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DESCRIPTION OF UNDERSTANDING MATHEMATICAL CONCEPTS ABILITY BASED ON BRAIN DOMINATION

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ABSTRACT

One of the essential cognitive aspects of learning mathematics is the ability to understand concepts. This study describes the ability to understand students' mathematical concepts based on brain dominance. The type of research used is descriptive qualitative. The research subjects were high school students. The instruments used were tests, questionnaires, and interview guidelines. Data analysis techniques consist of data reduction, presentation, and conclusion. The results showed that students left brain dominant student has excellent mathematical concepts understanding ability, provide clear and detailed information, provide examples with different shapes or arrangements, use symbols other than numbers, and they are confident that they understand the concepts. Meanwhile, right-brain dominant students have a relatively good mathematical concepts understanding ability, tend to convey information randomly using their language, provide examples with similar shapes or arrangements, and must be more sure that they understand the concept.

Keywords: Mathematical Concept Undertanding Ability, Brain Domination

INTRODUCTION

Online learning creates various obstacles and difficulties, including limited interaction between students and teachers. In learning mathematics, students experience difficulties in the learning process (Rosmawati & Sritresna, 2021). Even though a hybrid learning model has been implemented, it still has yet to significantly impact students' mathematical abilities (Sinarmata et al., 2022). The causes of students' mistakes and difficulties in solving math problems are difficulties in understanding concepts, associating concepts and facts, applying relevant formulas, using symbols, understanding the intent of the questions, and needing to be more thorough in working (Ruhyana, 2016). Even in the process of learning mathematics, students are required to have the ability to understand concepts so that they can apply concepts appropriately (Mawaddah & Maryanti, 2016).

One of the essential abilities is thinking that a student needs to have the ability to understand mathematical concepts (Ritonga et al., 2018; Rosmawati & Sritresna, 2021). Understanding concepts is the ability to understand something already known so that it can define, identify, interpret, and apply concepts according to its cognitive structure (Nuraina, 2021). Understanding concepts is an essential point in the mathematics learning process so that students can quickly solve mathematical problems and optimize other abilities, which are the goals of the mathematics learning process (Yulianty, 2019). If students can understand the concept of material, they can minimize errors when solving problems and explain the solutions obtained, so they are precise with what they have solved (Al-Mutawah et al., 2019; Darmawanti, 2020).

In understanding a concept, of course, it cannot be separated from the thought process, which must have the role of the brain in it. The human brain is an information-processing center that works based on its structure and function (Li et al., 2022). The human brain hemisphere is

classified into two essential parts, namely the left brain and the right brain, which have their respective roles (Purwanti, 2016). In solving math problems, of course, you need to understand the concept first. By optimizing brain dominance, students can understand mathematical concepts according to their respective brain dominance to work on problems and solve them properly and correctly (Sari, 2017). Based on the results of the interview process, there are still students who still need to fully understand the concepts of the mathematics material that has been presented. Based on these problems, researchers researched "Description of the Ability to Understand Mathematical Concepts of Students of SMA Negeri 1 Purwokerto based on Brain Domination".

METHOD

The method used in this research is descriptive qualitative. Qualitative research aims to describe what is related to a variable, symptom, or condition when the research was conducted (Sugiyono, 2015). The subjects in this study were 32 students of SMA Negeri 1 Purwokerto. The subjects were given a brain dominance questionnaire to obtain data on the right brain dominance (DOA) of 20 students and the left-brain dominance (DOI) of 12 students. This study used an instrument in the form of a brain dominance questionnaire and a test of the ability to understand mathematical concepts. The brain dominance questionnaire aims to determine students' brain dominance, whether right-brain or left-brain dominance. The ability test for understanding mathematical concepts is carried out after the brain dominance test and then grouped according to the learner's brain dominance.

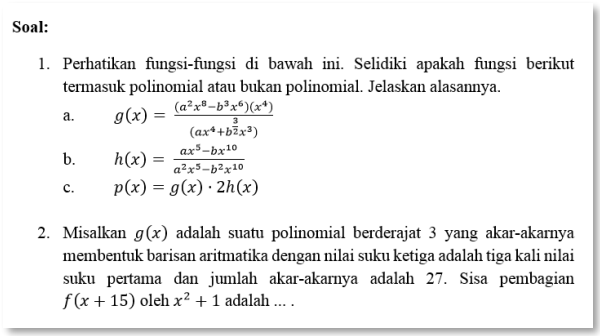
RESULTS AND DISCUSSION

Based on the brain dominance questionnaire results in Table 1, there were 20 students in the right brain dominance category and 12 students in the left-brain dominance category. Two people were taken from each category.

Table 1. The results of the brain dominance questionnaire

No	Initial	Score (X)	Categories
1	**MFM**,FKY,FKP,SDW,NN,LRA,NFU,RW,ANP,DAW,ALR,IDA,LP,**NH**,WDY,ADA,CBN,HYS,NFA,RNA	$1 \leq X \leq 15$	Right-Brain Domination
2	GGD,RWA,AZB,CKB,CHB,**KKH**,NFS,BBS,HNM,**FK**,MFA,SRA	$16 \leq X \leq 30$	Left-Brain Domination

The questions used in the ability test to understand mathematical concepts are in the form of description questions which consist of 2 questions. The following questions (Figure 1) are given:



Soal:

1. Perhatikan fungsi-fungsi di bawah ini. Selidiki apakah fungsi berikut termasuk polinomial atau bukan polinomial. Jelaskan alasannya.
   a. $g(x) = \frac{(a^2x^8 - b^3x^6)(x^4)}{(ax^4 + b^{\frac{3}{2}}x^3)}$
   b. $h(x) = \frac{ax^5 - bx^{10}}{a^2x^5 - b^2x^{10}}$
   c. $p(x) = g(x) \cdot 2h(x)$

2. Misalkan $g(x)$ adalah suatu polinomial berderajat 3 yang akar-akarnya membentuk barisan aritmatika dengan nilai suku ketiga adalah tiga kali nilai suku pertama dan jumlah akar-akarnya adalah 27. Sisa pembagian $f(x + 15)$ oleh $x^2 + 1$ adalah ... .

Figure 1. Mathematical Concept Understanding Ability Test Questions

The ability to understand students' mathematical concepts is described from the results of the test answers to the ability to understand mathematical concepts. The results of student answers are described as follows:

Right-Brain Domination Category Student Group

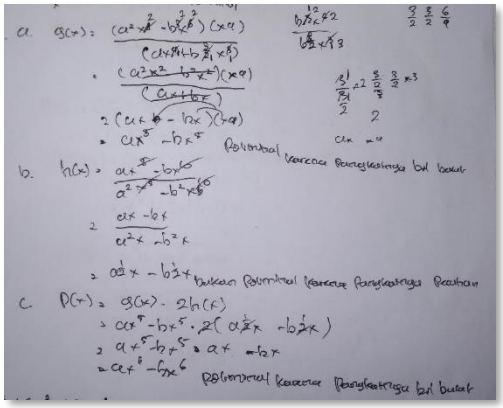


Figure 2. Answer to question number 1 DOA students

Based on Figure 2, students worked on the problem by writing down the known functions. Even though students did not rewrite what was asked in the problem, students understood what was known and asked. That is, it was known that there were somewhat complicated functions, and then explained whether these were polynomials or not.

Students can distinguish between polynomial and non-polynomial examples but need more detail in explaining why a function can be declared polynomial. Students write that *g(x)* is a polynomial because the exponent is an integer, *h(x)* is not a polynomial. After all, the exponent is a fraction, and *p(x)* is a polynomial because the exponent is an integer. Students do not write down what is meant by rank, whether variable, coefficient or constant. This is in line with the fact that right-brain-dominated students tend to be more general in solving a problem.

Students work on the problem by writing down the function and operating using polynomial multiplication. In the function *g(x)*, students directly divide the variable *x* so that it is obtained $\frac{(a^2x^8 - b^3x^6)(x^4)}{(ax^4 + b^{\frac{3}{2}}x^3)} = \frac{(a^2x^2 - b^2x^2)(x^4)}{(ax + bx)}$, then simplify again to get $g(x) = (ax + bx)(x^4) = ax^5 - bx^5$. This indicates that DOA-1 students view a problem in general.

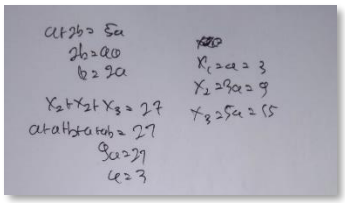


Figure 3. The answer to question number 2 is that DOA students

Based on Figure 3, students needed to rewrite what was known and what was asked in the questions. During the interview, students understood what was known in the problem, namely g(x) of degree 3, which means that it has three roots, the roots form an arithmetic sequence where the value of the third term is equal to five times the first term, and the sum of the roots is 27 and what is asked in the problem is the remainder of the division of $g(x + 15)$ by $x^2 + 1$.

Students write down *a+2b=5a* as the third term, whose value is five times the first term, so they get *b=2a*. Students write down $x_1 + x_2 + x_3 = 27$ so that the value is obtained$a = 3$ then by substitution is obtained $x_1 = 3,\ x_2 = 9,\ \text{and}\ x_3 = 15$.

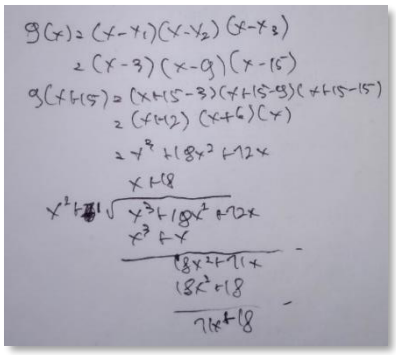


Figure 4. The answer to question number 2 is that DOA students

Based on Figure 4, students write down the function *g(x)* and then get *g(x+15)*. Then students divide $g(x + 15)$ by $x^2 + 1$ By the porogapit method, the remainder of the division is *71x+18*. Students operate the division of polynomials correctly. It is just that they are not careful in addition $(18x^2 + 71x) - (18x^2 + 18)$. Should be obtained *71x-18*, students write down the remainder of the division *71x+18*. Students need to write down their conclusion that the remainder is *71x+18*. In line with the results of Sukmaangara's research (2021), right-brain dominant students solve problems using the characteristics and functions of the right hemisphere, namely synthetic and random thinking. Students with right-brain dominance define polynomials in their language quite well. They tend to give examples and non-examples of polynomials with the same or similar form and arrangement of terms. Right-brain dominant students need to write what is known and what is asked in the problem in advance and tend to write it in general. Spontaneously, in expressing reasons for a function that can be expressed as a polynomial or not a polynomial, the function *g(x)* is a polynomial because it has a positive power. Not written down what is meant by a positive rank is a variable, coefficient, or constant. During the interview, students stated that they needed clarification about understanding and solving question number 4 because it was a HOTS question. However, students can do it correctly. There is only a slight inaccuracy in operating it. Nursupiamin (2020) explained that right-brain dominant students tend to have difficulty understanding the meaning of the questions. Hence, they need to be more fluent in explaining the intent and purpose of the questions.

Left-Brain Domination Category Student Group

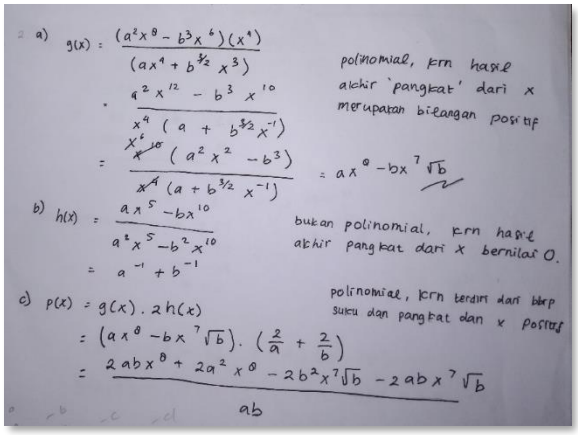


Figure 5. Answers to question number 1 of DOI students

Based on Figure 5 above, students can state why functions can be expressed as polynomials. By the indicators of left-brain dominance, DOI-1 students use logic more by stating that g(x) is a polynomial because the final product of the exponent of x is a positive number, and h(x) is not a polynomial. After all, the final product of the exponent of x is 0, and p(x) is a polynomial because it consists of several terms and powers of positive x. Students detail in working on problems by writing down known functions. Even though students did not rewrite what was asked in the problem, students understood what was known and asked. That is, it was known that there were several functions and then investigated whether these functions were polynomials or not polynomials. Students work on the problem in detail by writing down its function first, then when interviewing students explain that students simplify functions in the simplest form possible. Students multiply $(a^2x^8 - b^3x^6)$ with (x^4) in the quantifier with the result $a^2x^{12} - b^3x^{10}$. This shows that students can apply polynomial multiplication well. Students then group the *x* variable so that it is obtained $g(x) = \frac{x^6(a^2x^2-b^3)}{(a+b^{\frac{3}{2}}x^{-1})}$ and get the final result $g(x) = ax^8 - bx^7\sqrt{b}$. There is a student error in operating that is dividing $x^6(a^2x^2)$ with a and divided x^6b^3 with $b^{\frac{3}{2}}x^{-1}$. Similarly, when simplifying the functions *h(x)* and *p(x),* students directly divide the quantifier by the denominator. However, students calculate carefully by dividing each term between the numerator and denominator. Students find the value of the function *p(x)* by using the simplified *g(x)* and *h(x)* functions.

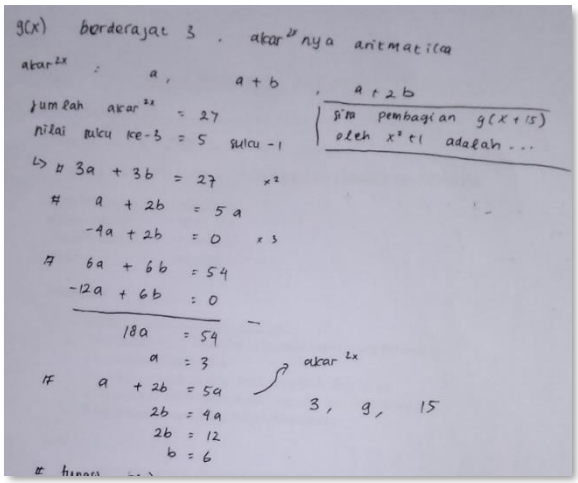


Figure 6. Answer to question number 2 DOI students

Based on the answers of DOI-1 students in Figure 6, students write down things that are known in the problem in detail, namely the function g(x). degree 3, the roots form an arithmetic sequence, the sum of the roots, and the known value of the term of the roots, namely the third term is equal to 5 times the first term, and write down what is asked in the problem, namely the remainder of the division $g(x+15)$ by x^2+1. This statement indicates that left-brain dominant students pay attention to specific things in detail and sequentially.

By the left-brain dominance character, students answered questions coherently and in detail, the first to write down *3a+3b=27* which was obtained by adding up the roots, namely *a+a+2b+a+2b=27*. Then look for the values of a and b so that the values of the roots are known using the elimination and substitution methods. However, finding the value of the third term or the third root value is not written.

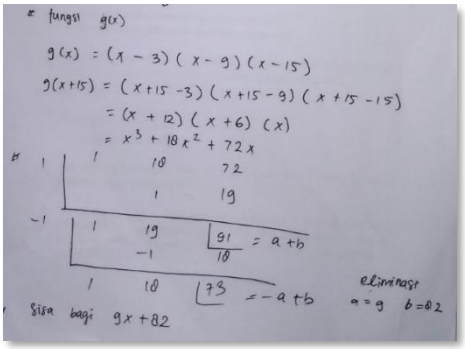


Figure 7. Answer to question number 2 DOI students

Figure 7 explains that students look for the function *g(x)* and then look for the value of the function *g(x+15)* in a coherent and precise manner. During the interview, the students explained that they found the remainder of the division by dividing $g(x+15)$ by x^2+1 using the Horner method. Then do the elimination to find the results $a = 9$ and $b = 82$. The a and b values are substituted into the equation *ax+b* to get *9x+82* as the remainder of the quotient $g(x+15)$ by x^2+1. The student's steps in solving the problem are correct, up to find the value of *g(x+15)*. Students are not correct in applying polynomial division. Division should be done by way of substitution $x^2 = -1$ into polynomial $g(x+15) = x^3 + 18x^2 + 72x$ so that the remainder is obtained $71x - 18$.

In line with the results of Sari (2017), which states that left-brain dominated students have more systematic, coherent, and thorough mindsets, as well as research by Sukmangaara and Pabrawati (2021), which states that left-brain dominant students solve problems using the characteristics and functions of the left brain, namely sequentially and regularly. Students with left-brain dominance define polynomials briefly and clearly, give examples and non-examples of polynomials in different forms and arrangements, and use other symbols, namely the letters *a, b,* or *c,* to represent coefficients or constants. Students with left-brain dominance first write down what is known and what is asked in the problem and tend to be able to explain the reasons for a function, including a polynomial, in detail. For example, the function $g(x)$ is a polynomial because it has a positive rank x variable. In addition, left-brain dominance students operate functions coherently.

When conducting interviews, students with left-brain dominance said that they understood the concept of polynomials and answered interview questions in a coherent manner by stating what was known and what was asked in the problem, then fluently explaining the results of their completion. This is in line with Nursupiamin (2020) that left-brain dominant students can understand concepts and questions and are fluent in explaining the intent and purpose of the questions.

CONCLUSION

The research results above provide an overview of student's ability to understand mathematical concepts. Left-brain-dominated students fulfilled the three indicators of understanding the concept, namely restating the concept and understanding the concept of a polynomial by reviewing the polynomial concept clearly and in detail. Students can identify examples and non-examples of concepts by writing examples and non-examples of polynomials of different shapes or arrangements and applying the concepts in solving problems. Left-brain-dominated students tend to think systematically and coherently, provide brief, clear, and detailed information, give examples in different shapes or arrangements, use symbols other than numbers, and believe that they understand concepts. Right-brain dominant students fulfill the three indicators of understanding concepts, namely restating concepts, namely being able to restate concepts from polynomials in a flowing and spontaneous manner based on their experiences. Students identify examples and non-examples of concepts by writing examples and non-examples of polynomials with similar shapes or arrangements and apply the concepts in solving problems. Right-brain-dominated students think synthetically, convey information randomly using their language, give examples in a similar form or arrangement, and need clarification on concepts.

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