Analysis of Student Ability Solving Hots Problems

Material Exponent Equation Reviewed From's Beginning Ability

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Abstrak

Penelitian ini bertujuan untuk mendeskripsikan kemampuan siswa SMA dalam menuntaskan soal jenis HOTS yang ditinjau dari segi kemampuan awal. Metode penelitian yang digunakan pada riset ini adalah kualitatif deskriptif. Subjek penelitian ini adalah tiga siswa kelas X yang terdiri dari 1 siswa berkemampuan tinggi, 1 siswa berkemampuan sedang serta 1 siswa berkemampuan rendah. Pengumpulan data atau informasi dalam penelitian ini menggunakan tes tertulis dan wawancara. Tes tertulis dilakukan dua kali, yaitu tes kemampuan awal dan tes pemecahan masalah. Instrumen yang digunakan adalah tes dan pedoman wawancara yang sudah divalidasi. Hasil dari penelitian ini ialah siswa yang memiliki kemampuan tinggi ternyata memiliki kemiripan dengan siswa yang memiliki kemampuan sedang, yaitu hanya sanggup menyelesaiakan soal nomor 1 dengan tingkat menganalisis (C4) meski memakai metode penyelesaian yang berbeda. Sedangkan siswa yang memiliki kemampuan rendah tidak mampu menanggapi ketiga soal dengan tepat. Secara umum kemampuan siswa SMA Negeri 1 Baureno dalam menyelesaikan soal kategori HOTS masih dibawah rata-rata. Hal ini dikarenakan mereka tidak terbiasa mengerjakan soal-soal kategori HOTS di sekolah. Selama ini, guru hanya memberikan soal-soal biasa yang terdapat pada buku paket ataupun LKS.

Kata Kunci: Kemampuan Siswa, HOTS, Persamaan Eksponen, Kemampuan Awal Siswa.

Abstract

This study aims to describe the ability of high school students in solving HOTS-type questions in terms of initial abilities. The research method used in this research is descriptive qualitative. The subjects of this study were three students of class X consisting of 1 high-ability student, 1 medium-ability student, and 1 low-ability student. Collecting data or information in this study using written tests and interviews. The written test was conducted twice, namely the initial ability test and the problem-solving test. The instrument used was a validated test and interview guide. The result of this study is that students who have high abilities turn out to have similarities with students who have moderate abilities, which are only able to solve problem number 1 with an analytical level (C4) even though they use different methods of solving. While students who have low abilities are not able to respond to the three questions correctly. In general, the ability of SMA Negeri 1 Baureno students in solving HOTS category questions is still below average. This is because they are not used to working on HOTS category questions at school. So far, teachers only give ordinary questions found in textbooks or worksheets.

Keywords: Student's Ability, HOTS, Exponential Equation, Student's Initial

INTRODUCTION

Education is a process of forming mindsets, changing attitudes and human behavior to become individuals who are more prepared and trained in solving a problem that has to do with life. With human education, it is expected to gain a broad knowledge and be able to compete in the current era of globalization. Education has a contribution in preparing quality human resources in the development of science and technology. Education that is managed and developed properly will certainly produce a good quality as well, will produce humans as subjects and objects of quality education. Based on Law no. 2 of 1985, the purpose of education is to educate the nation's life and develop a complete human being, namely fearing God Almighty, having knowledge, being physically and mentally healthy, having noble character, being independent, having a strong personality, and being responsible for the nation.

Mathematics is a compulsory subject at every level of education in Indonesia. The position of learning in schools contained in the curriculum focuses on improving human resources (HR) which include cognitive, affective, and psychomotor. One of the knowledge and skill resources is higher thinking skills order, so it must be improved and developed (Magdalena, 2016; Tanujaya, 2016). Therefore, one sign of the success of increasing human resources in the field of education is that students have good higher-order thinking skills because the main goal of education in the 21st century is to develop and improve students' HOTS (Arifin & Retnawati, 2015).

In teaching and learning activities, there are differences between students who are more inclined to rote memorization and students who practice higher-order thinking skills. By implementing HOTS category learning, students do not only memorize information but also practice high-level skills. Therefore, it is very important to train students' higher-order thinking skills so that they are not only memorized but also able to implement them in new problems. HOTS learning began to be implemented in the classroom with the hope that with HOTS students' thinking skills and creativity could be further improved. As of 2017, HOTS questions have begun to be presented during the National exam and are increasing at the 2018 UNBK and subsequent years. The purpose of continuing to apply HOTS questions is to improve students' thinking skills. This behavior received a good response among students and also not a few who responded badly, many students complained because the Mathematics questions in the 2018 National Examination were considered very difficult.

In this study, the researcher tried to analyze the ability of students in solving HOTS type problems (high order thinking skills) with the material of exponential equations. An exponential equation is an equation whose exponent contains a variable and the possible base number contains a variable. With base numbers, and, powers or exponents. The exponential equation will be indicated by two functions of the power of the number connected by an equal sign. Example: The researcher conducted an analysis based on the students' initial abilities.

The initial ability of students is one of the internal aspects that affect student learning outcomes. The initial ability of students is the ability that students have before participating in learning activities. The teacher needs to know the initial abilities of students before learning. With this, teachers will be able to design learning designs that are following students' abilities. Hamzah Uno summarized the initial abilities which were grouped into three parts, namely abilities related to the knowledge to be taught, which included high knowledge, moderate knowledge, low knowledge, and experiential knowledge. The knowledge that is outside the knowledge that will be discussed, in it contains unorganized meaningful knowledge and analogical knowledge. Knowledge of generic skills (generic skills) in it contains cognitive strategies.

There have been many previous studies that have discussed students' abilities in solving HOTS questions, such as (Nafi'an & Pradani, 2019) which analyzed students' problem-solving abilities in solving HOTS type math problems; (Wahyuddin et al., 2021) which analyzed the ability to solve HOTS questions in terms of logical thinking skills; (Esa Ria Permata Hati et al., 2018) which analyzes students' abilities in solving the Physics UN questions for high school materials based on Polya stages. However, research analyzing students' abilities in solving HOTS-based questions in terms of student's initial abilities has never been carried out by the studies mentioned above.

Based on the description above, the researcher intends to investigate further the students' ability to solve HOTS type questions with the exponential equation material in terms of the initial abilities of students in grade 1 SMA Negeri 1 Baureno. In general, the purpose of this study is to analyze and describe the ability of high school students in solving HOTS-type questions (higher-order thinking skills) on the subject of exponential equations.

RESEARCH METHODS

In this study, the researcher used a qualitative descriptive method. The main purpose of this research is to describe the students' ability in solving HOTS-type questions on the subject of exponential equations. Sudaryono (2017) explains that qualitative research is research conducted to analyze social life by describing the social world from the point of view of the interpretation of individuals (informants) in a natural setting. Qualitative research seeks to understand how an individual sees, interprets, or describes his social world by interacting directly. In addition to this, Sugiyono (2018) explains that descriptive research is a study conducted to identify the value of independent variables, either one or more (independent) variables without making comparisons or connecting with other variables. This means that this research only wants to know how the condition of the variable itself is without any influence or relationship to other variables such as experimental research or correlation.

The material applied in this research is the exponential equation. The subjects of this study were 3 students of SMA Negeri 1 Baureno who were selected based on their initial abilities. Where there is 1 high-ability student, 1 medium-ability student, and 1 low-ability student. The students are grouped based on the results of the initial ability test. The procedures for this research are (1) Preparing a proposal; (2) Developing instruments; (3) Validating instruments to lecturers; (4) Carrying out instrument trials on research subjects; (5) Digesting the data and drawing conclusions. The instruments used in this research are problem-solving ability tests and interview guidelines. Data collection techniques in the form of tests and interviews. The data analysis technique in this research is data reduction, information presentation, and conclusions.

RESEARCH RESULTS AND DISCUSSION

This research was carried out in Pasinan Village on December 19, 2021, by providing an initial ability test to group students based on students' abilities. Next, students are given a HOTS test for the material on the exponential equation which is used to measure students' ability to solve the HOTS questions for the material on the exponential equation. After students have finished working on the questions, students are alternately interviewed with previously prepared questions.

Data on the ability to solve HOTS questions was measured by 3 indicators of cognitive ability, namely levels C4 (analyzing), C5 (evaluating), and C6 (creating) which were made in 3 questions describing the exponential equation.

1. **Results of Students' Answers with High, Medium, and Low Initial Ability**

    a. **Description of S-1 Data**

        1) Question number 1

Figure 1. Results of Answers to Question Number 1 Subject S-1

Figure 1 shows the results of the S-1 subject's written test work on question number 1. The S-1 subject writes down the information that has been known from the question, namely $9^{p+1} = 82 - 9^{p-1}$. Furthermore, the subject of S-1 used the "switching segment" method. To determine the value of p, the subject S-1 factored the form $9^{p+1} + 9^{p-1}$ into $(9^2 + 1) \times 9^{p-1}$. After obtaining $p = 1$ the subject of S-1 substitute $p = 1$ it into the equation in question, namely $5^{1+1} = 5^2 = 25$.

From the snippet of the results of the S-1 subject's answer, it appears that the S-1 subject can understand the question very well, but when interviewed, the S-1 subject is not too sure of the answer. The following is an excerpt from an interview with the subject of S-1:

P   : Have you understood question number one well?

S-1   : I understand.

P   : Please explain the steps to solve it!

S-1   : From the question, it is already known $9^{p+1} = 82 - 9^{p-1}$. For Then I moved the left side from negative to positive. After that, I factored

$(9^2 + 1) \times 9^{p-1} = 82$ into and calculated the numbers in brackets so that the result becomes $82 \cdot 9^{p-1} = 82$. Then the numbers are 82 on the right and left sides, I will strike them out or divide them, but I   won't write them down here. So obtained $9^{p-1} = 1$. Then I equate the left side of the number to 9, meaning I have to change 1 to be 9^0 equal to 1. After the right and left sides are equal to 9, I crossed out the number 9 and I only wrote the rank, which is $p - 1 = 0$. I moved the side whose number -1 to the right side became 1. The value p is already known to be equal to 1, just plug $p = 1$ into the equation in question, the result is 25.

P   : Are you sure about your answer?

S-1   : Not too sure yet.

Based on the results of written answers and interviews with S-1 subjects on question number 1, S-1 subjects have tried to understand the information in question number 1 and look for p values by factoring equations.
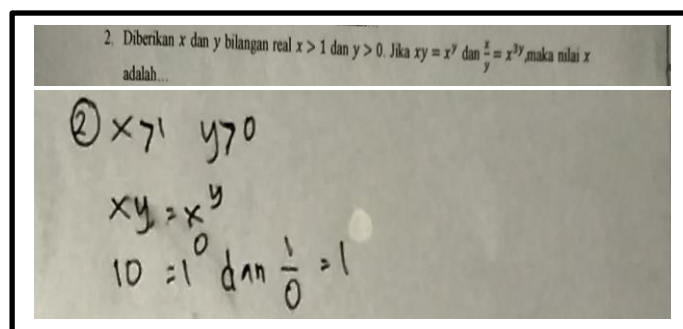
2) Question number 2

Figure 2. Results of Answers to Question Number 2 Subject S-1

Figure 2 shows the results of the written text of the subject S-1 in question number 2. The subject of S-1 writes down the information that has been known in question number 2, namely $x > 1$ and $xy = x^y$, For more details, let's look at the following excerpts from the interview with the subject of S-1:

P   : Have you understood question number two well?

S-1   : Don't understand. Honestly, I'm quite struggling.

P   : Please explain the steps in the solution you wrote!

S-1   : I write down what I already know in the problem, namely x > 1 and

y > 0, xy = x^y, Then I enter x = 1 and y = 0 so that the result is $10 =$

1^0 and $\frac{1}{0} = 1$.

Q   : How about the value?

S-1   : I have trouble finding the value.

Based on the results of the answers to the written test and interview with the subject of S-1 on question number 2, the subject of S-1 did not understand the information contained in the question so that the subject of S-1 simply solved the problem and did not complete it.
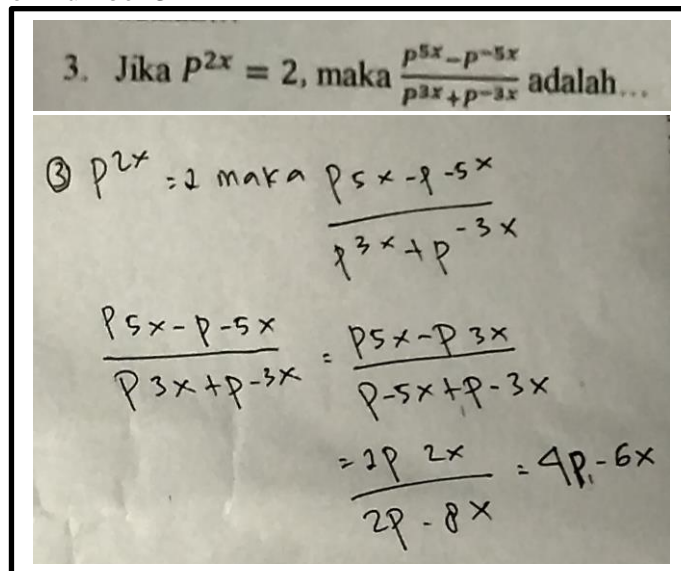
3) Question number 3

Figure 3. Results of Answers to Question Number 3 Subject S-1

Figure 3 shows the results of the written text of the subject S-1 in question number 3. The subject of S-1 writes down the information that has been known in question number 3 first. For an explanation of the completion steps, we consider the following excerpts from the interview with the subject of S-1:

P   : Have you understood question number three well?

S-1   : I don't understand.

P   : Please explain the steps in the solution you wrote!

S-1   : I wrote down what was known and what was asked in the question,

that is P^{2x} = 2, the result of the question was asked $\frac{P^{5x} - P^{-5x}}{P^{3x} + P^{-3x}}$. Then I

added it crosswise to become $\frac{P^{5x}-P^{3x}}{P^{-5x}+P^{-3x}}$. After that I add up to get

$\frac{2P^{2x}}{2P^{-8x}} = 4P^{-6x}$.

P   : Are you sure about your answer?

S-1 : I don't understand question number 3, so I answered it hesitantly.

Based on the results of the answers to the written test and interview with the subject of S-1 on question number 3, the subject of S-1 did not understand the information contained in the question so that the subject of S-1 could not complete it properly.

b. Description of S-2 Data

1) Question number 1

Figure 4. Results of Answers to Question Number 1 Subject S-2

Figure 4 shows the results of the S-2 subject's written test work on question number 1. The S-2 subject writes down the information that has been known from the question, namely $9^{p+1} = 82 - 9^{p-1}$. Similar to the subject of S-1 who uses the "moving segment" method, the subject of S-2 also uses this method so as to produce $9^{p+1} + 9^{p-1} = 82$. The subject of S-2 transforms $9^{p+1} + 9^{p-1}$ into $9 \cdot 9^p + \frac{1}{9} \cdot 9^p$ and adds the like. The result of the addition is obtained $\frac{1}{9} \cdot 9^p = 1$ and the number 1 on the right side is divided by the number $\frac{1}{9}$ on the left side to get $9^p = 9^1$. Because the bases are the same, then the subject of S-2 writes the exponent, namely $p = 1$. After

obtaining $p = 1$ the subject of S-2, substitute it into the equation in question, namely $5^{1+1} = 5^2 = 25$.

From the snippet of the S-2 subject's answer, it can be seen that the S-2 subject can understand the question well, but when interviewed, the S-2 subject is not too sure of the answer. The following is an excerpt of an interview with the subject of S-2:

Q   : Have you understood question number one well?

S-2   : Fairly understand but not sure about the answer.

Q   : Please explain the steps to solve it!

S-2   : From the question it is already known $9^{p+1} = 82 - 9^{p-1}$. For I moved the segment to the left to be positive. For I changed 9^{p+1} to $9 \cdot 9^p$ because if the bases are the same then the exponents are added up. Then 9^{p-1} I changed to $\frac{1}{9} \cdot 9^p$ and got $9 \cdot 9^p + \frac{1}{9} \cdot 9^p = 82$. I add up $9 + \frac{1}{9}$, and because both sides exist 9^p, I just make one so that it becomes $9 + \frac{1}{9} \cdot 9^p$. The result is obtained $p = 1$, and I put it in the question in question the result becomes 25.

Q   : Are you sure about your answer?

S-2   : Not sure.

Based on the results of written answers and interviews with the S-2 subject on question number 1, the S-2 subject has tried to understand the information in question number 1, and solved it very well.
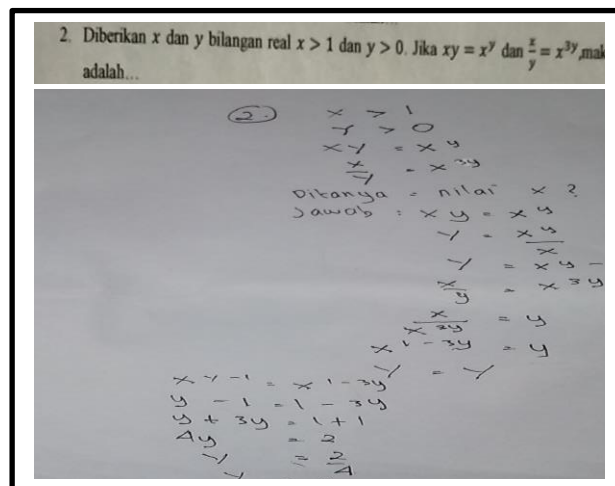
2) Question number 3

Figure 5. Results of Answers to Question Number 2 Subject S-2

Figure 5 shows the results of the S-2 subject's written test work on question number 2. The S-2 subject writes down the information that has been known in question number 2, namely $x > 1$ and $y > 0$, $xy = x^y$, $\frac{x}{y} = x^y$.

For more details, let's look at the following excerpts from the interview with the subject of Master's Degree:

Q : Have you understood question number two well?

S-2 : For number 2 I quite understand but for the solution final I can't finish it.

P : Please explain the steps in the solution you wrote!

S-2 : I wrote down what I already knew and asked the question first. Then I look for the y value of the equation $xy = x^y$ becomes $y = \frac{x^y}{x} \to yx^y - 1$. Then the next thing I don't really understand.

Based on the results of the answers to the written test and interview with the S-2 subject on question number 2, the S-2 subject did not understand the information contained in the question so that the S-2 subject solved the problem simply.

3) Question number 3

The subject of S-2 cannot answer question number 3 because the subject cannot understand the question.

b. Description of S-3 Data

1) Question number 1

Figure 6. Results of Answers to Question Number 1 Subject S-3

Figure 6 shows the results of the S-3 subject's written test work on question number 1. The S-3 subject writes down the information that has been known from the question, namely $9^{p+1} = 82 - 9^{p-1}$. Furthermore, the subject of S-3 uses the method of "moving the segment and adding up the exponents to obtain $9^{2p} = 82$. Next, the subject of S-3 determines the value $p = 41$ but the subject does not answer what is asked in the question.

From the snippet of the S-3 subject's answer, it appears that the S-3 subject cannot understand the question well. The following is an excerpt of an interview with the subject of S-3:

Q   : Have you understood question number one well?

S-3   : I don't understand.

Q   : Please explain the steps to solve it!

S-3   : I wrote what was known in the problem, namely $9^{p+1} = 82 - 9^{p-1}$. Then -9^{p-1} I moved the segment to the left to be positive. I add up the exponents $9^{(p+1)+(p-1)} = 82$ to get $9^{2p} = 82$. Next, I just take the exponents to be $2p = 82$, and $p = 41$.

Based on the results of written answers and interviews with S-3 subjects on question number 1, S-3 subjects have tried to understand the information in question number 1 but have not been maximal in solving the questions given.

2) Question number 2

The subject of S-3 cannot answer question number 2 because the subject cannot understand the question.

3) Question number 3

The subject of S-3 cannot answer question number 3 because the subject cannot understand the question.

Table 1. Three Students' Test Results

Number	Name	Question Number			Value
		1	2	3	
1	S-1	33,3	0	0	33,3
2	S-2	33,3	0	0	33
3	S-3	10	0	0	10

From table 1 it can be seen that there are no students who are able to correctly answer questions number 2 and 3. Students with high, medium and

low abilities cannot understand the information in questions number 2 and 3 properly. When the interview was conducted, they revealed the reason they did not answer questions number 2 and 3 because the two questions were considered very difficult and they were not used to working on HOTS category questions.

From table 1 it can also be seen that the three students are quite able to answer question number 1. Judging from the value obtained by each student. According to Bloom's taxonomy, the questions measure students' abilities in the analysis section or the level of the question is C4. Meanwhile, the lowest results of students answering correctly were on questions number 2 and 3. These questions refer to Bloom's taxonomy which measures students' abilities in the evaluating (C5) and creating (C6) sections.

2. **Recapitulation of Students' Ability in Solving HOTS Questions**

The table below is the result of students' ability to solve HOTS questions on the subject of exponential equations.

Table 2. Students' Ability to Solve HOTS Questions

Number	Name	Category of Mathematics Ability	Number of questions answered correctly	Question level (HOTS)
1	S-1	High	1	C4
2	S-2	Medium	1	C4
3	S-3	Low	-	-

3. **Description of Students' Ability in Solving HOTS Questions Based on Students' Ability Level**

a. High Ability Students (S-1)

Based on the results of the analysis, highly capable S-1 subjects were only able to answer the 3 questions given, but only question number 1 was successfully answered correctly at the C4 level (analyzing). When interviewed, for question number 1 the subject of S-1 was able to explain correctly even though the method of solving it was different from the rubric of completion that the researcher had previously made. Meanwhile, questions number 2 and 3 cannot be answered correctly. S-1 subjects are quite able to understand and analyze the information contained in the questions but have not yet reached the stage of evaluating or creating answers.

b. Medium Ability Students (S-2)

Based on the results of the analysis, moderately capable S-2 subjects were only able to answer 2 of the 3 questions given, but only question number 1 was answered correctly at the level of C4 (analyzing). Question number 2 cannot be answered correctly and question number 3 cannot be answered. When interviewed, the S-2 subject admitted that he had difficulty understanding the information contained in questions number 2 and 3.

c. Low Ability Students (S-3)

Based on the results of the analysis, S-3 subjects with low abilities were only able to answer 1 question out of 3 questions given. The subject of S-3 answered question number 1 with a question-level of C4 (analyzing) and it was not answered correctly. At first, the subject wrote down the steps of completion correctly, but the next steps had many misconceptions in calculating them. As for numbers 2 and 3 were not answered. After being confirmed through the interview, the subject admitted that he was very difficult with the three questions given because he was not used to being faced with HOTS category questions.

CONCLUSION

Students who have high abilities turn out to have students who have moderate abilities, which are only able to solve problem number 1 with analyzing level (C4) even though using a different method. While students who have low abilities are not able to answer the three questions correctly. In general, the ability of SMA Negeri 1 Baureno students in solving HOTS category questions is still below average. This is because they are not used to working on HOTS category questions at school. So far, teachers only provide routine questions found in textbooks or worksheets.

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BIBLIOGRAPHY

Faizin, M. (2019). Analisis Learning Obstacle Siswa dalam Mememcahkan Masalah Matematika Ditinjau Dari Kemampuan Awal Siswa. Skripsi, tidak dipublikasikan. Universitas Negeri Surabaya.

Febriyanti, A., Pranata, O.H., & Hamdu, G. (2020). Analisis Kemampuan Siswa dalam Menyelesaikan Soal Matematika pada Materi Bangun Datar dengan Taksonomi SOLO (Structure Of Observed Learning Outcome) di Sekolah Dasar. Jurnal Ilmiah Pendidikan Guru Sekolah Dasar, 7(2), 116-126.

Herawati. R.F., Mulyani, S., & Redjeki, T. (2013). Pembelajaran Kimia Berbasis Multiple Representasi Ditinjau dari Kemampuan Awal terhadap Prestasi Belajar Laju Reaksi. Jurnal Pendidikan Kimia, 2(2), 38-43.

Laman, E.G. (2019). Analisis Kesalahan Siswa dalam Memecahkan Masalah Matematika Higher Order Thinking Skills (HOTS) Berdasarkan Kriteria Hadar Ditinjau dari Kemampuan Awal Siswa Kelas XII SMAN 5 Makassar. Skripsi, tidak dipublikasikan, Universitas Negeri Makassar.

Nafi'an, M.I. & Shimawaty, L.P. (2019). Analisis Kemampuan Pemecahan Masalah Siswa dalam Menyelesaikan Soal Matematika Tipe Higher Order Thinking Skill (HOTS). Jurnal Matematika Kreatif-Inovatif, 10 (2), 2019, 112-118.

Nuragni, W.T. (2018). Analisis Kemampuan Siswa dalam Menyelesaikan Soal Matematika Tipe Higher Order Thinking pada Pokok Bahasan Pola Bilangan di Kalangan Siswa Kelas VIII E SMP Negeri 5 Yogyakarta Tahun Ajaran 2018/2019. Skripsi, tidak dipublikasikan, Universitas Sanata Dharma Yogyakarta.

Ramli, R.W. (2020). Analisis Kemampuan Siswa dalam Menyelesaikan Soal Matematika Tipe Higher Order Thinking Skill (HOTS) Pada Pokok Bahasan Pola Bilangan pada Kelas VIII A SMP Negeri 1 Sungguminasa. Skripsi, tidak dipublikasikan. Universitas Muhammadiyah Makassar.

Sofyan, F.A., Krisna, P., & Astuti, M. (2020). Analisis Kesulitan Belajar Matematika HOTS pada Siswa Kelas IV. Jurnal Pendidikan Dasar Islam, 7(1), 90-97.

Yarmayani, A. (2016). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Kelas XI Mipa SMA Negeri 1 Kota Jambi. Jurnal Ilmiah DIKDAYA, 6(2), 12-19.