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Analysis of Students' Difficulties in Solving Algebraic Operation Problems Based on Problem-Solving Skills in Grade VII at SMP Negeri 8 Tambun Selatan

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Abstract

The objective of this research is to examine the challenges encountered by students when tackling algebraic operation problems, focusing on their problem-solving abilities. The study aims to comprehend the factors contributing to students' struggles in dealing with algebraic problems. It employs a descriptive method with a qualitative approach, involving 35 seventh-grade students from class VII-G at SMP N 8 Tambun Selatan. Data collection encompasses observation, tests, questionnaires, and documentation, with analysis using the Miles and Huberman model. The validity of the data is ensured through method triangulation. The findings reveal that, among the 35 students studied, 1) 61% faced difficulties in comprehending the problems, 2) 57% encountered challenges in planning solutions, 3) 73% experienced obstacles in executing the plans, and 4) 86% struggled with reviewing their work. The primary factors influencing these challenges include students' grasp of fundamental algebraic concepts, difficulties in applying mathematical concepts to algebraic contexts, and underdeveloped problem-solving skills. Difficulties often arise when students attempt to understand mathematical problems and formulate the necessary steps to solve them.

Keywords: Student Difficulties, Mathematical Problem Solving Ability, Algebra.

1. Introduction

Based on Law number 20 of 2003 concerning the national education system in Indonesia, education is a conscious and planned effort to create a learning environment and learning process where students actively enhance their potentials, including cognitive, moral, and spiritual aspects. The law acknowledges that education is not only related to academic or cognitive intelligence. It emphasizes the importance of students developing spiritual and religious strength, self-control, quality of character, noble morality, as well as the abilities needed for themselves, society, the nation, and the country.

Problem solving is an effort to realize desires in accordance with the proper procedures and in line with one's wishes according to the correct procedures (Febriyanti & Irawan, 2017). Rianto & Yusmin (2017) demonstrate the importance of problem-solving skills in both learning and daily life.

From the above exposition, it can be concluded regarding the understanding of mathematical problem-solving skills. This is a skill that is crucial in life and career. It indicates that a successful approach to problem-solving involves creative, flexible, and proactive thinking. Perseverance in seeking solutions, a willingness to try repeatedly, and learning from failures are integral parts of problem-solving skills. With the development of technology and the emergence of new challenges, good problem-solving skills will become increasingly important in facing the complexities of the modern world.

Polya (1973) stated that there are four steps that students take in solving problems, namely, (1) understanding the problem; (2) planning a problem-solving strategy; (3) implementing the problem-solving strategy, and (4) checking the obtained solution. In a study conducted by Farida (2015), there were errors made by students when solving problem-solving questions, such as (1) understanding the problem, which includes errors in understanding language and translating it into a mathematical model; (2) planning the solution, which involves errors in associating one concept with another, and (3) implementing the solution, which includes errors in applying inappropriate formulas.

The research results obtained indicate that students' problem-solving skills are still relatively low, as revealed by Purnamasari in 2015. In her study, only 11.77% of students showed high problem-solving abilities, while 52.94% of other students had low to very low problem-solving abilities. Students face difficulties in solving these problems due to several factors, one of which is the lack of understanding of the given problems. Because of this lack of understanding, students encounter difficulties in progressing to the next stages, such as planning the solution, solving the problem, and reviewing the results of problem-solving. All of these stages are not accurately performed by students, thereby hindering their ability to solve problems effectively (Purnamasari, 2015).

The researcher found data regarding the low learning outcomes of students at one junior high school in Bekasi Regency, namely SMP Negeri 8 Tambun Selatan. Based on the data from daily algebraic operation tests for Grade VII students, all students received scores below the Minimum Completion Criteria (KKM) of 75. The average daily test score for students on algebraic calculation operations material was 59.8.

Based on the observations conducted at SMP Negeri 8 Tambun Selatan on April 13, 2023, it was revealed that students face difficulties in solving problems related to the Algebraic Operations subject. The results of interviews with mathematics teachers also indicate that many students struggle with mathematical problem-solving, particularly in the context of the teaching-learning process. The constraints include students' unfamiliarity with solving the given problems, especially the core material of algebraic calculation operations. This issue particularly arises in story problems, where students still do not fully grasp the content. It indicates that students have not fully understood and mastered the methods to solve mathematical problems involving algebraic operations in the context of everyday situations.

This is due to differences in students' responses to the types of problem-solving questions given. When students are given problems with routine patterns or similar types, they can solve them well. However, when faced with problems that are non-routine or have different variations, students experience difficulties. In the learning and teaching activities, students can solve problems when given similar types of questions. Still, when given problems that test problem-solving abilities with various variations, some students begin to encounter difficulties. Some issues faced by students include a lack of understanding of concepts, difficulty identifying symbols or keywords, misunderstanding the presented problems, difficulty making assumptions, difficulty in performing accurate calculations, and some even fail to complete problems to the end. Students' ability to overcome these problems varies from one student to another. Some students may have better abilities to understand and solve various types of problems, while others may experience greater difficulties. This indicates differences in the level of understanding and students' abilities in facing various mathematical problems involving problem-solving.

2. Methods

This type of research is descriptive qualitative, as suggested by Creswell (2016). Qualitative research, according to Creswell, is a type of research that explores and understands the meanings in a number of individuals or a group of people originating from social issues. According to Natalia and Ditasona (2019), the goal of qualitative research is to reveal the facts or phenomena from situations that really occur. Qualitative research, in general, can be used for studying various aspects of social life, history, behavior, concepts or phenomena, social issues, and others. One of the reasons for using a qualitative approach is the researcher's experience where this method can uncover and understand what is hidden behind phenomena, which can sometimes be difficult to comprehend.

The qualitative approach is employed by the researcher to depict how students solve problems and identify various types of difficulties faced by students when working on algebraic calculation operation problems based on their problem-solving abilities. The focus of this research is on students' difficulties in answering algebraic problem-solving questions, which are the main independent variables in this study. The test used in this survey is based on mathematical abilities, particularly problem-solving skills.

The research was conducted at Junior High School (SMP) Negeri 8 Tambun Selatan, located on Jl. Kalimusada Raya, Bekasi Timur Permai Housing, Setiamekar, Kec. Tambun Selatan, Kab. Bekasi, West Java Province. The research was carried out in the second semester of the academic year 2022/2023, spanning a period of 1 month from May 8, 2023, to June 12, 2023. The population in this study consisted of all students in grade VII.G in the academic year 2022/2023 at SMP Negeri 8 Tambun Selatan.

This research employs various data collection techniques such as tests and open-ended questionnaires. The test will be conducted within a 60-minute timeframe or one class period, consisting of 5 items that students need to answer. The test data includes responses on the provided answer sheets and the steps taken in the problem-solving process. The results of this test

will be analyzed by the researcher to identify the types of difficulties experienced in solving mathematical problems. The test results will serve as a foundation for developing a questionnaire aimed at gaining a deeper understanding of the factors causing difficulties faced by students.

The research employs an open-ended questionnaire approach, with questions aligned with problem-solving skill indicators that allow respondents to provide comprehensive and unrestricted answers. The objective of using this questionnaire is to collect data from respondents to gain insights into the difficulties faced by students and understand the factors influencing difficulties in solving algebraic calculation operation problems.

3. Result and Discussion

The research data were obtained from the test answers provided by 35 students. Subsequently, responses from 6 students with high, medium, and low abilities were selected for analysis. The overall test difficulty results for the students are presented in the following table and graph:

Table 1

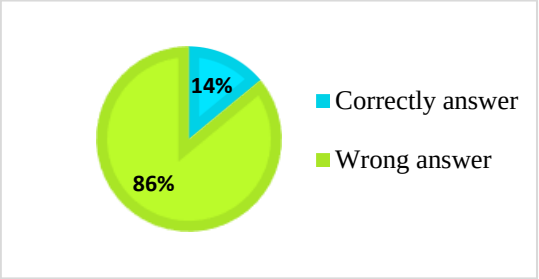
Problem Solving Ability Difficulty Test Results

Category of Difficulties	Understanding the Problem	Planning	Solution	Evaluation
Score	107	101	129	152
Percentage	61%	57%	73%	86%

Based on the data from the table, it is evident that students face difficulties in completing the research test, as shown by the presence of students struggling with the 5 problems provided by the researcher. Starting from 107 misunderstandings found out of 175 answers, 101 errors in planning out of 175 answers, 129 errors in executing the plan out of 175 answers, and 152 errors in reviewing out of 175 answers. These errors can only be identified in the answers of students who have completed the problem-solving process. Therefore, for students who did not attempt the problem or did not complete it, their difficulties cannot be detected. The following is a graph of the number of students who did not attempt 1 out of the 5 problems provided.

Figure 1

Percentage of student answers



In Figure 1, the chart illustrates the percentage of errors experienced by the 35 students. From the data, only 14%, or 5 students, did not make any errors in each of the given problems, meaning these students answered all questions correctly. Meanwhile, 86%, or 30 students, made errors in at least one question. In more detail, 4 students lacked an understanding of the prerequisite knowledge in algebraic calculation operations, and 26 students were unable to answer questions based on their mastery of problem-solving skills.

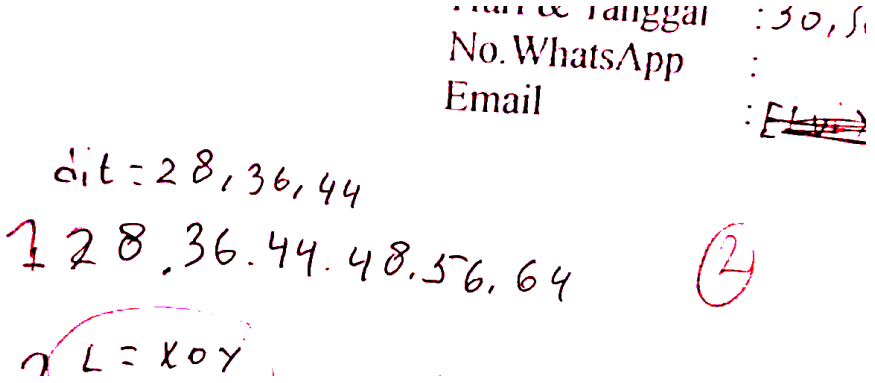
In this study, the researcher will analyze the level of difficulty faced by students in each problem, from number one to five. The aim of this research is to uncover the challenges and mistakes encountered by students in solving problems related to algebraic calculation operations.

Analysis of Question Number 1

Based on the answer sheet in the attached Figure 2, students made mistakes. These mistakes occurred because they only recorded the information provided by the problem and did not include what was explicitly asked. As a result, the answers were incomplete as they did not include all relevant information from the problem.

Figure 2

One of the student answer sheets for question number 1



Students also made mistakes because they could not determine the strategy to be used, were not suitable and could not be continued. It can be said that the students did not have an answer at all in solving the problem, and it can be said that there was no checking or any explanation in reviewing the results of the work they did.

Based on the data analysis of 35 randomly selected students, here are the findings and conclusions regarding the students' level of understanding of the problem-solving topic in the context of algebraic operation problems. In the problem understanding stage, only 39% of the 35 students were able to understand the problems in each item well. This finding aligns with the research by Buyung and Sumarli (2021) and Ardiyanti & Farihah (2019), revealing that students' abilities in solving story problems or problems related to problem-solving are still lacking, and

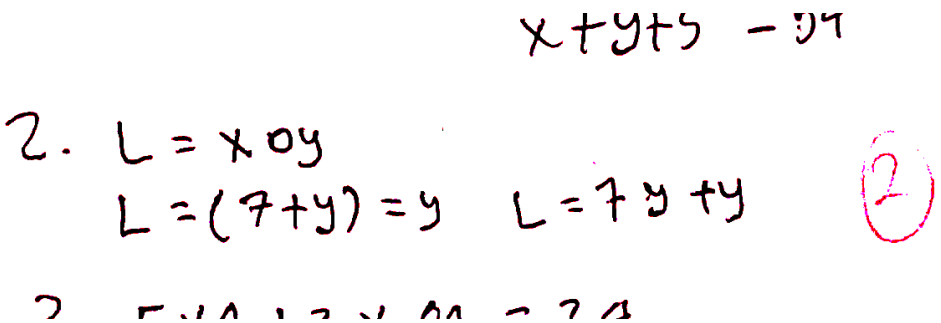
some students are not accustomed to working on such types of questions. Additionally, there is an issue in capturing the implied meaning behind the given problems.

Analysis of Question Number 2

Based on the answer sheet in the attached Figure 3, the students made errors in solving problem number 2, such as mistakes in understanding the problem. The students did not include complete information as stated in the problem, such as not listing the known and asked information on their worksheet. The students also made mistakes because they could not determine the strategy or steps to solve the problem that they would use. Instead, they directly attempted to solve the problem inaccurately and couldn't proceed.

Figure 3

One of the student answer sheets for question number 2



Furthermore, students made a mistake in executing the plan, and this error occurred because of an error in writing the formula $L = x \, o \, y$, The correct formula to be used should be $L = P \times L$ if we assume to be $L = x \times y$. Since the student made a mistake from the beginning, when the student executed the plan until determining the final answer, they also made an error. Hence, it can be said that the student did not conduct any review or provide any explanation in checking their work.

In the planning stage, 43% of students from the total number of students demonstrated the ability to plan problem-solving steps. The difficulty in making a plan arises from the students' inability to understand the problem. Some students failed to write down the strategy or solution formula due to a lack of practice in solving problems. Ardiyanti & Farihah's (2019) research also indicates that "difficulty in the aspect of making a plan is the low ability of students to understand the problem and a lack of problem-solving practice."

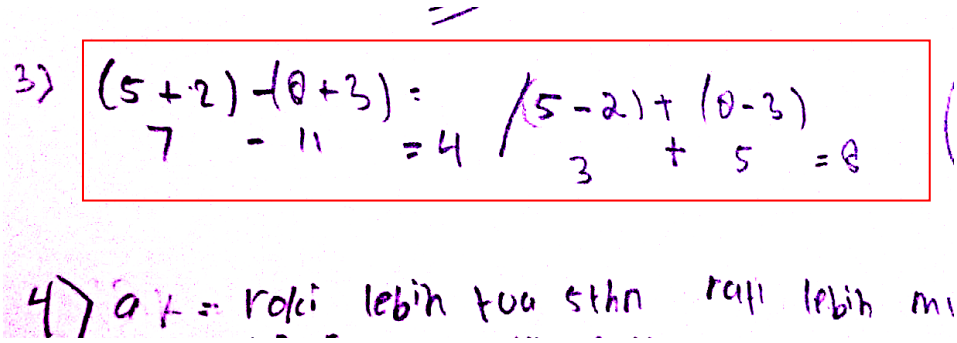
Analysis of Question Number 3

Based on the answer sheet in the attached Figure 4, the students made errors in solving problem number 3, such as mistakes in understanding the problem. From the data of each student's answer sheet, the students did not list the known information related to the problem and did not write

down what was asked in the problem. Therefore, it can be said that they did not include complete information from the problem.

Figure 4

One of the student answer sheets for question number 3



Thus, the students could not determine a strategy, and the execution of the plan until determining their final answers also contained errors. The students only added and subtracted in the usual way and reached their final conclusion: the remaining toys for Dimas = robot; 7, cars: 5. However, the expected final answer is: : $5x + 8y + 2x - 3y = 5x + 2x + 8y - 3y = 7x + 5y$ or $5y + 7x$. Therefore, the robots and toy cars that Dimas currently has are $7x + 5y$ which is 7 robots and 5 toy cars. The students did not perform any checks or provide any explanations when reviewing the results of their work.

Furthermore, during the execution stage of the problem-solving plan, only 27% of the 35 students were able to complete the plan. Errors in writing formulas resulted in incorrect solution calculations. This difficulty aligns with the research by Ardiyanti & Farihah (2019), which indicates that "students' difficulty in the execution of the plan occurs because students are less careful in calculations, the steps are too long, and there are errors in writing formulas".

Analysis of Question Number 4

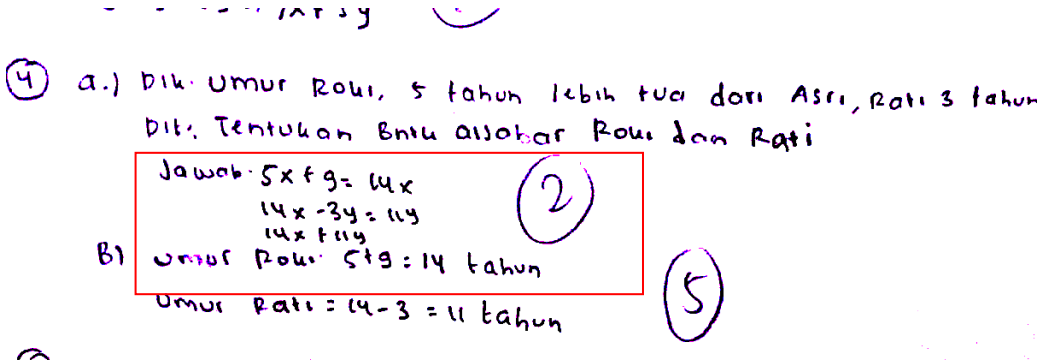
Based on the answer sheet in Figure 5 attached, the student was able to show and prove the known and unknown aspects of question number 4, as well as recognize the information present in the given problem. However, the student did not create a suitable procedure in formulating a plan because the strategy used led to the wrong answer or did not attempt another strategy. Consequently, the student could not complete stages three and four, which are the stages of executing the plan and reviewing, corresponding to the problem-solving process.

In the rechecking stage, only 14% of students were able to review their answers. This difficulty arises because students cannot solve the problems correctly or have incorrect calculations. Some students also did not include conclusions at the end of their answers due to a lack of understanding that conclusions should be part of the answer. This aligns with the findings of the study by Ardiyanti & Farihah (2019), which indicates that difficulties in the reviewing aspect

include the inability of students to review correct answers, poor time management, and laziness in rechecking answers.

Figure 5

One of the student answer sheets for question number 4

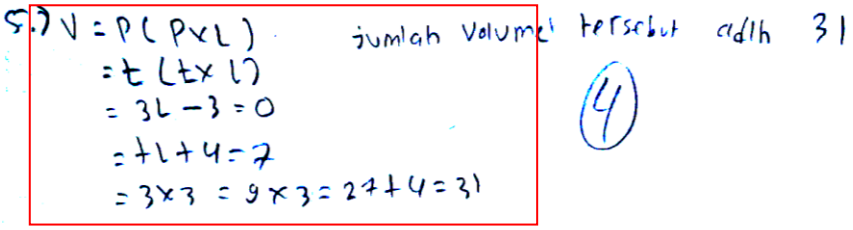


Analysis of Question Number 5

Based on the answer sheet in Figure 6 attached, students were unable to go through the problem understanding stage. It is evident that students could not demonstrate or prove what was known and asked, and they could not accurately identify the information presented in the problem. Consequently, they could not comprehend the strategy or mathematical model to be used in solving the problem for question number 5 and did not know the formula for the spatial structure (rectangular prism). Hence, it can be said that students did not perform any review or provide any explanation in checking their work.

Figure 6

One of the student answer sheets for question number 5



In line with the research conducted by Haryono, Juwita, & Vioni (2021), their findings indicate that students face challenges in planning solutions, executing solution plans, and conducting rechecks when dealing with problems. To overcome these difficulties, steps can be taken by

students to enhance their problem-solving skills in algebraic topics. One effective measure is to engage in rereading to gain a better understanding of the material. Additionally, providing students with practice problems can help them hone their skills in solving such questions. Moreover, it is crucial to pose various questions to students to enable them to develop their abilities in tackling diverse problems.

4. Conclusion

Based on the research results and discussion, it can be concluded that students with high problem-solving abilities can complete three stages of problem-solving indicators, starting from understanding the problem, designing a solution plan or strategy, and implementing the plan. Meanwhile, students with moderate abilities can still address problems but may not be fully structured, and students with low abilities are unable to complete the stages in problem-solving.

From the analysis of student responses, various difficulties in the problem-solving process were identified. One of them is the lack of detailed answers from students, indicating their difficulty in conveying their understanding effectively. Additionally, some students did not fully comprehend the problem statement, leading to difficulties in finding accurate solutions. Not only that, but several students also could not elaborate on the process or steps to solve the problem, indicating a lack of understanding of problem-solving strategies. An interesting finding from this analysis is that problem-solving difficulties are not only experienced by students with low abilities but are also encountered by students with high abilities. In other words, high proficiency in problem-solving does not guarantee that students will be exempt from challenges in solving problems.

Overall, students' difficulties in solving algebraic operation problems are influenced by internal factors such as focus, confidence, and understanding, as well as external factors such as the quality of classroom learning.

6. References

Aditya Cahyani, C., & Sutriyono, S. (2018). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Pada Materi Operasi Penjumlahan dan Pengurangan Bentuk Aljabar Bagi Siswa Kelas VII SMP Kristen 2 Salatiga. *JTAM | Jurnal Teori Dan Aplikasi Matematika*, *2*(1), 26. https://doi.org/10.31764/jtam.v2i1.257

Ardiyanti, S. A., & Farihah, U. (2019). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Cerita pada Materi Teorema Pythagoras Ditinjau dari Pemecahan Masalah Polya. In *Electronic Thesis and Dissertations Universitas Muhammadiyah Surakarta* (pp. 389–398).

Buyung, B., & Sumarli, S. (2021). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Cerita Berbasis Kemampuan Pemecahan Masalah. *Variabel*, *4*(2), 61. https://doi.org/10.26737/var.v4i2.2722

Creswell, John W (2016). *Research Design: Pendekatan Metode Kualitatif, Kuantitatif, dan Campuran*, terjemahan, Yogyakarta: Pustaka Pelajar

Ditasona, C., Kartika, R. Y., & Lumbantoruan, J. H. (2023). Analisis Kesulitan Belajar Siswa dalam Pembelajaran Matematika Pada Materi Perbandingan Di SMPN 58 Jakarta Kelas VII.2. *EduMatSains : Jurnal Pendidikan, Matematika Dan Sains*, *8*(1), 55-71. https://doi.org/10.33541/edumatsains.v8i1.4615

Dwi Kusumawati, A., & Sutriyono, S. (2018). Analisis Kesulitan Belajar Siswa Pada Materi Operasi Aljabar Bagi Siswa Kelas Vii Smp Negeri 3 Salatiga. *Paedagoria | FKIP UMMat*, *9*(1), 30. https://doi.org/10.31764/paedagoria.v9i1.265

Farida, N. (2015). Analisis Kesalahan Siswa Smp Kelas Viii Dalam Menyelesaikan Masalah Soal Cerita Matematika. *AKSIOMA Journal of Mathematics Education*, *4*(2), 42–52. https://doi.org/10.24127/ajpm.v4i2.306

Febriyanti, C., & Irawan, A. (2017). Meningkatkan Kemampuan Pemecahan Masalah Dengan Pembelajaran Matematika Realistik. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *6*(1), 31–41. https://doi.org/10.33387/dpi.v6i1.350

Haryono, Y., Juwita, R., & Vioni, S. (2021). Analisis Kesulitan Dalam Pemecahan Masalah Matematika Ditinjau Dari Minat Belajar Siswa Berdasarkan Langkah Polya. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(2), 849–859. https://doi.org/10.24127/ajpm.v10i2.3510

Istiqomah. (2017). Penerapan ajaran tamansiswa untuk menumbuhkan kecintaan anak terhadap matematika sejak dini. *Jurnal Penelitian LPPM IKIP PGRI Madiun, Volume 5, Nomor 1, Januari 2017: 76-82 Kalimat*, *5*(1), 76–82. http://e-journal.unipma.ac.id/index.php/JP-LPPM/article/view/943/842

Natalia, S., & Ditasona, C. (2019). Analysis of the Difficulties in Determining the Right Evaluation Instrument in Teaching Practice Student Teachers of Mathematics Education Study Program. Intenational Jurnal of Inovation, Creativity and Change. Volume 5, Issue 3, 2019 Special Edition: Science, Applied Science, Teaching and Education.

Perdana, R. D. P. (2018). Eksperimentasi Model TSTS pada Operasi Hitung Aljabar Ditinjau dari Kecerdasan Emosional Siswa SMPN 1 Ngronggot. *Briliant: Jurnal Riset Dan Konseptual*, *3*(2), 260. https://doi.org/10.28926/briliant.v3i2.182

Purnamasari, P. D. (2015). *Analisis Kemampuan Pemecahan Masalah Matematika Siswa Kelas XI SMK MUHAMMADIYAH I Patuk Pada Pokok Bahasan Peluang*.

Sumartini, T. S. (2018). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa melalui Pembelajaran Berbasis Masalah. Mosharafa: Jurnal Pendidikan Matematika, 5(2), 148-158. https://doi.org/10.31980/mosharafa.v5i2.270

Vina Muthmainna Rianto, Edy Yusmin, dan A. N. (2017). Kemampuan Pemecahan Masalah Siswa Berdasarkan Teori John Dewey Pada Materi Trigonometri. *Jurnal Pendidikan Dan Pembelajaran Untan*, *6*(7), 194562.

Widodo, S. A., Prahmana, R. C. I., Purnami, A. S., & Turmudi. (2018). Teaching materials of algebraic equation. *Journal of Physics: Conference Series*, *943*(1), 0–7. https://doi.org/10.1088/1742-6596/943/1/012017