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ANALYSIS OF PROBLEM SOLVING SKILLS OF X GRADE STUDENTS FOR TRIGONOMETRY MATERIAL AFTER EXPERIENCING LEARNING USING A REALISTIC MATHEMATICS APPROACH ASSISTED BY GEOGEBRA

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Abstract

One of the abilities that students need to build when learning mathematics is problem solving ability, so that students can implement their mathematical knowledge. From the results of student tests in the previous year and exploring the problem, researchers found that the problem solving ability of students faced for Trigonometry material is analyzing problems, organizing ideas and solving problems. The purpose of this study is to describe how students' problem solving skills after experiencing learning with the Realistic Mathematics Education Approach (PMR) for Trigonometric Comparison material assisted by Geogebra. The research subjects were 31 grade X students in one of the private high schools in Bekasi city in 2024/2025. The data collection methods used were field notes, written tests, and interviews. The instrument validation technique used expert validation techniques, while to validate the data, triangulation techniques were used. The research results from the written test are as follows: (a) the most difficulties found for problems 1 and 2 were executing the plan to get a solution, and looking back at the solution process; (b) the most difficulties found for problem 3 were making a plan, executing the plan, and looking back at the solution process. From the interviews with five students, it was found that the most experienced difficulties were making a plan, carrying out the plan, and reviewing the solution process; (b) the most experienced difficulties for problem 3 were making a plan, carrying out the plan, and reviewing the solution process.

Keywords: problem solving ability; hypothetical learning trajectory; pmr; geogebra

1. Introduction

The priority of teachers in learning mathematics is to build problem solving skills (Mayratih et al., 2019). Branca said that problem solving skills are very important for students to build because (1) problem solving is one of the main objectives of teaching mathematics, (2) problem solving in which there are methods, procedures, and strategies is the main process in the mathematics curriculum, and (3) problem solving is a basic ability in exploring mathematics (Trionanda, 2022). This is in line with the learning objectives of mathematics contained in Permendiknas Number 22 of 2006, namely: students are able to solve problems, design models, solve, and interpret solutions (Dwita Imannia et al., 2022).

Problem solving ability is a person's ability to use his skills, knowledge and understanding to find solutions when working on mathematical problems and building mathematical concepts (Agustina & Imami, 2022). Problem solving ability according to Ormrod is the ability to use existing knowledge and skills to answer unanswered questions or difficult situations (Septina et al., 2018). Polya stated that problem solving ability is an effort to find a solution to a problem or difficulty to achieve completion and goals (Hadi & Radiyatul, 2014). So, it can be concluded that problem solving ability is the ability of students to connect and use their previous experience and knowledge to solve a problem.

In this study, the indicators to be used are indicators of problem solving ability derived from Polya's problem solving steps, namely: (a) understanding the problem. At this stage, students are expected to be able to explain what data is in the problem; (b) planning problems.

Students are expected to be able to design a problem solving plan that will be carried out by students, and the reasons why students choose these steps; (c) working on solutions. At this stage, students are expected to be able to solve the problem based on the steps that have been designed in the previous stage; and (d) checking back. In this stage, students are expected to re-examine the solution steps that have been done (Hadi & Radiyatul, 2014). This indicator was chosen because through this step, researchers hope that students can think systematically to solve a problem.

From the results of observations made by researchers to students at a private high school in Bekasi, it was found that students feel happier if (1) the teacher explains the material that must be learned by students, (2) the teacher gives examples of how to solve problems related to the material studied by students, and (3) provides practice problems that are similar to the examples that have been given by the teacher. Another finding found by the researcher is that when students have to solve a new problem that has never been given before, students prefer to use practical applications to help them solve the problem. Another observation is that in general, there are still many students who have difficulty in analyzing problems, organizing ideas and solving problems (Ritonga et. al., 2021).

From the process of exploring the problem of students' problem solving skills for Trigonometry material conducted by researchers by giving two problems about Trigonometry to students, researchers obtained the following results: students have difficulty in analyzing problems, organizing ideas, and solving problems.

Gravemeijer said that there are three principles in learning mathematics using the PMR approach, namely: (a) guided reinvention and progressive mathematization In the learning process, students are expected to make guided discoveries and experience a continuous mathematization process; (2) didactical phenomenology. Learning conducted by the teacher focuses on the exploration of phenomena that can be used by students to build mathematical concepts, and (c) self-developed models. Students are able to build patterns/ models to connect their initial information (informal) with formal mathematical concepts (Wati et al., 2021).

PMR has five characteristics which include: (1) The use of context: connecting daily life experiences with mathematics so that learning becomes meaningful, (2) The use of models: models as a bridge to help solve a problem, (3) Student contribution: providing space and time for students to actively think and contribute to the mathematics learning they experience, (4) Interactivity: interaction between students and students with teachers is needed so that mathematics learning that occurs is dynamic and lively, (5) Intertwining (linkage) mathematical material with material outside of mathematics is something that cannot be separated (Agusta, E.S., 2020).

From the research conducted by Sibarani (2022), it was found that the Indonesian Realistic Mathematics Education (PMRI) approach can improve students' problem solving skills and learning outcomes. From the research by Rahman and Setyaningsih (2022), it was found that problem

solving ability increased after experiencing the learning process using the PMR approach. The increase in students' problem solving ability can be seen from the increase in the average score of students' problem solving ability.

The formulation of the problem to be solved by researchers in this study is how the problem solving ability of grade X students for Trigonometry material after experiencing learning using the Realistic Mathematics Education approach with the help of Geogebra.

2. Method

This study uses design research developed by Cobb and Gravemeijer which consists of three stages, namely: developing a lesson plan, implementing the lesson plan, and analyzing the data obtained (Nursyahidah et al., 2020). The subjects in this study were grade X students at a private school in Bekasi city. The object of this research is students' problem solving ability after experiencing the learning process using the PMR approach. The data collection methods used were making field notes, written tests and interviews. The selection of subjects to be interviewed was based on the score categories obtained from the written test results. There are three groups made based on the written test results, namely low, medium, and high problem solving ability groups. The categorization uses the criteria for grouping the value interval limits (Arikunto, 2016).

The first step is to determine the standard deviation of the written test scores using the following formula: $SD = \sqrt{\frac{\sum X^2}{N} - \left(\frac{\sum X}{N}\right)^2}$ with, SD = Standard deviation, N = a lot of data, X = the value obtained by students

After that the data is categorized using the following interval limit classification:

Table 1. Classification of Student Score Interval

Category	Limit
Upper	$X > M + 1\,SD$
Middle	$M = 1\,SD \leq X \leq M + 1\,SD$
Lower	$X < M - 1\,SD$

The research instruments used in this study were field notes, test sheets, and interview sheets. The instrument validation technique used is expert validation technique, while the technique used in the data validation process is to use technical triangulation. Technical triangulation is a data collection process carried out by checking data to the same source with different techniques. Data obtained through test results related to problem solving ability will be checked again by conducting interviews with subjects in the high, medium, and low categories.

The data analysis technique used is the data analysis technique proposed by Miles and Huberman which consists of three steps, namely: (1) Data Condensation, in this study, the data taken was then translated in the form of transcripts. Furthermore, researchers conducted data reduction. The data reduction process was carried out through a data grouping process. Data on activities that occur in the learning process obtained from field notes and documentation will be classified based on indicators of problem solving ability. Data from written test results and interviews used to explain students' thinking strategies in solving problems will be classified using problem solving ability indicators (2) Data display, In this research, data will be obtained related to the realization of HLT or the learning process. Researchers will present data on the description of activities that occur in the learning process obtained from field notes and documentation, Researchers will present data from written test results and interviews by explaining students' thinking strategies in solving problems based on indicators of problem solving ability by explaining students' thinking strategies in solving problems based on problem solving ability indicators. (3) Drawing and Verifying Conclusions, Drawing conclusions in this study based on the formulation of the problems that have been compiled. Conclusions are also based on the discussion of the results of data analysis carried out which comes from daily notes, test results and interview results based on problem solving indicators.

3. Results and Discussion

3.1 Results

After the learning process using the PMR approach was completed, researchers gave tests to students. The written test consisted of three problems. There were 31 students who took the written test. The following presents the results of the analysis that has been done by researchers on the results of students' written tests:

Table 2. Analysis of Problem Solving Ability of 31 Students for Problem 1

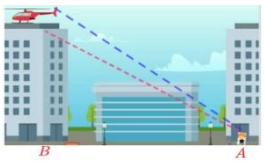
Problem 1	Analysis of Achievement of Problem Solving Ability Indicators
There is a helicopter on the roof of Maestro Tower.  The distance from the measurement site to the nearest building foot is AB=30√3 meters. The elevation angle formed by the top of the building and the observation point is 30^0, while the elevation angle between the tip of the helicopter and the observation point is 45^0 a. Explain what is known from this problem! b. Make a plan to determine the height of the Maestro Tower building! Explain the reason for each step! c. Make a plan to determine the height of the helicopter! Explain the reason for each step! d. Find the height of the Maestro Tower building! e. Find the height of the helicopter! f. Check your answers again, are there any mistakes? If so, explain and how did you correct them?	1. Ten subjects were able to understand the problem, able to plan the solution, compile the appropriate mathematical model, solve the problem, able to look back and explain the results according to the original problem. 2. Six subjects were able to understand the problem, able to plan the solution, construct the appropriate mathematical model, solve the problem but not yet able to look back and explain the results according to the original problem. 3. Eleven subjects were able to understand the problem, able to compile an appropriate mathematical model by making an appropriate sketch, making a problem solving plan, able to determine the height of the building but not yet able to determine the height of the helicopter. 4. Four subjects were only able to understand the problem.

Table 3. Analysis of Problem Solving Ability of 31 Students for Problem 2

Problem 2	Analysis of Achievement of Problem Solving Ability Indicators
On a sunny day, Carlos was flying a kite with some of his friends, when the wind was blowing east. It is known that Carlos' kite string is 24 meters long. One of his friends named Hosea was standing 12(√6-√2) meters to the west of Carlos and was watching Carlos play with his kite. Carlos' evaluation angle to the kite is 45^0. a. Write down what is known from the problem! b. Draw a sketch depicting the situation above! c. Make a plan to determine the height of the kite from Carlos' hand! Explain the reason for each step! d. Draw a plan to determine the angle of elevation between Hosea and Calos kite! e. Determine the height of the kite from Carlos' hand! f. Find the angle of elevation between Hosea and Carlos' kite! g. Check your answers again, are there any mistakes, if so, explain and how did you correct them?	1. Four subjects were able to understand the problem, able to plan the solution, compile the appropriate mathematical model, solve the problem, able to look back and explain the results according to the original problem. 2. Eight subjects were able to understand the problem, able to plan the solution, construct the appropriate mathematical model, solve the problem but not yet able to look back and explain the results according to the original problem. 3. Sixteen subjects were able to understand the problem, develop a suitable mathematical model by making a suitable sketch, make a problem solving plan, able to determine the height of the kite but not yet able to determine the elevation angle between Hosea and Carlos' kite, not yet able to look back and explain the results according to the original problem. 4. Three subjects were only able to understand the problem.

Table 4. Analysis of Problem Solving Ability of 31 Students for Problem 3

Problem 3	Analysis of Achievement of Problem Solving Ability Indicators
In a square field, there was going to be a competition to commemorate the independence of the Republic of Indonesia. Sammy, who is in one corner of the field, sees a light pole in the other corner of the field that is diagonally aligned with him. The distance between Sammy and the light bulb is 10√6 meters. a. Explain what is known from this problem!	1. Five subjects were able to understand the problem, able to plan the solution, compile the appropriate mathematical model, solve the problem, able to look back and explain the results according to the original problem. 2. Fourteen subjects were able to understand the problem, able to plan the solution, construct the appropriate mathematical model, solve the problem

Problem 3	Analysis of Achievement of Problem Solving Ability Indicators
b. Make a plan to determine the area of the field! Explain the reason for each step! c. Draw a sketch depicting the situation above. d. Determine the area of the field! e. Check your answer again, are there any mistakes? If so, explain and how did you correct them?	but not yet able to look back and explain the results according to the original problem. 3. Five subjects have not met the indicators of understanding the problem because they did not write down what was known completely. Subjects were able to make appropriate sketches and were able to make several plans to determine the area of the field. The subject has not been able to determine the area of the field correctly. And the subject has not been able to look back, explain according to the original problem so that the subject has not found a mistake in his work. 4. Six subjects are only able to understand the problem, and are able to compile an appropriate mathematical model by making an appropriate sketch.

Based on the test results obtained, researchers classified students' problem solving skills into three groups, namely high, medium, and low groups. Based on the problem solving ability grouping steps, the following results were obtained: (1) the average written test score is 57.96, (2) the standard deviation of the written test score is 19. 22, (3) the score limit for the high group is 79-100, (4) the score limit for the medium group is 39-77, (5) the score limit for the low group is 0-38, (6) the number of students in the high group is eight students, (7) the number of students in the medium group is twenty students, (8) the number of students in the low group is three students, and (9) the number of students from the high, medium, and low groups interviewed is one, three, and one student respectively. The process of determining the number of students interviewed for each group was carried out proportionally.

The following presents the results of analyzing students' abilities based on the results of interviews with students:

Table 5. Analysis of Students' Problem Solving Ability for Problem 1 based on Interviews

Subject	Analysis of Achievement of Problem Solving Ability Indicators
Upper Group Subject	1. The subject is able to understand the problem by collecting information related to problem 1. 2. The subject can explain what is known from problem 1. 3. The subject can plan the solution to determine the height of the building and the height of the helicopter by using tangent. The subject was able to explain how to use the tan 30^0ratio in determining the height of the building and the tan 45^0 ratio when finding the height of the helicopter. 4. The subject can develop a mathematical model in the form of a sketch of problem 1 by illustrating the situation in the problem with a right triangle and writing what is known and asked in the sketch made. 5. The subject can solve the problem by finding the height of the building is 30 m and the height of the helicopter is (30√3-30)m. 6. The subject has also re-examined the problem solving that has been made and did not find any errors in each step of the solution.
First Subject of Medium Group	1. The subject was able to collect information related to problem 1 and explain what was known from problem 1. 2. The subject was able to plan a solution to determine the height of the building and the height of the helicopter by using tangent comparison. 3. The subject can develop a mathematical model using a sketch. 4. The subject can find the height of the building 30 m and the height of the helicopter (30√3-30) m The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Second Subject of Medium Group	1. The subject is able to collect information related to problem 1. 2. The subject was able to plan how to determine the height of the building and the height of the helicopter by using tangent comparison. 3. The subject has not been able to develop a mathematical model in the form of a sketch of problem 1. 4. The subject can determine the height of the building 30 m and the height of the helicopter (30√3-30)m.

Subject	Analysis of Achievement of Problem Solving Ability Indicators
	5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Third Subject of Medium Group	1. The subject is able to collect information related to problem 1. 2. The subject was able to plan how to find the height of the building and the height of the helicopter by using tangent comparison. 3. The subject can develop a mathematical model in the form of a sketch of problem 1. 4. The subject can determine the height of the building 30 m and the height of the helicopter $(30\sqrt{3}-30)$m. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Lower Group Subject	1. The subject is able to collect information related to problem 1. 2. The subject has not been able to plan how to determine the height of the building or the height of the helicopter using tangent. 3. The subject has not been able to develop a mathematical model in the form of a sketch of problem 1. 4. The subject has not been able to determine the height of the building and the height of the helicopter. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.

Table 6. Analysis of Students' Problem Solving Ability for Problem 2 based on Interviews

Subject	Analysis of Achievement of Problem Solving Ability Indicators
Upper Group Subject	1. The subject was able to collect information related to problem 2 and explain what was known in problem 2. 2. The subject was able to plan how to determine the height of the kite from Carlos' hand by using the Sine ratio. Hosea's elevation angle with the kite was obtained using the tangent function. 3. The subject was able to compile a mathematical model in the form of an illustration of the problem using a right triangle, and wrote what was known and asked in the sketch made. 4. The subject was able to find that the kite height is $12\sqrt{2}$ m and the elevation angle between Hosea and Carlos' kite is 30^0. 5. The subject was able to review the solution process that had been made and explain the results obtained in accordance with the original problem.
First Subject of Medium Group	1. The subject was able to collect information related to problem 2 and explain what was known. 2. The subject was able to plan how to determine the height of the kite by using the Sine ratio, but was not able to plan how to find the elevation angle between Carlos' and Hosea's kites. 3. The subject was able to compose a mathematical model in the form of an illustration of the problem using a right triangle, and wrote down what was known and asked in the sketch made. 4. The subject was able to find that the kite height is $12\sqrt{2}$ m, but was not able to find the elevation angle between Hosea and Carlos' kite. 5. The subject was able to review the solution process that had been made and explain the results obtained in accordance with the original problem.
Second Subject of Medium Group	1. The subject was able to gather information related to problem 2. 2. The subject was able to plan how to determine the height of the kite by using the Sine ratio, but was not able to plan how to find the elevation angle between Hosea and Carlos' kite . 3. The subject was able to develop a mathematical model in the form of a sketch of problem 2. 4. The subject was able to find that the kite height was $12\sqrt{2}$ m, but was not able to find the elevation angle between Hosea and Carlos' kite. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Third Subject of Medium Group	1. The subject is able to collect information related to problem 2. 2. The subject was not able to plan how to determine the kite height using the Sine ratio, and was not able to plan how to find the elevation angle between Carlos' and Hosea's kites. 3. The subject was able to develop a mathematical model in the form of a sketch of problem 2. 4. The subject could not find the kite height and elevation angle between Hosea and Carlos' kite. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Lower Group Subject	1. The subject is able to collect information related to problem 2. 2. The subject was not able to plan how to determine the kite height using the Sine ratio, and was not able to plan how to find the elevation angle between Carlos' and Hosea's kites. 3. The subject was not able to develop a mathematical model in the form of a sketch of problem 2.

Subject	Analysis of Achievement of Problem Solving Ability Indicators
	4. The subject was unable to find the kite height and elevation angle between Hosea and Carlos' kite. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.

Table 7. Analysis of Students' Problem Solving Ability for Problem 3 based on Interviews

Subject	Analysis of Achievement of Problem Solving Ability Indicators
Upper Group Subject	1. The subject was able to collect information related to problem 3, and explain what was known. 2. The subject was able to plan how to find the area of the field. 3. The subject was able to develop a mathematical model of problem 3 by illustrating the field into a square and drawing a diagonal line so as to produce two congruent right triangles and writing what was known and asked in the sketch made. 4. The subject was able to find the area of the field is 300 m^2. 5. The subject was able to look back at the solution process that had been made and explain the results obtained in accordance with the original problem.
First Subject of Medium Group	1. The subject was able to collect information related to problem 3, and explain what was known. 2. The subject was able to plan how to find the area of the field. 3. The subject is able to compile a mathematical model in the form of a sketch of problem 3. 4. The subject could not find the area of the field. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Second Subject of Medium Group	1. The subject was able to collect information related to problem 3, and explain what was known. 2. The subject was able to plan how to find the area of the field. 3. The subject is able to compile a mathematical model in the form of a sketch of problem 3. 4. The subject could not find the area of the field. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.
Third Subject of Medium Group	1. The subject has not been able to collect information related to problem 3 and has not been able to explain well what is known. 2. The subject has not been able to plan how to find the area of the field. 3. The subject has not been able to develop a mathematical model in the form of a sketch of problem 3, 4. The subject could not find the area of the field. 5. The subject has not reviewed the solution process that he has made, and has not been able to explain the results obtained into the context of the original problem.

3.2 Discussion

In this study, GeoGebra was used as a tool for students to better understand Trigonometric Comparison material in the form of a worksheet in which students were previously presented with a contextual problem about the use of drones in aerial photography in an oil palm plantation. From the observation results, students look more active in learning. Students can freely change the value of the slider and see directly the changes that occur in a right triangle so that the math being studied can be realistically felt by students. This is in accordance with the characteristics of PMR, namely (1) The use of context: connecting daily life experiences with mathematics so that learning becomes meaningful, (2) The use of models: models as a bridge to help solve a problem, (3) Student contribution: providing space and time for students to actively think and contribute to the learning of mathematics they experience. The use of GeoGebra in this study has more or less played a role in the way students see a problem, but it is not an in-depth discussion in this study.

From the results of the research described earlier, it was identified that there were still some students who experienced difficulties when they solved problems and not all students could achieve all indicators of problem solving ability. Students who experience difficulties from the results of the study can be seen in Figure 1 below:

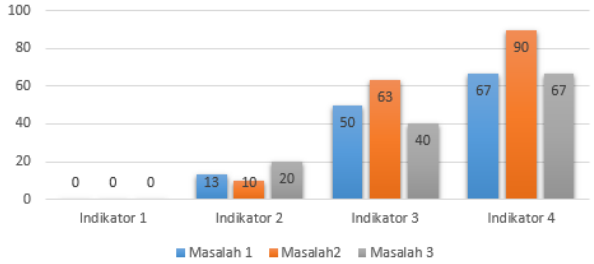


Figure 1. Percentage of Students Experiencing Difficulties based on Polya Indicators

Student difficulties as in Figure 1. above in terms of indicators of problem solving ability according to Polya can be described as follows: (1) Indicators of understanding the problem. Students feel that the time given to solve the problem is quite

short or not long enough, so students feel no need to write down what is known completely in order to solve the problem on time; (2) Indicator of determining the problem solving plan. Students are less careful and have not been able to recall the Trigonometric comparison material that students have learned in the first and second meetings. Students have not been able to connect the Trigonometric comparison material with the new problem at hand. This shows that the mathematization process both horizontally and vertically has not reached the formal level and is well internalized; (3) Problem solving indicators. Students' difficulties that arise when planning solutions and making mathematical models have an impact on the stage of implementing the plan. Students have not been able to implement the strategy or plan made previously so that they have not been able to find the right and correct solution. There are also students who have not been able to make plans so that students are confused about how to take the right steps to solve the problem; and (4) Indicators of re-examining the answers obtained. Students feel that this stage is a part that does not really need to be done so students immediately continue their work to solve the next problem without working on the looking back stage. From the results of interviews with students, the difficulties that are still found after learning with PMR, occur because some students lack preparation when facing a written test, some feel a lack of time, and some are in a hurry so they skip the stage to look back at the answer. Students should continue to be trained and practice in the future so that they can be more thorough, more trained when understanding problems, connecting what is known, asked into a mathematical model and making good time efficiency when working on math problems. This is in line with the research of Rahman & Nur (2021) which states that the factors that cause errors in working on mathematical problems are that students have not been able to find out important information in the problem, prerequisite material that has not been understood, students are less careful during calculation operations and are not used to dealing with story problems so that they do not use time properly.

A learning approach that is believed to be able to link Mathematics concepts with real life is the Realistic Mathematics Approach. This Realistic Mathematics Approach helps students to more easily understand Mathematics concepts because it departs from real problems that students understand. The realistic approach is highly proposed to be used and applied by teachers in schools because it is able to develop children's mathematical thinking (Magdalena et al., 2022). If teachers use the Realistic Mathematics Education approach, then students are expected to learn step by step in solving math problems that are often encountered in real life. Hopefully, students' problem solving skills will also develop with the presence of real problems that can make students think critically when understanding and working on a math problem.

4. Conclusion

The research results obtained in this study are as follows: (1) Based on the results of written tests on 31 students, it can be concluded that: (a) for problem 1, there are no students who have not been able to understand the problem, there are four students who have not been able to make a problem solving plan, there are fifteen students who have not been able to carry out the plan to get a solution to the problem, and there are twenty-one students who do not look back at the solution process; (b) for problem 2, there are no students who have not been able to understand the problem, there are three students who have not been able to make a problem solving plan, there are nineteen students who have not been able to carry out the plan to get a solution to the problem, and there are twenty-seven students who do not look back at the solution process; and (c) for problem 3, there are no students who have not been able to understand the problem, there are six students who have not been able to make a problem solving plan, there are twelve students who do not look back at the solution process. (2) Based on the results of interviews with five students, the results obtained that (a) for problem 1, there are no students who have not been able to understand the problem, there is one student who has not been able to make a problem solving plan, there is one student who has not been able to carry out the plan to get a solution to the problem, and there are two students who do not look back at the solution process; (b) for problem 2, there are no students who have not been able to understand the problem, there are three students who have not been able to make a problem solving plan, there are four students who have not been able to carry out the plan to get a solution to the problem, and there are two students who do not look back at the completion process; and (c) for problem 3, there are no students who have not been able to understand the problem, there is one student who has not been able to make a problem solving plan, there are four students who have not been able to carry out the plan to get a solution to the problem, and there are two students who do not look back at the completion process.

In this study, the use of the PMR approach with the help of GeoGebra has brought a little new touch to the teaching of mathematics. From this study, it was also concluded that practice is needed especially in mathematics teaching to minimize students' difficulties when facing written tests. This research is limited to discussing how students' problem solving skills after experiencing mathematics learning with the PMR approach in Trigonometry material with the help of GeoGebra. It is hoped that in the future there will be more effective innovations to help students, especially students' problem solving skills.

References

Agusta, E. S. (2020). Peningkatan Kemampuan Matematis Siswa melalui Pendekatan Pendidikan Matematika Realistik. *Algoritma: Journal of Mathematics Education*, *2*(2), 145-165. 10.15408/ajme.v2i2.17819

Agustina & Imami (2022). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Kelas X Dalam Menyelesaikan Soal Pisa Berdasarkan Langkah Polya. *EduMatSains : Jurnal Pendidikan, Matematika Dan Sains*, *7*(1), 39–50. https://doi.org/10.33541/edumatsains.v7i1.3852

Arikunto, S. (2016). *Dasar-Dasar Evaluasi Pendidikan*. Jakarta : PT Bumi Aksara

Dwita Imannia, Jumroh, & Destiniar. (2022). Kemampuan Pemecahan Masalah Matematis Siswa Pada Materi Program Linear. *Inomatika*, *4*(1), 19–30. https://doi.org/10.35438/inomatika.v4i1.279

Hadi, S., & Radiyatul, R. (2014). Metode Pemecahan Masalah Menurut Polya untuk Mengembangkan Kemampuan Siswa dalam Pemecahan Masalah Matematis di Sekolah Menengah Pertama. *EDU-MAT: Jurnal Pendidikan Matematika*, *2*(1).

Magdalena , I., Kurniawan, I., Pratiwi, A. D., Fitriah, H., Firlyansyah, H., & Yuliyani, T. (2022). Efektifitas Pendekatan Matematika Realistik terhadap Keterampilan Berpikir Kritis Siswa SD. *Anwarul*, *2*(6), 427–435. https://doi.org/10.58578/anwarul.v2i6.693

Mayratih, G. E., Leton, S. I., & Uskono, I. V. (2019). Pengaruh Disposisi Matematis Terhadap Kemampuan Pemecahan Masalah Matematis Siswa. *Asimtot : Jurnal Kependidikan Matematika*, *1*(1), 41–49. https://doi.org/10.30822/asimtot.v1i1.97

Nursyahidah , F., Saputro, B. A., Albab, I. U., & Aisyah, F. (2020). Pengembangan *Learning Trajectory Based Instructio*n Materi Kerucut Menggunakan Konteks Megono Gunungan. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(1), 47-58. https://doi.org/10.31980/mosharafa.v9i1.591

Rahman & Nur (2021). Analisis kesalahan siswa menyelesaikan soal pemecahan masalah polya. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *4*(6), 1413-1422. https://doi.org/10.22460/jpmi.v4i6.p%25p

Rahman, Z. H., & Setyaningsih, R. (2022). Meningkatkan Kemampuan Pemecahan Masalah Siswa Melalui Pendekatan Realistic Mathematics Education. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(2), 1620. https://doi.org/10.24127/ajpm.v11i2.5139

Ritonga, M. W., Ritonga, I., & Sangkot. (2021). Pengembangan Model Pembelajaran RME (Realistic Mathematics Education) Berbantuan Geogebra Untuk Meningkatkan Kemampuan Pemahaman Konsep Matematis Siswa. *Jurnal Pendidikan Matematika*, *2*(2), 5–11.

Septina, N., Farida, F., & Komarudin, K. (2018). Pengembangan Lembar Kerja Siswa dengan Pendekatan Saintifik Berbasis Kemampuan Pemecahan Masalah. *Jurnal Tatsqif*, *16*(2), 160-171. https://doi.org/10.20414/jtq.v16i2.200

Sibarani, G. (2022). Analisis Kesulitan Komunikasi Matematis Dan Pemecahan Masalah Matematika Siswa Dalam Penerapan Pendekatan Pembelajaran Matematika Realistik Di Kelas X SMA Swasta Sultan Iskandar Muda Medan. UNIMED.

Trionanda, S. (2022, August). Analisis Kesiapan dan Pelaksanaan Pembelajaran Matematika Jarak Jauh Berdasarkan Profil TPACK di SD Katolik Tanjungpinang Tahun Ajaran 2020/2021. In *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika* (Vol. 6, pp. 69-76).

Wati, A. R., Kurniasih, K., & Iriawan, S. B. (2021). Penerapan Pendekatan PMR untuk Meningkatkan Pemahaman Konsep Matematis Siswa Kelas I SD. *Jurnal pendidikan guru sekolah dasar*, *6*(2), 14-23**.** 10.15408/ajme.v2i2.17819