good stages to use in both conscious and unconscious states of activity. The Wallas stage is a process of creative thinking stages by carrying out four stages, namely the preparation stage, the incubation stage, the illumination stage, and the verification stage (Savic, 2016). This background causes researchers to be interested in Wallas' stages so that mathematical creative thinking processes are analyzed based on Wallas' stages.

There is a link between three fields, namely neuroscience, psychology, and education (Ozdogru, 2014). The thinking process of the study of psychology, while the dominance of the brain in the study of neuroscience is the brain. thought process and brain dominance can be applied in the field of education. The linkage between the three explains that the working system of the brain is an internal factor that influences learning. Jensen (2008) suggests the relationship between learning and the brain, that 7 things affect learning, one of which is the brain. The link between the brain in learning causes a connection between the brain and the student's thinking process.

The human brain hemisphere consists of two hemispheres, namely the left hemisphere and the right hemisphere. Humans use the left and right hemispheres of the brain alternately and work together. The use of brain tendencies can affect learning because brain dominance is an important factor in one's performance (Kordjazi & Ghonsooly, 2015). Hemispheric dominance is the use of different brain hemispheres in studying and listening to the intended pattern, consistency using one hemisphere of the brain compared to the other hemisphere (Singh, 2015).

The right brain and left brain have similar physiological forms but have different work functions (Caine & Caine, 1990). Some of the roles of the left brain are analysis, drawing conclusions, solving problems logically, verbal response, analytical thinking, processing and memory, linear thinking, and preferring phenetic reading systems, while the role of the right brain is synthesis, generating ideas or being creative, solving problems. intuitively, non-verbal responses, thinking holistically and then processing memory, thinking laterally, and preferring to read all languages (Sukmaangara, 2020). The left brain works actively when thinking logically, while the right brain works more actively to work on problems related to creativity (Ferdinand & Ariebowo, 2009). The left hemisphere of the brain is the hemisphere that is very important in solving math problems because the left brain works actively when thinking logically, while the right brain is the hemisphere that plays a very important role in completing problem-solving because work is related to creativity. The right hemisphere is critical for creative problem-solving (Falcone & Loder, 1984). This proves that brain performance is closely related to creativity.

Research on the brain in learning still requires further research development. The interest in and the development of neuroscience, one of which is the brain, triggers a need for further research (Ozdogru, 2014). Researchers need to research to develop brain connections in the learning process. The need for further research in the field of neuroscience and the link between the brain and learning has made researchers interested in research based on brain dominance. Research on thinking processes based on brain dominance has been studied by Sukmaangara et al. (2020), Yohanes (2013), Permatasari (2020), and Nurazizah et al. (2022). All of these studies analyze thinking processes based on brain dominance, but these studies review from different perspectives. Research conducted by several researchers shows that no one has examined the thought process in solving specific problems on aspects of originality and elaboration based on brain dominance. This is what makes this research novelty. This research aims to know the description of students' thinking processes in solving originality questions and elaboration on mathematical creative thinking based on brain dominance.

METHODS

Research Design

This research method is a qualitative method with an exploratory approach. This method is used because the researcher describes in writing and explores more deeply related to students' thinking processes in solving originality problems and elaboration of mathematical creative thinking based on Brain Domination.

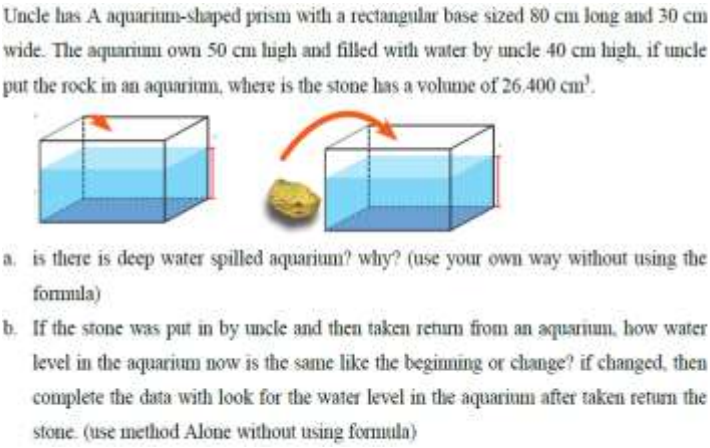
The selected research subjects were 3 subjects. First, a subject who was dominated by the left brain. Second, a subject who was dominated by a balanced brain, and the last who was dominated by the right brain. Subjects were selected based on brain dominance test results. The brain dominance test used is the brain dominance test in Tendero's dissertation (Tendero, 2000). Subjects were given a brain dominance test 3 times to strengthen the brain dominance test results. This aims to produce valid data so that it is more credible (Sugiyono, 2017). The number of selected research subjects is adjusted to the research needs until the research questions are answered. Subjects were selected with certain considerations to have characteristics that match the research objectives. In addition, subjects were also chosen by considering the students' potential in solving mathematical problems and students' potential in describing information orally. The research subjects were class IX students of SMPN 1 Tasikmalaya. The following table shows the results of the brain dominance test:

Table 1
Student Brain Domination Test Result

Subject	First Test Score	Second Test Score	Third Test Score	Category
S1	-5	-6	-4	Left Brain Domination
S2	0	0	0	Balanced Brain Domination
S3	3	4	4	Right Brain Domination

Data Collection and Analysis

The data collection technique for this research was the results of brain dominance tests, mathematical creative thinking tests with indicators of originality and elaboration, and structured interviews. The mathematical creative thinking test instrument was validated before conducting the research. The instrument was validated by three experienced validators. The creative thinking test questions are presented as follows:


Uncle has A aquarium-shaped prism with a rectangular base sized 80 cm long and 30 cm wide. The aquarium own 50 cm high and filled with water by uncle 40 cm high. if uncle put the rock in an aquarium, where is the stone has a volume of 26.400 cm^3.

a. is there is deep water spilled aquarium? why? (use your own way without using the formula)

b. If the stone was put in by uncle and then taken return from an aquarium, how water level in the aquarium now is the same like the beginning or change? if changed, then complete the data with look for the water level in the aquarium after taken return the stone. (use method Alone without using formula)

Figure 1. Mathematical Creative Thinking Test

The data analysis technique in this study is the Miles & Huberman Model. The stages in the Miles & Huberman Model are data reduction, data display, and conclusion drawing/verification (Miles & Huberman, 1994).

RESULT

The students' thinking process will be displayed in the form of students' thinking process flow design. The design flow of students' thinking processes is formed from the analysis results in the form of students' answers results in answering questions, video recording results and results of interviews. The following is a description of students' thinking processes in solving originality and elaboration questions of mathematical creative thinking:

Left Brain-Dominated Student Thinking Process

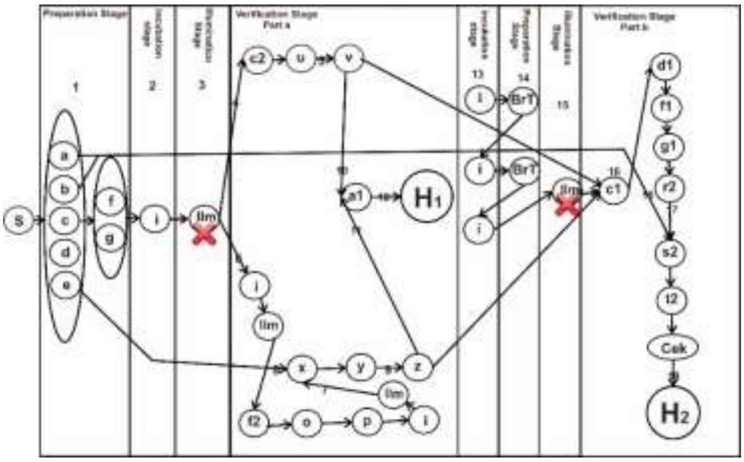


Figure 2. Thinking Process of Left-Brain-Dominated Students

The following is a description of the code in Figure 2:

Table 2.

Explanation of Coding of Thinking Processes of Left-Brain Dominated Students

Code	Description	Code	Description
a	$Length_{Aquarim} = Length_{water} = 80cm$	y	$V_{water + stone} = 96.000cm^3 + 26.400cm^3$
b	$Width_{Aquarium} = Width_{water} = 30cm$	z	$V_{water + stone} = 122.400cm^3$
c	$Height_{Aquarium} = 50cm$	a1	$V_{water + stone} > V_{Aquarium}$
d	$Height_{Water} = 40cm$	H1	Spilled Water
e	$V_{stone} = 26.400\ cm^3$	BrT	Ask
f	Did the water spill? why?	c1	$V_{spilledwater} = 122.400\ cm^3 - 120.000cm^3$
g	The water level after taking the stone?	d1	$V_{spilledwater} = 2.400\ cm^3$
i	Looking for ideas or ideas	f1	The volume of water after taking the stone = $96.000\ cm^3 - 2.400\ cm^3$
c2	$Volume_{Aquarium}$ = Base area x $height_{Aquarium}$	g1	The volume of water after taking the stone = $93.600\ cm^3$
u	$V_{Aquarium} = 80cm \times 30cm \times 50cm$	r2	$V_{cuboid} = p \times l \times t_{water}$
v	$V_{Aquarium} = 120.000cm^3$	s2	$93.600cm^3 = 80cm \times 30cm \times t_{water}$
f2	$V_{water} = p \times l \times t$	t2	$93.600cm^3 = 2.400cm^3 \times t_{water}$
o	$V_{water} = 80\ cm \times 30\ cm \times 40\ cm$	Cek	Double check answers
p	$V_{water} = 96.000\ cm^3$	H2	Water change height in the aquarium (t_{water}) = $39\ cm^3$
Ilm	Get ideas	1-19	The sequence of Problem-Solving Flow
x	$V_{water + stone} = V_{water} + V_{stone}$		

Based on Figure 2, the preparation stage students write down the length of 80cm (code a), width of 30cm (code b), height of 50cm (code c), water height of 40cm (code d), and stone volume $26.400cm^3$ (code e). In addition, students write down what to look for, namely a) is there any spilled water in the aquarium? why? (code f) and b) what is the water level when the stone is taken back? Find out the water level! (g code). Students look for ideas or ideas to use and read the questions again before answering the questions in part a (code i) in the incubation stage. Students can find ideas for solving problems by using the prism volume formula including the cuboid volume at the illumination stage.

The verification phase begins with students calculating the volume of the aquarium using the prism volume formula (code c2). Students replace the length of 50cm, width of 30cm, and height of 50cm in the prism volume formula (code u) so that the result for the volume value of the aquarium is 120.000cm^3 (code v). Before calculating the volume of water in the aquarium, students brood over it a moment more than the students who read the questions for about 1 minute to find ideas (Ilm code). Students begin to continuously calculate the water volume in the aquarium using the volume of a cuboid formula (code f2). Students replace the length of 80cm, width of 30cm, and water height of 40cm in the formula for the volume of the cuboid (code o) so that the resulting value for the volume of water in the aquarium is 96.000cm^3 (code p).

In the next step, students calculate the volume of water plus the volume of rock (code x). Students get the answer 122.400cm 3 (code y). Students conclude that water will spill over (code H1) because the volume of the aquarium is smaller than the volume of water plus the volume of rocks (code a1). This is reinforced by the results of student answers as follows:

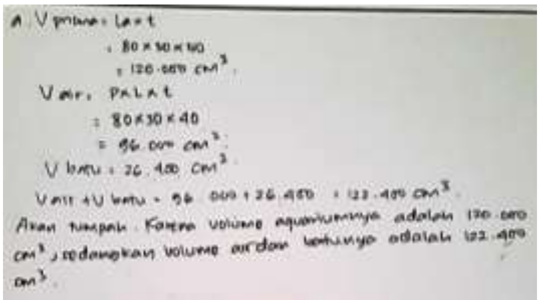


Figure 3. Completion of Part a Problems by Left-Brain Dominated Students

After completion of part b, students reopen the question and try to re-understand the meaning of the answer to part b (code i). Students need a longer time than when working on the previous problem in solving problem number 2 part b. A few moments later, the students felt that there must have been a change because some water had spilled. This is reinforced by the student's question to the researcher (code BrT) as follows:

S : do you have to write down the reasons if the results are still the same as before?
P : no need to write down the reason if the results are still the same as before
S : there seems to be a change. because the water is spilled, the height is reduced a little (while moving the hand down)
P : if there is a change like that, then try to do it.

Students begin to understand the questions again by looking at the results of the answers in part a and reading the questions again (code i). A few moments later, students find ideas for solving part b. Students start working on question part b by doing the incubation stage beforehand compared to the preparation stage. Students perform calculations by finding the volume of water spilled in the aquarium by subtracting the volume of water in the aquarium and rocks from the volume of the aquarium (code c1) so that the resulting value for the volume of water spilled in the aquarium is 2.400cm ^{3} (code d1). The calculation is done while understanding the results of the answers to part a. In the next step, students calculate the remaining volume of water in the aquarium after spilling by subtracting the volume of water in the aquarium and the volume of water spilled in the aquarium (code f1) so that the remaining volume of water after spilling is 93.600cm^3 (code g1).

Students use the volume cuboid formula to find the height of the water in the aquarium after taking the stones (code r2). Students replace the length of 80cm, width of 30cm, and the volume of water in the aquarium after spilling 93.600cm ^{3} in the cuboid formula so that it produces the equation 93.600 = 80 x 30 x t (code s2). Students had counted with wrong results, but students tried to check the results of their answers again and found an error in the calculation (check code). This check is carried out repeatedly. Students get the correct result, namely the height of the water in the aquarium after spilling is 39cm (code H2). This answer indicates that the student was able to get the correct result for question number 2 in either part a or part b. This is in accordance with the results of student answers in the following figure:

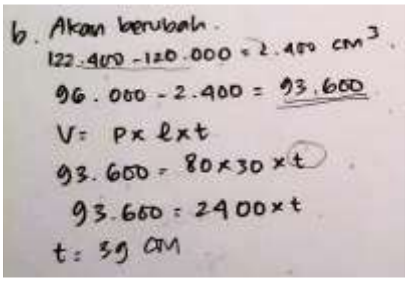


Figure 4. Completion of Part b Problems by Left-Brain Dominated Students

The results of the research discussion were strengthened by interviews as follows:

P : In your opinion, is there another way without using formulas in problem-solving?

S : (pauses) there is no other way but the way to use the formula. (with a smile)

P : Describe the results of the work you did in part a?

S : I first find the volume of the prism using the formula for the area of the base times the height. The prism volume is calculated as 80cm x 30cm x 50cm so that the resulting prism volume is 120.000cm^3. In the next step, I look for the volume of water in the aquarium by multiplying the length of 80cm, width of 30cm, and height of 40cm in the aquarium so that the resulting volume of water in the aquarium is 96.000cm^3. Furthermore, because it is known that the volume of the rock is 26.400cm^3, the sum of the water volume in the aquarium and the volume of the rock is 122.400 cm^3. I conclude that the water will spill over because the volume of the prism-shaped aquarium is 120.000cm ^{3}, while the volume of water plus the volume of the rock is 122.400cm^3.

P : Explain the results of the work you did in part b?

S : when the stone is taken, then the water level will change. It is calculated by subtracting the volume of water and rock from the volume of the prism, which is 122.400cm^3 minus 120.000cm ^{3}

P : to find what explanation just now?

S : to find the difference between the volume of water before and after taking the stone. The result of this reduction is 2.400cm^3. Previous calculations yielded a water volume of 96.000cm^3. The result of the volume of water reduced by the subtraction between the volume of water and rock minus the volume of the prism results in a volume of 93.600 cm^3.

P : why should it be reduced by 2.400cm^3 first?

S : (pause) to find out the new volume of water (meaning the volume of water in the aquarium after spilling) in the aquarium after taking the stones. The next step, find the height with the new volume of water using the formula p x l x t so that it is written 93.600cm^3 = 80cm x 30cm x t. I calculated the new water level in the aquarium using a division between 93.600cm^3 and 2.400cm^3 so the resulting new water height in the aquarium is 39cm.

Thinking Process of Students with Balanced Brain Domination

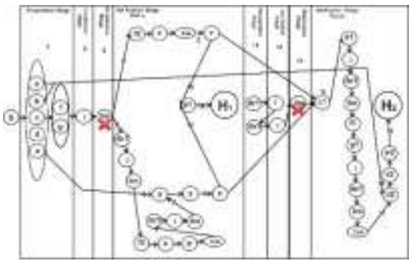


Figure 5. Thinking Processes of Students with Balanced Brains

The following is a description of the code in Figure 5:

Table 3.
Explanation of Coding of Thinking Processes of Balanced-Brain Dominated Students

Code	Description	Code	Description
u2	$t_{water} = p_{water}$ x l_{water}: 93.600cm^3	w2	t_{water} = 2.400cm ^{2}: 93.600cm ^{3}
v2	t_{water} = 80cm x 30cm: 93.600cm^3		

Based on Figure 5, Students carry out the preparation stage by writing down data such as the length of the aquarium 80cm (code a), the width of the aquarium 30cm (code b), and the height of the aquarium 50cm (code c). Students also write down the height of the water in the aquarium which is 40cm (code d) and the volume of stones that are put in is 26.400cm^3 (code e). Students try to understand what to look for in the question, then write it down on the answer sheet (codes f and g). Students don't think too long about what method to use in solving part questions. In the incubation stage students only read the questions that have been written on the answer paper and pause for a moment then immediately write the solution in part a (code i). Students find ideas at the illumination stage.

The verification phase begins by calculating the volume of the aquarium using the cuboid volume formula (code f2). Students replace the length of 80cm, width of 30cm, and height of 50cm in the formula for the volume of a cuboid (code u) so that the resulting value for the volume of the aquarium is 120.000cm^3 (code v). Students try to understand the problem again by asking the researcher several questions (code BrT):

S : still confused about using 40cm.
P : The logic is now, if you want to know whether there is spilled water or not, what should you look for?
S : the volume of rock with water. The volume of the rock is known. how to find the volume of water? (pause). Oh yes.

Students get ideas after discussing with researchers so they don't wait a long time for students to work on solving the problem again (Im code). Students calculate the volume of water by substituting the length of 80cm, width of 30cm, and water height of 40cm in the cuboid volume formula (code o) so that the resulting value for the volume of water in the aquarium is 96.000cm^3 (code p). Students check the answers that have been made before (check code). The student conducts another discussion with the researcher to seek information (code BrT).

S : sir, how do you know if there is spilled water or not?
P : try to find, where to find out?
S : means (pause).

Students find ideas after this conversation (Ilm code). Students answered by adding the volume of water to the volume of the rock (code x) so that the volume of water after adding the rock was 122.400cm^3 (code z). Students conclude that water will spill (code H1). Students think the water will spill because when the stone is put into the water it exceeds the volume of the aquarium (code a1). The process of solving part questions can be seen in the picture as follows:

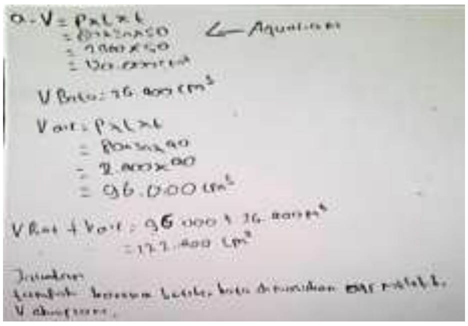


Figure 6. Completion of Part b Questions by Students with Balanced Brain Domination

Next step, students begin to solve part b questions. Students start looking for information by asking the researcher several things (code BrT):

S : if the stone is taken so the water will spill. because there is spilled water, the water level must also decrease so this volume (while indicating the volume of the rock plus the volume of water) must be reduced by this volume (while pointing to the volume of the aquarium).

P : how tall do you think it is?

Students think of a strategy for solving the problem in a relatively long time (code i). The students asked again (BrT code) as follows:

S : means that the only thing that doesn't change is the length and width?

P : it could be

A few moments later the students found an idea and started working on the problem (Im code). Students start by calculating the volume of water that comes out using the volume of rocks along with the volume of water minus the volume of the aquarium (code c1) so that the subtraction is 2.400cm^3 (code d1). Students carry out the conversation again with the researcher (code BrT). The conversation occurred after the students thought for a moment (code i). The results of conversation resulted in students working on the problem by subtracting the initial volume of water from the volume of spilled water, namely 96.000cm^3 – 2.400cm^3 (code f1). The result of this reduction is a valuable volume is 93.600cm^3 (code g1). These results are the calculation of the volume of water after the stone is taken back. The students stopped for a moment (code i) and continued the conversation (code BrT) as follows:

S : how do find the height with this volume (pointing 93.600cm^3) divided not by the length and width? Is that how it's done?

P : just try it first

First, calculate the division between 93.600cm^3 and the length of the water and the width of the water before writing down the completion of part b. This is done to check whether the method used is correct or incorrect (check code). Students write down the calculation results after getting the correct result. Students wrote that finding the height can be done by the length of the water multiplied by the width divided by 93.600cm^3 (code w2) so that after the operation the result is that the height of the water after taking the stone is 39cm (code H2).

Students can solve the problem correctly, but there is a mistake in writing the formula for finding the height of water after taking stones. Even though the writing is wrong, in calculating the distribution students can work on the answer correctly. The process of solving part questions can be seen in the picture as follows:

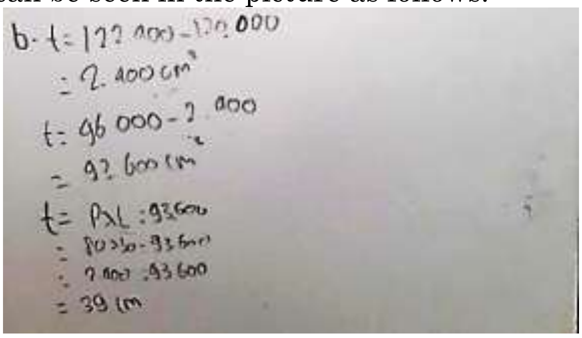


Figure 7. Completion of Part b Questions by Students with a Balanced Brain Domination

Thinking Process of Right Brain-Dominated Students

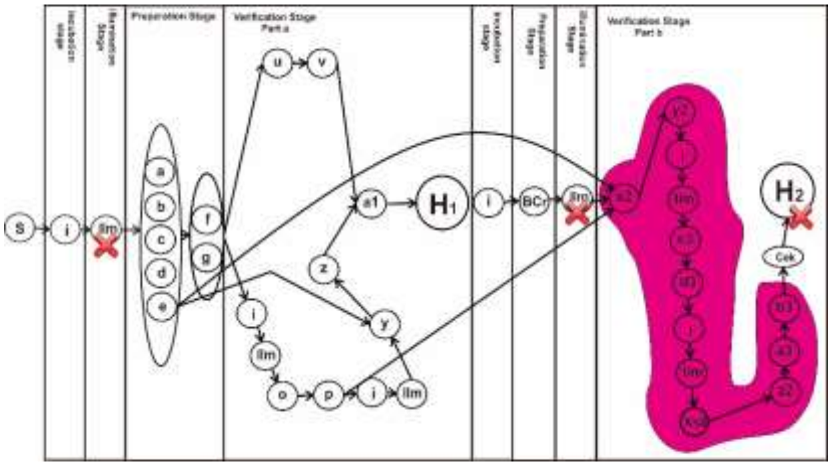
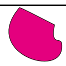


Figure 8. Thinking Processes of Right-Brained Students

The following is a description of the code in Figure 8:

Table 4.
Explanation of Coding of Thinking Processes of Left-Brain Dominated Students

Code	Description	Code	Description
BCr	Try several ways to solve the problem	Ks2	there, reduced to 69.600cm^3
x2	The set volume has been taken of the stone = 96.000cm^3 – 26.400cm^3	z2	80cm x 60cm x x = 69.600cm^3
y2	The set volume has been taken of the stone = 69.600 cm ^{3}	a3	2.400cm^2 x x = 69.600cm^3 .
c3	The set volume has been taken of the stone = 120.000cm^3 – 26.400cm^3	b3	x = 29cm
d3	The set volume has been taken of the stone = 93.600cm^3		Error Stages in Solving Problems

Based on Figure 8, students start with the incubation stage by contemplating to get ideas or ideas to use (code i). Reflecting is done until you get an idea to start working on the problems at the illumination stage. Students carry out the preparatory stage starting with writing down the information obtained from the questions such as the length of the prism 80cm (code a), the width of the prism 30cm (code b), and the height of the prism 50cm (code c). Students also write down the height of the water in the aquarium which is 40cm (code d) and the volume of the rock that is inserted is 26.400cm^3 (code e). The next step is to understand and write down what to look for in the question (codes f and g).

Students do the calculations not long after the preparation is done (code i). The Verification Stage begins with students multiplying the prime length, prism width, and prism height, namely 80cm x 30cm x 50cm to calculate the volume of the aquarium (code u) resulting in a volume value of 120.000cm^3 (code v). The students pondered for a while when you want to calculate the volume of water in the aquarium (code i). Not long after, the students got the idea to continue working on the problem (Ilm code). Students begin to calculate the volume of water in the aquarium by multiplying the length of the prism, the width of the prism, and the height of the water in the aquarium, which is 80cm x 30cm x 40cm (code o) to produce a volume value of 96.000cm^3 (code p).

Students do the same thing as before, namely students ponder for a while (code i), and students even look back at what is known in the problem. It wasn't long before the students got the idea to continue solving the problem (code Ilm). The volume of water after adding the rock is calculated by adding up the volume of water and the volume of the rock, namely 96.000cm^3 + 26.400cm^3 (y code), so the resulting volume value is 122.400cm^3 (z code). Students write down the conclusions generated in part a, that is, there is spilled water (code H1) because the volume of water after adding the stones exceeds the volume of the aquarium. This is also in accordance with the results of student answers as follows:

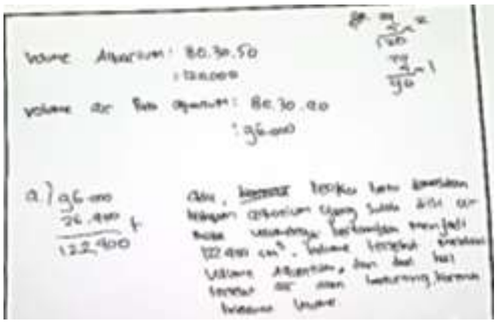


Figure 9. Completion of Part a Problems by Right-Brained Students

In the next step in solving part b questions, students start by reading the questions first to understand what the questions mean (code i). Students answering questions part b are relatively long. Students can start working again after the researcher asks questions ((BCr) as follows:

P : In your opinion, can you do this problem?

S : (nods) I was looking for several ways pa and finally, I found the way

The researcher asked because of the gaze which indicated that the students wanted to discuss. Students prepare by trying several ways to solve the problem before starting the calculation. A few moments later, the students found an idea and started working on the problem again. Students start by calculating the volume of spilled water by subtracting the volume of water from the volume of rock, namely 96.000cm^3 – 26.400cm^3 (code x2) so that the resulting volume value is 69.600cm^3 (code y2). This calculation makes students get the wrong conclusion to get the results in part b. This is because students think that the volume spilled is the same as the volume of rock taken.

Students ponder looking for ideas or ideas before continuing to solve the problem. After going through these stages, students conclude that there is, because it is reduced to 69.600cm^3 (code z2). The next step is to calculate the height after the water is spilled. Students make an equation that is 80cm x 30cm x x = 69.600cm^3 (code a3). Students operate the part to become x = 69.600cm^3/2.400cm^2 so that it produces x = 29cm (code b3). The result of 29cm is the height of the water after spilling which is obtained after doing calculations for a long time. This corresponds to the results of the answers as follows:

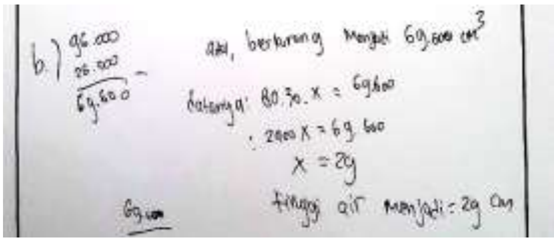


Figure 10. Completion of Part b Problems by Right-Brained Students

The results of the research discussion were strengthened by interviews as follows:

P : try to describe what you think when doing this problem?

S : I calculated the volume of the aquarium to produce 120.000cm^3 and the volume of water to 96.000cm^3. the conclusion of the answer to part a is yes, when a stone is placed in an aquarium filled with water, the volume increases to 122.400cm^3. This volume exceeds the volume of the aquarium, so the water will decrease because of the excess volume. conclusion answer part b is there because it is reduced to 69.600cm^3. I looked for the water level after taking the stones resulting in a height of 29cm because I used this formula (pointing to a section of 80cm x 30cm x x = 69.600cm^3)

DISCUSSION

Left Brain Dominated Student Thinking Process

Based on Students' thinking processes in Figure 3, Students in solve questions in part a and part b can be passed well through all Wallas stages at the preparation stage, incubation stage, illumination stage, and verification stage. The preparation stage begins with preparing themselves by understanding the questions and writing down what is known. Students are silent for a moment to look for ideas at the incubation stage. Students get an idea after a moment of silence at the illumination stage. Students carry out their ideas to get the correct answer by 1) students write the formula; 2) students carry out arithmetic operations by substituting known data into the formula at the verification stage. Students check their answers after completing the questions. Students experience a few problems only in completing part b, but students can pass after understanding the problem and asking the researcher so that students can continue working on the problem. Students are categorized as unable to meet the originality indicator. Students do not meet the indicators of originality because students use the method commonly used, namely students use formulas in problem-solving. An idea is said to be original if it shows a unique response that is unusual or commonly used (Wilson et al., 1953). Even though students do not meet the indicators of originality, the answers to the results of solving the questions are fulfilled. Students can enrich, develop, and detail the details of an idea. This indicates that students can fulfill elaboration indicators (Munandar, 2014). These results are research conducted by Lusiana & Andari (2022) that left-brain dominant students do not show unique responses in the originality indicator, but can show detailed answers in the elaboration indicator.

The students' thinking process cannot be separated from the characteristics of the functions of the left and right hemispheres of the brain. Students read the questions in parts at the preparatory stage in solving part questions. This proves that students are carrying out a phenotic reading system. The function characteristics of the left brain are stated by Jensen (2008) that the left brain works with a phenotic reading system. Students also start working on questions by preparing in advance rather than looking for ideas or ideas. This indicates that students do the process first compared to memory. The left hemisphere of the brain processes first then the memory (Olivia, 2013).

Students can solve problems logically in the conclusion section. This conclusion is also based on the calculation of the volume of the aquarium and the volume of water so that a logical conclusion can be drawn. This was proven by the students answering "It will spill, because the volume of the aquarium is 120.000cm^3, while the volume of water and rocks is 122.400cm^3 ". This is in accordance with the opinion of Taggart and Torrance (Torrance & Rockenstein, 1988) that one description of left hemisphere behavior is solving problems logically.

The completion of part b also has work that indicates the characteristics of the left hemisphere brain functions. Students try to communicate with researchers to be able to re-understand the intent of the questions when students experience problems in solving part b questions. This is a feature of the left hemisphere brain functions at its completion. The characteristics of the left hemisphere brain function work actively when mastering language or communication (Ferdinand & Ariebowo, 2009). This is a completion with a verbal response. Verbal responses to learning include short talks, discussions, and sharing ideas (Wahyuni, 2017). The ability to write and speak well is a verbal ability (Andrew et al., 2005). Student answers also show that students complete this question very coherently and regularly. This is also a feature of the left hemisphere function (Olivia, 2013).

There are several conditions, students complete with the feature of the cleavage function character right brain. Students start working on part b questions by looking for ideas or ideas in advance rather than preparation. This indicates that students do the memory first compared to the process. Prior memory compared to process is a feature of the right brain (Olivia, 2013). Not only that, students make conclusions intuitively or intuitively. This can be seen from students making conclusions first and then calculating them to strengthen their arguments. Before doing the calculations, the students also believed that it would change because there was spilled water so the height would decrease compared to the initial water level. Intuitive is thinking without going through rational reasoning, the thought process occurs quickly by producing some knowledge (Hastjarjo, 1999). The right hemisphere of the brain is functional when it comes to solving problems intuitively (Weigmann, 2013).

The thought process that cannot be separated from the function characteristics of the hemispheres of the brain that have been described as concluded that the tendency of the students' brains to be dominated by the left brain always accentuates the characteristics of the function of the left hemisphere, even though there are conditions where students complete the problem with the feature of the cleavage function right brain. This is to research conducted by Sukmaangara et al. (2021) left-brain dominance students solve dominant questions using the characteristics of the function of the left hemisphere. this research too according to the research conducted by Nurazizah et al. (2022), as well as Yohanes (2013) left-brain dominant students solve problems with the characteristics of the function of the left hemisphere.

The Thinking Process of Students with Balanced Brains

Based on Students' thinking processes in Figure 6, Students Solving part a and part b questions can be passed well through all Wallas stages at the preparation stage, incubation stage, illumination stage, and verification stage. The preparation stage begins with preparing themselves by reading, writing down what they get from the questions they have understood, and asking the teacher or other students. Students are silent for a moment to look for ideas at the incubation stage. Students get an idea after a moment of silence. Students carry out their ideas to get the correct answer by 1) students write the formula; 2) students carry out arithmetic operations by substituting known data into the formula at the verification stage. Students check their answers after completing the questions. Students always ask researchers or other students when they have problems so they try to understand the problem deeper to find solutions to solve the problem. Students are categorized as unable to meet the originality indicator. Students do not meet the indicators of originality because students use the method commonly used, namely students use formulas in problem-solving. An idea is said to be original if it shows a unique response that is unusual or commonly used (Wilson et al., 1953). Even though students do not meet the indicators of originality, the answers to the results of solving the questions are fulfilled. Students can enrich, develop, and detail the details of an idea. This indicates that students can fulfill elaboration indicators (Munandar, 2014).

The students' thinking process cannot be separated from the function characteristics of the left and right brain hemispheres. Students read about the parts. This indicates that the student is carrying out a phenotic reading system. The functional characteristics of the left brain were stated by Jensen (2008) that the left brain works with a phonetic reading system. Not only that, students are always looking for solutions by asking which is a feature of the function of the left hemisphere with verbal responses (Menzal (Singh, 2015)). A verbal response is a response that is expressed verbally in a conversation (Sutiyatno, 2018).

Students solve problems logically in the conclusion section. This conclusion is also based on the calculation of the aquarium volume and the water volume so that it results logically. This is evidenced by the results of the student's answers, namely "spill over, because when the stone is inserted, the water exceeds the volume of the aquarium". Solving problems logically is a feature of the left brain function. One description of the behavior of the left hemisphere is to solve problems logically (Taggart and Torrance (Torrance & Rockenstein, 1988)).

Students also carry out solutions with the characteristics of the functions of the right hemisphere of the brain. Before concluding, students conclude using intuition first. This withdrawal is based on the belief that the water does not spill because the volume of the aquarium is larger than the water after the stone is inserted. The right hemisphere of the brain is functional when it comes to solving problems intuitively (Hastjarjo, 1999).

The thought process that cannot be separated from the function characteristics of the hemispheres of the brain that have been described has concluded that students can optimize the function of both hemispheres of the brain equally well. This is to the research conducted by Sukmaangara et al. (2020) that students with dominant balanced brains can optimize both hemispheres of the brain. this research too according to research conducted by Sukmaangara et al. (2021) balanced brain dominance students solve dominant balanced questions using both hemispheres of the brain.

Right Brain-Dominated Students' Thinking Process

Based on the thought process flow in Figure 9, The Student in Solving problem part a can pass all Wallas stages in the preparation stage, incubation stage, illumination stage, and verification stage, while solving problem number 2 part b it only passes well in the preparation stage, incubation stage, and illumination stage. The thinking process of right-brain dominant students in solving problems begins with a moment of silence to contemplate to get an idea first at the incubation stage. Students get an idea after a moment of silence at the illumination stage. Preparations are made after getting an idea. Students can understand the problem by writing down what is known and asked about the problem, and trying several ways. Students carry out their ideas to get answers by performing arithmetic operations on data that is substituted into the formula at the verification stage. Students check their answers after completing the questions. Students cannot pass well for the verification stage. This is because, at the verification stage, students cannot complete the questions. Students make mistakes in calculating the volume of water after taking stones. The mistake was when the students calculated the volume of water after taking the stones by subtracting the volume of water from the volume of the stones. Students are categorized as unable to meet the originality indicator. Students do not meet the indicators of originality because students use the method commonly used, namely students use formulas in problem-solving. An idea is said to be original if it shows a unique response that is unusual or commonly used (Wilson et al., 1953). Students also did not meet the elaboration indicator because students answered with wrong results. Students can solve questions only in part a and cannot solve questions in part b. Students can't enrich and develop an idea or product. These results are research conducted by Lusiana & Andari (2022) that right-brain dominant students are unable to show detailed answers in the elaboration indicator.

The students' thinking process cannot be separated from the characteristics of the functions of the left and right hemispheres of the brain. Students read in its entirety to understand the questions in the preparation section. This is a feature of the function of the right brain, namely the system for reading all languages (Jensen, 2008). Students read carefully while connecting with the material that has been obtained to understand the problem more deeply. Students work on the questions after understanding what to do and counting. This is the students' process of students doing memory first then the process is done. This is a feature of the function of the other right brain hemisphere, namely memory and processing (Olivia, 2013).

There is a condition in communicating. This communication occurs because of a non-verbal response in the form of eye contact. The gaze indicates that students want to communicate.

At first glance, it looks like there is a verbal response because of communication, but this communication occurs because there is a non-verbal response first in the form of a look in the eyes indicating that you want to ask a question. Nonverbal responses use body movements, touch, gestures, head nods, smiling, eye contact, paralinguistics, and interacting by allowing others to interact (Andersen, 1979). Non-verbal responses are characteristic of right brain function (Singh, 2015).

Students only have one condition that they use the characteristics of the left hemisphere brain function. The hallmark of the left hemisphere functions that occurs in solving part of questions is solving problems logically. This conclusion is also based on the calculation of the aquarium volume and the water volume so that a logical conclusion is obtained. This is evidenced by the student's answers results, namely "It will spill, when a stone is put into an aquarium that has been filled with water, the volume increases to 122.400cm^3. This volume exceeds the volume of the aquarium, and from this, the water will decrease because of the excess volume. One description of the behavior of the left hemisphere is to solve problems logically (Taggart and Torrance (Torrance & Rockenstein, 1988)).

The thought process is inseparable from the characteristics of the function of the hemispheres of the brain that have been described, concluding that the tendency of students' brains to dominate the right brain always accentuates the characteristics of the functions of the right hemisphere, even though there are conditions where students carry out solutions with characteristics of the functions of the left hemisphere. This is research conducted by Sukmaangara et al. (2021) right-brain dominance students solve dominant questions using the characteristics of the function of the right hemisphere. The research conducted by Nurazizah et al. (2022) and Yohanes (2013) that right-brain dominant students solve problems with the characteristics of the function of the right hemisphere.

CONCLUSION

Based on the results of research and discussion, the thinking process carried out by all research subjects in solving problems of originality and elaboration of mathematical creative thinking based on brain dominance performed with pass preparation stage, incubation stage, illumination stage, and verification stage. Students with left-brain dominance and balanced brain carry out the stages sequentially in sequence, while students with right-brain dominance carry out the incubation and illumination stages first. Another difference is Right-brain dominance students to try several alternatives before doing the problem-solving at the preparation stage.

All research subjects did not meet the indicators of originality because students use the method commonly used, namely students use formulas in problem-solving. Indicators of elaboration can be fulfilled by students who are dominated by the left brain and only a balanced brain, while students who are dominated by the right brain cannot fulfill these indicators. Right-brain dominant students are unable to develop an idea in solving part b. In addition, the thinking process of students in solving problems originality and elaboration of mathematical creative thinking cannot be separated from the role of the function of the right brain hemisphere and hemisphere left. The student's thinking process shows that students use the characteristics of the function of the hemispheres of the brain according to the dominance of the student's brain. The following describes the characteristics of the function of the hemispheres of the brain used:

a. Left-brain dominance students use the characteristics of the left hemisphere functions, namely: a phenotic reading system, the process first then memory, solving problems logically, and verbal responses, as well as coherent and orderly, while the characteristics of the functions of the right hemisphere are: memory first compared process and make inferences intuitively or intuitively. The tendency of the students' brains to be dominated by the left brain always accentuates the characteristics of the left hemisphere functions, even though there are conditions where students carry out solutions with the right brain characters.

b. Balance-brain dominance students predominate the use the characteristics of the left hemisphere functions, namely: a phenotic reading system, solving problems logically, and verbal responses, while the characteristics of the functions of the right hemisphere are: prior memory compared to process and making conclusions intuitively or intuitively. Students can optimize the function of both hemispheres of the brain equally well.
c. Right-brain dominance students use the characteristics of the left hemisphere functions, namely: solving problems logically, while the characteristics of the functions of the right hemisphere are: the system reads all languages, performs memory first then processes, and non-verbal responses. The tendency of the students' brains to be dominated by the right brain always accentuates the characteristics of the right hemisphere functions, even though there are conditions where students carry out solutions with the features of the cleavage function left brain.

IMPLICATION

This research can be an illustration for teachers of how students' thinking processes in solving originality and elaboration questions are based on the dominance of the students' brains. Teachers can begin to get used to giving questions of originality and elaboration of mathematical creative thinking in teaching and learning activities which are completed using the preparation stage, incubation stage, illumination stage, and verification stage. It aims to assist students in the formation and habituation of a creative mindset in solving math problems, especially on indicators of originality. In addition, the teacher should explain that the completion of math problems is adjusted to the dominance of the students' brains because the students' thinking processes in solving problems are by the characteristics of the function of the dominant hemispheres of the brain. For future researchers, it is hoped that they can develop questions to develop students' right brains so that students can solve math problems by optimizing both hemispheres of the brain.

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