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ANALYSIS OF STUDENTS DIFFICULTIES IN SOLVING MATHEMATICAL PROBLEMS BASED ON HIGHER ORDER THINKING SKILLS FOR JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

Higher-order thinking skills (HOTS) are essential in fostering students' critical and creative problem-solving abilities, particularly in mathematics. This study aims to determine the level of difficulty students face in solving HOTS-based mathematics problems. This qualitative descriptive study was conducted at SMPN 1 Latambaga with 23 eighth-grade students (class VIII A) as participants. The instruments, comprising tests and interviews, were constructed based on three indicators of HOTS: analyzing, evaluating, and creating. From the participants, six students were selected to represent three ability levels: high, moderate, and low. Students in the high category met all HOTS indicators. Moderate-level students achieved analyzing and evaluating but struggled with the creating aspect. Low-level students were only able to analyze and faced difficulties in evaluating and creating solutions. Their challenges included misapplication of principles, procedural errors, and verbal misunderstandings of question instructions. The findings highlight the need for targeted strategies to enhance students' critical and creative thinking in solving contextual and open-ended mathematics problems.

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1. INTRODUCTION

Education plays a central role in equipping individuals with the cognitive skills needed to face the challenges of the 21st century, particularly in developing critical and creative thinking. This results in resources that can be utilized by the community, nation, and state. Through the educational process, it is hoped that a smart and productive society will be created, one that is able to apply its knowledge for the benefit of individuals and others (Tahir & Marniati, 2019).

One crucial aspect of education is the learning process itself, as it significantly affects students' understanding and ability to apply knowledge, particularly in mathematics. One important aspect of education is how the learning process takes place, because the quality of learning greatly determines the level of understanding and ability of students to apply the knowledge they have acquired. Winkel in (Djamaluddin & Wardana, 2019) states that learning is an active process involving interaction between students and their environment. In this process, students are not only required to memorize information, but also to understand, analyze, and apply knowledge in real life. Such an approach fosters critical and creative thinking, which are essential for solving complex mathematical problems. Therefore, it is necessary to implement learning strategies that stimulate students to think more deeply, especially in subjects that require problem-solving skills, such as mathematics.

Despite these goals, mathematics instruction often fails to adequately develop students' higher-order thinking skills. A good learning process does not only focus on theoretical understanding of concepts but also encourages students to develop critical, analytical, and creative thinking skills (Djamaluddin & Wardana, 2019). Therefore, mathematics learning must encompass more than just teaching basic concepts. This learning should be focused on developing more complex higher-order thinking skills, which can help students tackle more intricate problems. Integrating Higher Order Thinking Skills (HOTS) into mathematics learning is one strategy to bridge this gap. HOTS integration plays a vital role in enhancing students' mathematical reasoning and problem-solving abilities.

Lubis et al. (2023) states that the success of mathematics learning can be measured by students' ability to solve problems using higher-order thinking skills or Higher Order Thinking Skills (HOTS). However, many junior high school students still struggle with HOTS-based problems, highlighting a gap in both instruction and research. In a preliminary observation at SMPN 1 Latambaga, a school in Southeast Sulawesi, it was found that students had difficulty solving HOTS-based problems despite prior exposure to such tasks. This lack of in-depth analysis underscores the need for a study that identifies the specific difficulties students face in solving HOTS problems, so that the specific challenges faced by students in solving these problems can be identified. As a result, appropriate teaching methods to help students overcome their difficulties in solving HOTS problems can be determined.

Previous research (Milenia et al., 2022; Sitanggang & Syahputra, 2023; Aryani & Maulida, 2019; Faizzah & Sutarni, 2023) has identified several obstacles in students' HOTS performance, including limited practice, basic concept mastery, and ineffective learning resources. Milenia et al. (2022), which showed that students have difficulty understanding HOTS-based questions on number patterns, caused by a lack of practice questions and limited mastery of basic concepts. Research by Sitanggang & Syahputra (2023) also revealed that students lack higher-order thinking skills due to the minimal integration of HOTS questions in the learning process. Research by Aryani & Maulida

(2019) found that students' errors lie in conceptual, procedural, and computational aspects. Research by Faizzah & Sutarni (2023) also noted that students' difficulties arise from a lack of HOTS question practice, students' anxiety in solving problems, ineffective textbook sources, and teachers frequently assigning routine problems rather than non-routine ones.

Thus, this study aims to examine students' levels of difficulty in solving HOTS-based mathematics problems at SMPN 1 Latambaga, categorized by ability level (high, moderate, low), in order to inform more targeted teaching strategies. This study was conducted with the aim of determining the level of difficulty students face in solving HOTS-based mathematics problems at the junior high school level. This study is expected to contribute to the development of more targeted teaching methods and assist teachers in designing instructional approaches that can stimulate students' higher-order thinking skills. Thus, the results of this study are expected to not only address academic issues but also have practical implications for improving the quality of mathematics education at the junior high school level.

2. METHOD

This study employed a qualitative research method. According to Sugiyono (2017), qualitative research seeks to understand phenomena in depth through exploration of social interactions and individual behaviors in context. This understanding is achieved by exploring the meaning contained in social interactions, behavior, and communication between individuals in a specific context.

The primary instrument in this study was the researcher, supported by test items and unstructured interview guides. Three HOTS-based questions were developed to assess students' difficulty levels. These questions were aligned with three HOTS indicators: analyzing (C4), evaluating (C5), and creating (C6). The questions were validated by two mathematics education experts and one mathematics teacher for content validity. Unstructured interviews were then conducted to identify the specific difficulties students encountered. The research was conducted during the even semester of the 2023/2024 academic year at SMPN 1 Latambaga. The research subjects consisted of class VIII A students who were given HOTS-based problems. Based on test results, six students were selected—two from each ability level (high, medium, low)—for interviews. The subjects for the interviews will be selected based on the results of the HOTS questions.

After conducting a comprehensive test analysis, six students were selected to represent each category. The student ability categorization followed Azwar's method in (Astuti & Adirakasiwi, 2019) which includes the following steps:

1. Determine each student's score
2. Find the ideal mean and ideal standard deviation using the following formulas.

   Ideal Mean $= \frac{1}{2}$ (ideal maximum score + ideal minimum score)

   Ideal SD $= \frac{1}{6}$ (ideal maximum score - ideal minimum score)
3. Determine the boundaries of the category groups as follows:
   - 3.1 The High category group, wich is all students who score as much as the ideal mean + 1 SD ideal and above.
   - 3.2 The Moderate category group, wich is all students who have scores between the ideal Mean - 1 SD ideal and ideal Mean + 1 ideal SD.

3.3 The Low category group, all students who have an ideal mean score - 1 ideal SD and below

So that the categorization of student ability levels groups is presented in Table 1.

Table 1. Student Ability Level Group Categorization

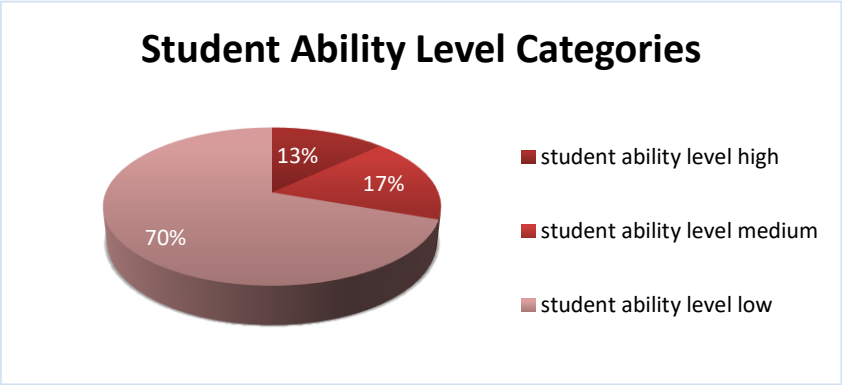
No	Score	Category
1.	Score ≥ 86,67	High
2.	73,33 ≤ Score < 86,67	Medium
3.	Score < 73,33	Low

Data analysis followed the interactive model by Miles and Huberman, which includes data reduction, data display, and conclusion drawing. Data validity was ensured through source triangulation by comparing results from tests, interviews, and observations. This triangulation of data sources is used to uncover the truth of certain information by utilizing various data sources such as documents, archives, interview results, test results, observation results, or by interviewing more than one subject who is considered to have a different perspective.

3. RESULTS AND DISCUSSION

3.1. Results

The study was conducted at a public junior high school in Kolaka Regency, involving 23 students from class VIII A as research participants. Based on the students' responses to HOTS-based test items, subject selection and data reduction were conducted. This was based on the categorization of student ability levels. The distribution of student ability levels is illustrated in the pie chart below.



Based on the categorization, six representative students were selected: S17 and S12 (high ability), S15 and S19 (medium ability), and S05 and S18 (low ability). Table 2 presents the performance of these six students in solving HOTS-based mathematics problems based on Bloom's taxonomy indicators (C4, C5, C6).

Students in the high-ability group successfully fulfilled all HOTS indicators, demonstrating skills in analyzing (C4), evaluating (C5), and creating (C6). Students in the medium-ability group met indicators C4 and C5 but did not meet indicator C6 (creating). Meanwhile, students in the low-ability group were only able to meet indicator C4 (analyzing), but failed to meet indicators C5 and C6. The next section presents detailed analysis of student responses from each ability category.

Tabel 2. Students ability to solve HOTS questions according to Bloom's taxonomy

Students	Indicator HOTS (Higher Order Thinking Skills)		
	C4	C5	C6
S17	✓	✓	✓
S12	✓	✓	✓
S15	✓	✓	×
S19	✓	✓	✓
S05	✓	×	×
S18	✓	×	×

3.2. Discussion

The discussion explores the students' performance based on HOTS indicators. Students S17 and S12, categorized as high ability, showed no significant difficulties in answering questions involving C4, C5, and C6 indicators. They demonstrated an ability to comprehend question instructions, analyze given data, and evaluate alternatives systematically. Moreover, they developed new solution models beyond single approaches, fulfilling all cognitive expectations.

S15 and S19 are students in the medium-ability level category. In solving question 1, which includes the C4 indicator (analyzing), this is evident from their ability to identify important information in the question, such as the operating times of machines I and II, the production time requirements for each type of product, and the profit per unit for products A and B. The student was able to break down each component of the problem, formulate linear inequalities as a mathematical model of the situation presented, and use the appropriate concept, namely the concept of finding the solution to a single-variable linear inequality. The student was also able to perform the calculations correctly and obtain the correct results. Based on this, it can be concluded that the student did not experience any difficulties in solving question number 1.

In item 2, which assesses indicator C5 (evaluating), S15 and S19 demonstrated their evaluation skills effectively. In completing the question, the students were able to critically and systematically assess the answers given by the three students (Rina, Budi, and Sari). Students not only chose the correct answer but also provided logical reasons based on valid mathematical calculations and identified conceptual or procedural errors in incorrect answers. During the problem-solving process, students first identified key information from the question, including the total purchase price, the price per kilogram of apples, and the number of apples purchased. They then developed an appropriate mathematical model. Such evaluation skills indicate that students not only understand basic concepts but also can assess the validity of a solution based on objective criteria, as well as identify and explain errors that occur in the problem-solving process. Based on this, it can be concluded that students did not encounter difficulties in solving question number 2.

As shown in Figure 1, the work of student S15 on item 3 (C6 - creating). Students in S15 were able to determine the area of each section of the garden to be planted with vegetables and fruits. They were able to identify the perimeter and length of one side of a rectangle, then correctly calculate the area of the garden for vegetables and fruits, taking into account the total known land area. However, the student was unable to clearly design two alternative flat shapes, as requested.

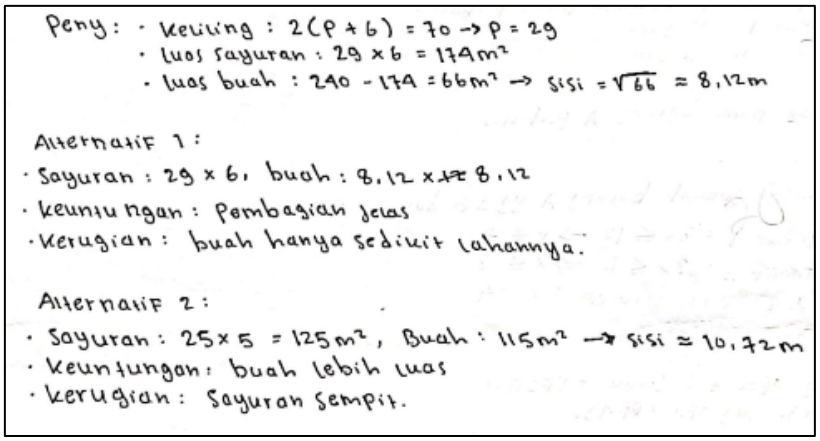


Figure 1. Item number 3 work by student S15

This indicates limited development in model creation and geometric innovation. Thus, the students still have difficulty in creating new solutions in model development and numerical solutions and have not yet reached the stage of design innovation. This indicates that students are not yet able to apply geometric design principles as solutions to contextual problems. This indicates difficulty in comprehending the meaning of the question, which is a characteristic of verbal difficulties in mathematics. In line with Seogiono's opinion in (Dewi et al., 2020), it is stated that the problems faced by students in solving verbal problems include their inability to use data, understand language, and draw conclusions.

Meanwhile, the work of student S19 for question number 3, which covers indicator C6 (creating), is presented in Figure 2. This shows the student's ability to generate creative ideas, although attention to detail in calculations remains a challenge.

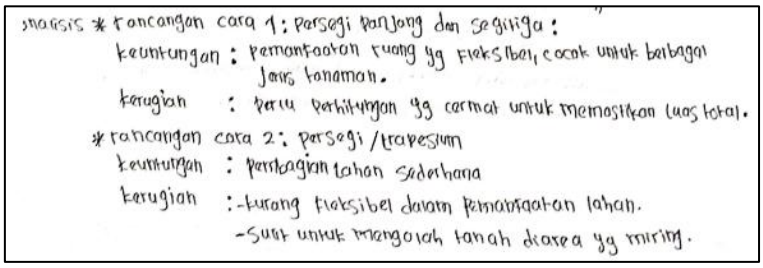


Figure 2. Item number 3 work by student S19

Students in S19 were able to determine the area of each section of the garden to be planted with vegetables and fruits. They were able to identify the perimeter and length of one side of a rectangle, then correctly calculate the area of the garden for vegetables and fruits by considering the total known land area and developing two designs for dividing the garden into two sections in different shapes. However, at the final stage, the students did not include the area calculations for each shape in each design. This indicates that the students have the ability to create alternative solutions to the problem but are still lacking in attention to detail when completing alternative designs.

Students S05 and S18 were categorized as having low academic ability. In completing question number 1, which covers indicator C4, namely analyzing, this can be seen from their ability to identify important information contained in the question, such

as the operating time of machines I and II, the production time required for each type of goods, and the profit value per unit of goods A and B. The student was able to break down each component of the problem, formulate linear inequalities as a mathematical model of the situation presented, and use the appropriate concept, namely the concept of finding the solution to a single-variable linear inequality. The student was also able to perform the calculations correctly and obtain the correct results. Based on this, it can be concluded that the student did not experience any difficulties in completing question number 1.

The work of students S05 and S18 in completing the HOTS questions for item number 2 is presented in Figures 3 and 4.

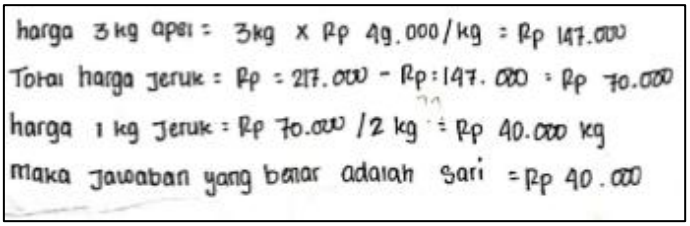


Figure 3. Item number 2 work by student S05

Question number 2 covers indicator C5, which is evaluation. Student S05 demonstrated the ability to complete the question, as evidenced by his success in determining the price of 1 kg of oranges accurately through his understanding of the information provided in the question. The student was able to interpret the problem, construct a relevant mathematical model, and obtain the correct calculation results.

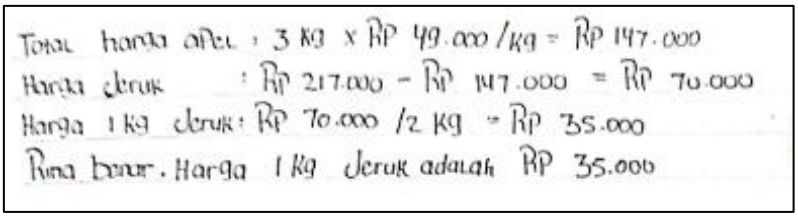


Figure 4. Item number 2 work by student S18

Meanwhile, the work of student S18 showed that the student understood the information in the question, was able to construct a relevant mathematical model, and understood the basic concepts asked in the question, but still made mistakes in the calculation process. This was demonstrated by the correct solution steps, the selection of the appropriate formula, and the construction of an appropriate mathematical model.

However, in terms of the evaluative aspect requested by the question, both students S05 and S18 did not fully understand the question instructions. This indicates students' difficulty in interpreting descriptive instructions, supporting Soegiono's findings (Dewi et al., 2020) about verbal difficulties in mathematical problem solving. The question explicitly asked students to evaluate the answers of three other students (Rina, Budi, and Sari), identify which ones were correct, explain the reasoning process systematically, and point out the errors in the incorrect answers. In this case, the students only provided numerical answers without logical arguments and systematic explanations related to the evaluation process for each of the answers given by the three students. This shows that the students' thinking skills at level C5 (evaluating) were not fully met, indicating a

misunderstanding of the descriptive and complex instructions in the question. In line with Sugiyono's opinion in (Dewi et al., 2020), verbal difficulties occur when students fail to correctly understand and interpret the language or instructions of the question.

Student S05's work in solving the HOTS question for item number 3 is presented in Figure 5.

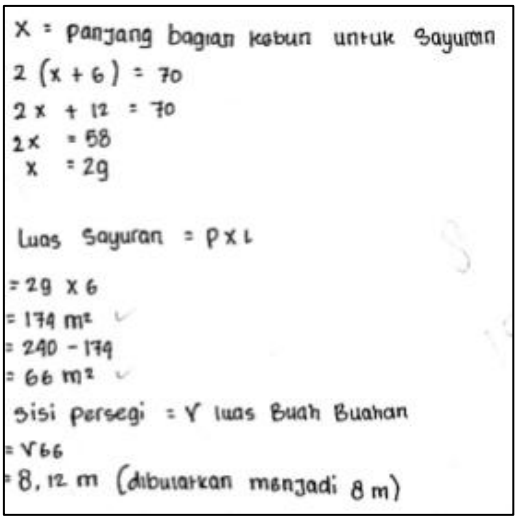


Figure 5. Item number 3 work by student S05

Students in S05 were able to determine the area of each section of the garden to be planted with vegetables and fruits. They were able to identify the perimeter and length of one side of a rectangle, then correctly calculate the area of the garden for vegetables and fruits, considering the total known land area. However, in the next stage, which requires students to develop two different design alternatives using two types of known flat shapes, students showed difficulties at this stage, which demonstrates creativity and skills in creating new solutions, as well as the ability to assess the potential advantages and disadvantages of each design. This suggests that student S05 struggled to apply mathematical design principles, particularly in generating alternative geometric layouts.

Meanwhile, the work of student S18 in completing the HOTS question for item number 3 is presented in Figure 6.

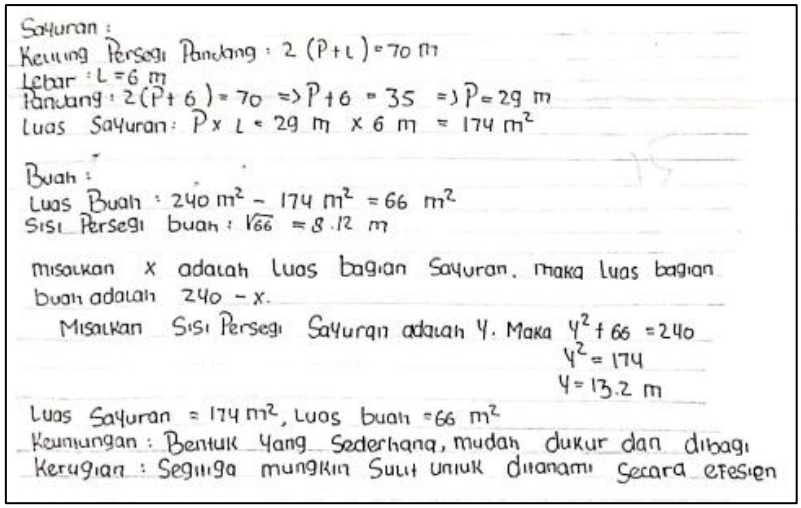


Figure 6. Item number 3 work by student S18

Student S18, in answering question number 3, was able to develop a mathematical model using a single variable linear equation to solve the problem of dividing a garden plot into two sections for vegetables and fruits. The calculations for the area of each section were performed accurately. However, in designing alternative plans as requested in the question, the student still experienced difficulties, indicating that their creative thinking skills and ability to generate ideas have not yet developed optimally.

4. CONCLUSION

This study involved six students from three ability categories, selected through tests and interviews. Students with high ability levels (S12 and S17) were able to fully meet all HOTS indicators, namely C4, C5, and C6. They were able to comprehend and analyze problems, assess solutions logically, and design creative and systematic alternatives. This confirms their well-developed higher-order thinking skills, with minimal difficulties encountered. Students in the medium-sized ability group (S15 and S19) managed to complete tasks up to the C5 level (evaluating), but were not yet able to achieve indicator C6 (create). Their main difficulties involved expressing alternative designs and accuracy in final outputs. This indicates that their creative thinking skills have not developed optimally, despite sufficient understanding of concepts and evaluation. Low-ability students (S05 and S18) could only address questions requiring C4-level thinking. They experience difficulties in evaluating and creating solutions, as evidenced by their inability to explain their thought processes, evidenced by misinterpreting instructions, inability to explain their reasoning, and difficulty designing solutions. The difficulties experienced by students in this category generally include verbal, procedural, and principle-based difficulties, particularly in translating problem instructions into appropriate problem-solving steps. Overall, all students demonstrated C4 (analyzing) proficiency, while challenges remain in achieving C5 and C6 levels.

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REFERENCES

Astuti, N., & Adirakasiwi, A. G. (2019). Analisis Kesulitan Siswa SMP dalam Menyelesaikan Soal HOTS (Higher Order Thinking Skill). *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika Sesiomadika 2019*, 415–426. https://journal.unsika.ac.id/index.php/sesiomadika/article/view/2741

Dewi, N. K., Untu, Z., & Dimpudus, A. (2020). Analisis Kesulitan Menyelesaikan Soal Matematika Materi Operasi Hitung Bilangan Pecahan Siswa Kelas VII. *Primatika : Jurnal Pendidikan Matematika*, *9*(2), 61–70. https://doi.org/10.30872/primatika.v9i2.217

Djamaluddin, A., & Wardana, W. (2019). *Belajar Dan Pembelajaran*. CV. KAAFFAH

LEARNING CENTER.

Faizzah, S. N., & Sutarni, S. (2023). Investigasi Kesulitan Siswa dalam Menyelesaikan Masalah HOTS Matematika. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(2), 1963–1975. https://doi.org/10.31004/cendekia.v7i2.2438

Irma Aryani, & Maulida. (2019). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matematika Melalui Higher Order Thinking Skill (Hots). *Jurnal Serambi Ilmu*, *20*(2), 274–290. https://doi.org/10.32672/jsi.v20i2.1088

Lubis, R. N., Meiliasari, & Rahayu, W. (2023). Kemampuan Komunikasi Matematis Siswa pada Pembelajaran Matematika. *Jurnal Riset Pembelajaran Matematika Sekolah*, *7*(2), 23–34. https://doi.org/10.21009/jrpms.072.03

Milenia, D., Resti, N. C., & Rahayu, D. S. (2022). Kemampuan Siswa SMP dalam Penyelesaian Soal Matematika Berbasis HOTS Pada Materi Pola Bilangan. *Jurnal Ilmiah Matematika Realistik (JI-MR)*, *3*(2), 100–108. https://doi.org/10.33365/ji-mr.v3i2.2297

Mita Miranda Sitanggang, & Edi Syahputra. (2023). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal-Soal Higher Order Thinking Skills. *Journal of Student Research*, *2*(1), 10–22. https://doi.org/10.55606/jsr.v2i1.2081

Sugiyono, S. (2017). *Metode Penelitian Kuantitatif, Kuantitatif dan R&D*. Alfabeta.

Tahir, T., & Marniati, M. (2019). Pengaruh Model Pembelajaran Discovery Learning dengan Pendekatan Kontruktivisme terhadap Peningkatan Hasil Belajar Matematika Siswa. *Square : Journal of Mathematics and Mathematics Education*, *1*(1), 1. https://doi.org/10.21580/square.v1i1.4021