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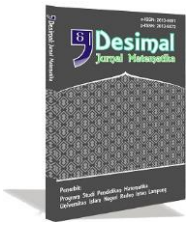

# The effect of problem based learning on students' mathematical literacy ability

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## ABSTRACT

*This research is motivated by the many problems that often arise during learning in the classroom, especially mathematics. The purpose of this study was to determine how the description of students' abilities and problems in learning mathematics about relations and functions is taught using problem-based learning models and conventional learning models. With a post-test-only control group design, this research is quasi-experimental. Based on the results of data analysis obtained sig. (2-tailed) of 0.000 <0.05. Therefore, it can be concluded that Problem Based Learning and conventional learning produce significantly different levels of mathematical literacy. The practical implication of this study is that educational practitioners, particularly mathematics teachers at the junior high school level, can utilize these findings to improve their teaching. PBL can be used as a basis for designing more innovative and student-centered learning units, which can help students develop a deeper understanding of mathematical concepts and improve their ability to solve problems. Adequate support and training for teachers in implementing PBL is also important to ensure its successful implementation in the classroom.*

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## INTRODUCTION

Mathematics is a subject that must be taught to all students, starting from elementary school to the next level of education (Hasanah, Silalahi, & Utama, 2023). Students usually consider math difficult because of the monotonous or unpleasant way of learning, which causes students to be less proficient in mathematics (Mulyati & Evendi, 2020).

In Problem Based Learning, students are trained to solve real problems in an open and unstructured manner as a means for them to develop problem-solving skills while building new knowledge commonly encountered in everyday life (Astuti, 2020). The Problem Based Learning learning model is expected to help students get used to solving and analyzing problems so that students' problem-

solving skills will be maximally formed (Nugroho & Muhroji, 2022).

Mathematics is closely related to mathematical literacy (Ananda & Wandini, 2022). Mathematical literacy is a person's ability to formulate, apply, and interpret mathematics in various contexts, including the ability to reason mathematically and use mathematical concepts, procedures, facts, and tools to describe a phenomenon or event (Tabun, Taneo, & Daniel, 2020), so this mathematical literacy ability is closely related to everyday life and participating in social life (Hanum, Mujib, & Firmansyah, 2020).

Indicators of mathematical literacy are: identifying mathematical aspects of problems in real-context situations and identifying important variables; converting problems into mathematical language or appropriate mathematical models into appropriate drawings or graphs; applying mathematical model designs to find mathematical solutions; interpreting mathematical results; and evaluating mathematical solutions in the context of real-world problems (Selan, Daniel, & Babys, 2020). Meanwhile, according to Syifani & Siregar, the indicators of mathematical knowledge ability in 2023 are understanding the information provided, the ability to form mathematical models, determining the procedures to be used, applying mathematics in different situations, and the ability to apply it in real life. Communicate problem-solving solutions using arguments.

Based on the description above, it can be concluded that the indicators of mathematical literacy skills are: formulate mathematics in different contexts, understand the information provided, convert problems into mathematical language, and use mathematical concepts to describe phenomena or events. Low mathematical literacy skills make obstacles for students in developing critical thinking skills. Therefore, this study aims to determine the impact of the Problem Based Learning (PBL) model on students' mathematical literacy skills (Ahmad & Nasution, 2019).

Based on field facts, it shows that students' literacy is still relatively weak. This is shown through the results of student observations in class VIII. Based on the question instruments used by students, researchers found that students' mathematical literacy skills on the subject of relations and functions were still weak (Rosidah, Hasanah, Nadya, & Sulistiawati, 2019). Students' inability to create mathematical models for more complex problems (Syifani & Siregar, 2023).

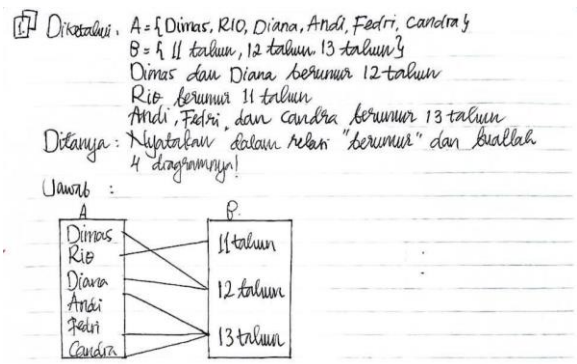


**Figure 1.** Question number 1 results of observations on students

In question no. 1, students are incomplete in formulating mathematics in various contexts; students are also unable to understand the information provided; and students are unable to use concepts to describe phenomena.

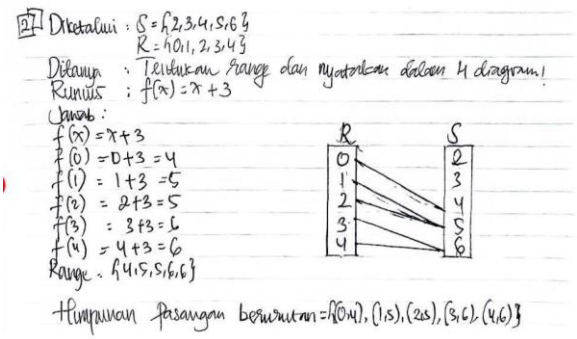


**Figure 2.** Question number 2 results of observations on students

In question no. 2, students are less careful in converting problems into mathematical language; students are unable to use concepts to describe phenomena; and students are incomplete in describing four diagrams.

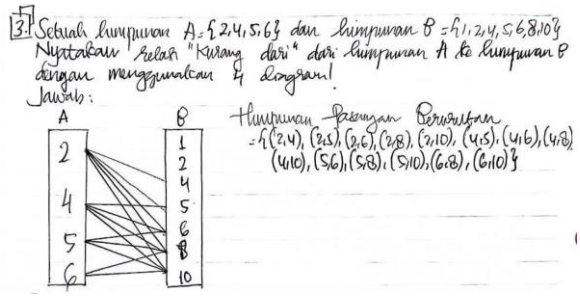

**Figure 3.** Question number 3 results of observations on students

In question no. 3, students are unable to understand the information given; students are unable to formulate in various contexts; and students are unable to use concepts to describe phenomena.

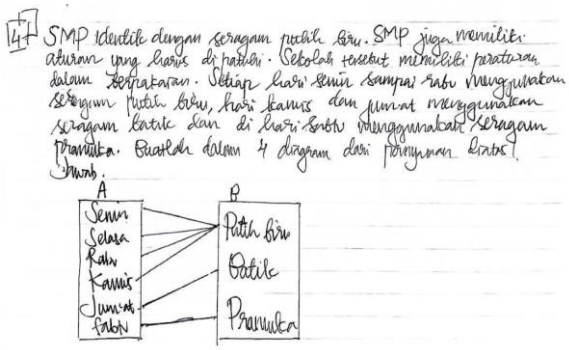

**Figure 4.** Question number 4 results of observations on students

In question no. 4, students are unable to formulate mathematics in various contexts; students are also unable to understand the information provided; and students are unable to use concepts to describe phenomena.

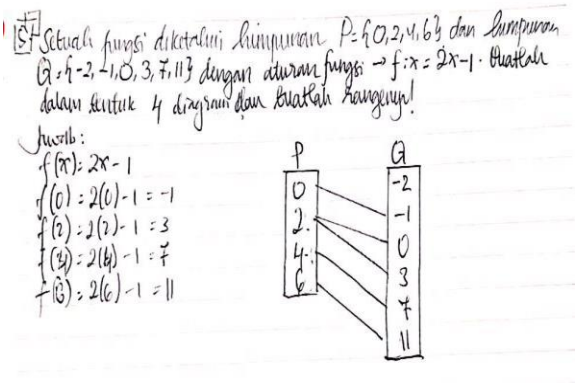

**Figure 5.** Question number 5 results of observations on students

In question no. 5, students are unable to understand the information given; students are unable to formulate mathematics in various contexts; students are unable to use concepts to describe phenomena; but students are able to convert problems into mathematical language.

In addition, observations made by the author on students of SMP Swasta Bahagia Medan in the 2023–2024 school year showed directly that SMP Swasta Bahagia students did not have good mathematical literacy skills. observations showed that of the 36 students who responded to the observation, only 27.77% of students were able to answer the questions correctly, while 16.68% were only able to answer one of the questions given and 55.55% were not able to correctly answer any of the questions given (Sepriliani, Zulkardi, & Somakim, 2022).

Based on the explanation above, the author applies a problem-based learning model, which involves presenting problems, helping students, asking questions, providing facilities that help students solve problems, and presenting the solutions formed (Qur'ani & Aziz, 2023). According to Hotimah (2020), problem-based learning is now student-centered learning, where the teacher is only a facilitator who supports students in carrying out problem-solving activities. So it can be said that problem-based learning

is a teaching model taught by the teacher by presenting problems for students to learn and solve through a problem-solving approach.

There are variations in the way PBL is applied across different educational contexts. Some studies may have focused on one particular PBL approach, but there is still a need to understand how different PBL strategies and models affect students' mathematical literacy.

Fery, Wahyudin, & Tatang (2020) have previously examined the exploration of the effects of PBL on elementary students' mathematical literacy, providing additional insight into its impact at earlier levels of education. Demirel & Dağyar (2021) have also discussed cross-study analysis to gather evidence from previous studies and comprehensively evaluate the impact of PBL on mathematical literacy. The research of Crowley (2020), which observed students' mathematical literacy over several years after implementing PBL, helps to understand the long-term effects of this approach.

The steps for implementing Problem Based Learning are as follows: providing problem orientation to students, organizing students to learn, organizing presentations of results by students, assisting individual and group investigations (Juandi, 2021), and conducting analysis and evaluation of students in solving problems where the Problem Based Learning model makes students' mathematical literacy skills greatly improve (Syifani & Siregar, 2023).

Based on the explanation above, researchers are interested in conducting updated research that is able to discuss in more depth the influence of problem-based learning on students' mathematical literacy abilities.

## METHOD

This research quasi-experiment was conducted in class VIII of SMP Swasta Bahagia Medan in the even semester of the 2023–2024 school year. The population taken was all students in class VIII of SMP Swasta Bahagia Medan in the 2023–2024 school year, consisting of 5 classes, where each class had 36 students. Sampling was done using the cluster random sampling technique, where class VIII-2 was obtained as the experimental class and class VIII-3 as the control class. By using the cluster random sampling technique, this study tries to select a sample that represents the population of students in class VIII of SMP Swasta Bahagia Medan in the 2023–2024 school year. This can increase the generalizability of the research results to a wider population.

The experimental class was given treatment in the form of Problem Based Learning (PBL), and the control class was only taught using conventional learning (Astuti, 2020) because the two classes had the same standard of learning ability based on the results of daily tests and semester exams, where the average score of the two classes was the same, namely class VIII-2 had an average score of 75 while class VIII-3 had an average score, so the researchers wanted to see the ability of the two classes if tested with different learning models. At the end of the meeting, after getting treatment, both classes were given test questions to measure mathematical literacy skills. In this design, there are two groups, each of which is randomly selected. The first group is called the experimental class given treatment in the form of Problem Based Learning (PBL), and the second group is called the control class given treatment in the form of conventional learning (Mayanti, Poluakan, & Tumimomor, 2022). This study chose two classes with the same standard of learning ability as the experimental and control groups. Thus, this study tries to control external factors that may affect the results, such as students' initial ability.

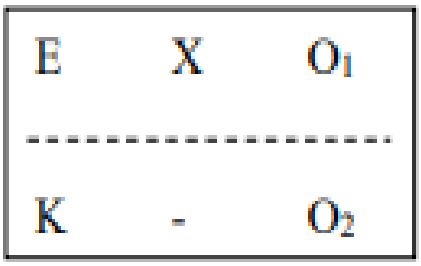


**Figure 6.** Posttest Only Control Group Research Design
(Putri, Rati, & Mahadewi, 2019)

Description:
$x_1$: *Problem Based Learning* Model
$-$ : Convensional Model
$0_1$: Post-test of mathematical literacy in the experimental class
$0_2$: Post-test of mathematical literacy in the control class

In this study, a test with five questions in the form of descriptions that have been validated and declared valid as research instruments is used, and tested with the help of SPSS Statistics 25 software. The classical assumption test consists of a Normality Test and a Homogeneity Test, then the data will be proven to have met the test requirements. An independent sample t-test will then be used to analyze the data. The statistical hypothesis in this study, namely:

$H_0$: $\mu_1 \leq \mu_2$ opposite $H_a$: $\mu_1 > \mu_2$

Description:

$\mu_1$: The mean value of the difference in students' mathematical literacy skills in the experimental class

$\mu_2$: The mean value of the difference in students' mathematical literacy skills in the control class

Testing criteria:

If sig. value > $\alpha$ then Ho is accepted.

If sig. value < $\alpha$ then Ho is rejected.

## RESULTS AND DISCUSSION

The descriptive test results are presented in Table 1.

**Table 1.** Descriptive Test Results

| Class | N | Min | Max | Mean | Std. Dev |
|---|---|---|---|---|---|
| Experiment | 36 | 78 | 100 | 85.94 | 6.615 |
| Control | 36 | 37 | 92 | 54.72 | 12.116 |

Based on Table 1, it can be seen that the mathematical literacy test in the experimental class obtained a mean value of 85.94 with a minimum value of 78 and a maximum value of 100; the standard deviation value is 6.615. While the control class obtained a mean value of 54.72 with a minimum value of 37 and a maximum value of 92, the standard deviation was 12.116. Then, the classical assumption test is carried out, namely, the Normality Test using the Kolmogorov-Smirnov method and the Homogeneity Test with Levene's test. The resulting test results are in Table 2.

**Table 2.** Normality Test Results

| | *Kolmogorov-Smirnov* | | |
|---|---|---|---|
| **Class** | ***Statistic*** | ***Df*** | ***Sig*** |
| Experiment | .105 | 36 | .200 |
| Control | .122 | 36 | .198 |

Based on Table 2, the normality test results show that the sig. value for data in the experimental class is 0.200 > 0.05 and the control class is 0.198 > 0.05. Because 0.200 > 0.05 and 0.198 > 0.05, it is concluded that the research data is normally distributed.

**Table 3.** Homogeneity Test Results

| *Levene Statistic* | *df1* | *df2* | *Sig* |
|---|---|---|---|
| .671 | 1 | 60 | .617 |

Based on Table 3, it can be seen that the results of the Homogeneity Test conducted resulted in a sig. value of 0.617 > 0.05. Because 0.617 > 0.05, the data is proven to be homogeneous. Because the data has been proven to be normally distributed and homogeneous, it has met the requirements for hypothesis testing using the independent Sample t-Test

technique. The test results are presented in Table 4.

**Table 4.** Hypothesis Test Results

| | t-test Equality | | |
|---|---|---|---|
| | **t** | ***df*** | **sig.** |
| Equal Variances Assumed | 14.28 | 70 | .000 |
| Equal Variances Not Assumed | 14.28 | 51.88 | .000 |

Based on table 4, the results of the hypothesis test show a sig. (2-tailed) of 0.000 > 0.05. Because 0.000 > 0.05, based on the test criteria, Ho is rejected. So it can be concluded that there is an effect of Problem Based Learning on students' mathematical literacy skills.

The application of Problem Based Learning in the experimental class gave a mean result of 85.94, according to the research data. This result is better than the mean value of the control class taught with conventional learning, which is 54.72. The results of hypothesis testing showed sig. = 0.000. Because 0.000 > 0.05, it is clear that students who experience the learning process with the Problem Based Learning model and students who experience the conventional learning process have significantly different levels of mathematical literacy.

The results of this study have significant practical implications for educational practitioners, especially mathematics teachers at the junior high school level. By showing that Problem Based Learning (PBL) positively influences students' mathematical literacy, this study provides encouragement to apply more innovative and student-centered learning methods in mathematics teaching.

Educational practitioners can use these findings as a basis for introducing or improving the implementation of PBL in their classrooms. They can design and develop learning units that are problem-based, allowing students to experience mathematics learning in a more active and engaged manner. Thus, teachers can help students develop a deeper understanding of mathematical concepts and improve their ability to solve problems.

In addition, the results of this study also emphasize the importance of adequate support and training for teachers to implement PBL effectively. Educational practitioners can use this information to plan relevant training programs and support teachers in implementing PBL well in the classroom.

This research also contributes to educational theory, especially in the fields of mathematics learning and constructivist learning theory. The finding that PBL can improve students' mathematical literacy strengthens the concept that student-centered and contextualized learning can enrich their understanding of the subject matter.

In addition, this study also shows the importance of the local educational context in evaluating the effectiveness of a particular learning method. By involving a population of students from a junior high school in Medan, this study highlights the importance of taking into account cultural, social, and educational contexts in designing and evaluating learning practices.

Overall, the results of this study enrich our understanding of the relationship between learning methods and students' mathematical literacy skills and provide valuable insights for educational practitioners and the development of educational theory.

The results of this study provide important insights into the effect of Problem Based Learning (PBL) on the mathematical literacy skills of grade VIII students at SMP Swasta Bahagia Medan. Specifically, this study showed that the PBL-treated class showed a significant improvement in mathematical literacy skills compared to the class taught using conventional learning. These results are

consistent with the findings of a number of previous studies.

For example, research conducted by Astuti (2020) also found that the implementation of PBL improved students' mathematical literacy skills. However, this study broadens our understanding by involving a different student population, namely grade VIII students at SMP Swasta Bahagia Medan, thus providing a richer and more varied context to evaluate the effectiveness of PBL.

On the other hand, there are also studies that show different results. For example, research by Mayanti et al. (2022) found no significant difference between the class that received PBL and the control class in terms of mathematical literacy skills. This difference may be due to variations in the implementation of PBL, differences in the student population, or other factors that influence the results.

The similarity between this research and previous research lies in the focus on the effect of PBL on students' mathematical literacy skills. They both used an experimental research design to compare the effectiveness of PBL with other learning methods and used tests to measure students' mathematical literacy skills.

However, this study makes additional contributions by involving different student populations and different educational contexts, as well as by expanding our understanding of the impact of PBL on mathematical literacy skills.

Based on the results of hypothesis testing and data analysis, it is known that the experimental class treated using Problem Based Learning accompanied by LKPD (Lembar Kerja Peserta Didik) has higher mathematical literacy skills than the control class treated using a conventional approach accompanied by LKPD. Students can participate more actively and create a friendly learning environment through the Problem Based Learning model because it is different from conventional learning, which is not student-centered, so that students are unable to collaborate with one another (Awami, Yuhana, & Nindiasari, 2022).

In addition, the LKPD in Problem Based Learning approach helps students practice mathematical literacy skills. This is because working on LKPD that is completed in groups can train students to have the character to respect other people's opinions, work together, be responsible for their tasks, and develop students' communication skills (Pamungkas & Franita, 2019). The results of the study concluded that there was a big difference between the mathematical literacy skills of students who were educated with Problem Based Learning and conventional learning (Ayunda, Lufri, & Alberida, 2023).

## CONCLUSIONS AND SUGGESTIONS

From the series of paragraphs above, it can be concluded that the application of Problem Based Learning (PBL) in the experimental class provides significant results in improving students' mathematical literacy skills compared to conventional learning. The research data showed that the experimental class that received PBL treatment had a higher mean (85.94) than the control class taught with conventional learning (54.72). Hypothesis testing results also indicated that there was a significant difference between the two groups, with a very low significance value ($sig. = 0.000$). Thus, PBL has a significant positive impact on students' mathematical literacy skills, and its implementation can provide practical benefits and important theoretical contributions in the context of mathematics education at the junior high school level.

Further research could compare the effectiveness of PBL with other alternative learning methods, such as Inquiry-Based

Learning or Cooperative Learning, in improving students' mathematical literacy skills. This will help in understanding the relative merits of each learning approach in a particular context.

## REFERENCES

Ahmad, M., & Nasution, D. P. (2019). Peningkatan kemampuan literasi matematika siswa sekolah menengah pertama melalui pendekatan kontekstual. *Jurnal Education and Development*, *7*(2).

Ananda, E. R., & Wandini, R. R. (2022). Analisis kemampuan literasi matematika siswa ditinjau dari self efficacy siswa. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(5), 5113–5126. https://doi.org/10.31004/obsesi.v6i5.2659

Astuti, A. D. K. P. (2020). Pengaruh problem based learning terhadap kemampuan literasi matematis siswa kelas vii di smp negeri 1 bobotsari. *AlphaMath : Journal of Mathematics Education*, *4*(2), 37. https://doi.org/10.30595/alphamath.v4i2.7359

Awami, F., Yuhana, Y., & Nindiasari, H. (2022). Meningkatkkan kemampuan literasi numerasi dengan model problem based learning (pbl) ditinjau dari self confidence siswa smk. *MENDIDIK: Jurnal Kajian Pendidikan Dan Pengajaran*, *8*(2), 231–243. https://doi.org/10.30653/003.202282.236

Ayunda, S. N., Lufri, L., & Alberida, H. (2023). Pengaruh model pembelajaran problem based learning (pbl) berbantuan lkpd terhadap kemampuan berpikir kritis peserta didik. *Journal on Education*, *5*(2), 5000–5015. https://doi.org/10.31004/joe.v5i2.1232

Crowley, B. M. (2020). The effects of problem-based learning on mathematics achievement of elementary students across time. *Masters Theses & Specialist Project*.

Demirel, M., & Dağyar, M. (2021). Effects of problem-based learning on attitude: A meta-analysis study. *EURASIA Journal of Mathematics, Science and Technology Education*, *12*(8). https://doi.org/10.12973/eurasia.2016.1293a

Fery, M. F., Wahyudin, & Tatang, H. (2020). Improving primary students mathematical literacy through problem based learning and direct instruction. *Educational Research and Reviews*, *12*(4), 212–219. https://doi.org/10.5897/ERR2016.3072

Hanum, A., Mujib, A., & Firmansyah, F. (2020). Literasi matematis siswa menggunakan etnomatematika gordang sambilan. *JIPMat*, *5*(2), 173–184. https://doi.org/10.26877/jipmat.v5i2.6777

Hasanah, L. W., Silalahi, H., & Utama, N. B. P. (2023). Strategi pembelajaran berdiferensiasi pada pembelajaran matematika materi keliling bangun datar kelas iv sekolah dasar. *Jurnal Didaktika Pendidikan Dasar*, *7*(1), 237–258. https://doi.org/10.26811/didaktika.v7i1.1064

Hotimah, H. (2020). Penerapan metode pembelajaran problem based learning dalam meningkatkan kemampuan bercerita pada siswa sekolah dasar. *Jurnal Edukasi*, *7*(3), 5. https://doi.org/10.19184/jukasi.v7i3.21599

Juandi, D. (2021). Heterogeneity of problem-based learning outcomes for improving mathematical competence: A systematic literature review. *Journal of Physics: Conference Series*, *1722*(1), 012108. https://doi.org/10.1088/1742-6596/1722/1/012108

Mayanti, A., Poluakan, C., & Tumimomor, F. R. (2022). Pengaruh model problem based learning (pbl) menggunakan metode demonstrasi dan eksperimen pada pembelajaran fisika tentang hukum newton. *Charm Sains: Jurnal Pendidikan Fisika*, *3*(1), 9–14. https://doi.org/10.53682/charmsains.v3i1.144

Mulyati, S., & Evendi, H. (2020). Pembelajaran matematika melalui media game quizizz untuk meningkatkan hasil belajar matematika smp. *GAUSS: Jurnal Pendidikan Matematika*, *3*(1), 64–73. https://doi.org/10.30656/gauss.v3i1.2127

Nugroho, D. D. B., & Muhroji, M. (2022). Budaya sekolah dalam menumbuhkan karakter peduli lingkungan di sekolah dasar. *Jurnal Basicedu*, *6*(4), 6301–6306. https://doi.org/10.31004/basicedu.v6i4.3233

Pamungkas, M. D., & Franita, Y. (2019). Keefektifan problem based learning untuk meningkatkan kemampuan literasi matematis siswa. *Jurnal Penelitian Pendidikan Dan Pengajaran Matematika*, *5*(2).

Putri, G. A. M. D., Rati, N. W., & Mahadewi, L. P. P. (2019). Pengaruh model pembelajaran berbasis proyek terhadap hasil belajar ipa. *Journal of Education Technology*, *3*(2), 65. https://doi.org/10.23887/jet.v3i2.21705

Qur'ani, S. R., & Aziz, T. A. (2023). An instructional design process with problem based learning (pbl) in probability. *Khazanah Pendidikan*, *17*(2), 351. https://doi.org/10.30595/jkp.v17i2.18048

Rosidah, I. D., Hasanah, U., Nadya, & Sulistiawati. (2019). Analisis problematika peserta didik pada mata pelajaran matematika materi relasi dan fungsi. *Prosiding Seminar Nasional Penelitian Pendidikan Matematika (SNP2M) 2019 Universitas Muhammadiyah Tangerang*.

Selan, M., Daniel, F., & Babys, U. (2020). Analisis kemampuan literasi matematis siswa dalam menyelesaikan soal pisa konten change and relationship. *AKSIOMA : Jurnal Matematika Dan Pendidikan Matematika*, *11*(2), 335–344. https://doi.org/10.26877/aks.v11i2.6256

Sepriliani, S. P., Zulkardi, Z., & Somakim, S. (2022). Development of pisa-like activities using the inquiry-based learning model and the context of religious holidays during the pandemic. *Jurnal Pendidikan Matematika*, *17*(1), 37–54. https://doi.org/10.22342/jpm.17.1.17765.37-54

Syifani, M. A., & Siregar, T. J. (2023). Perbedaan kemampuan literasi matematis siswa smp negeri 3 medan pada soal cerita yang diajarkan dengan problem based learning dan konvensional. *Euclid*, *10*(1), 76–87. https://doi.org/10.33603/e.v10i1.8526

Tabun, H. M., Taneo, P. N. L., & Daniel, F. (2020). Kemampuan literasi matematis siswa pada pembelajaran model problem based learning (pbl). *Edumatica : Jurnal Pendidikan Matematika*, *10*(01), 1–8. https://doi.org/10.22437/edumatica.v10i01.8796