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# Application of the RME Approach on Concept Understanding Ability and Students' Mathematics Problem Solving

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**Keywords**

RME, Pemahaman Konsep, Pemecahan Masalah

**ABSTRACT**

Tujuan penelitian ini untuk (1) mengetahui apakah kemampuan matematika yang dihasilkan oleh pendekatan RME sama atau tidak dengan kemampuan matematika yang dihasilkan oleh pendekatan saintifik; (2) mengetahui apakah pendekatan RME memberikan kemampuan pemahaman konsep yang lebih baik dibandingkan dengan pendekatan saintifik; dan (3) mengetahui apakah pendekatan RME memberikan kemampuan pemecahan masalah yang lebih baik dibandingkan dengan pendekatan saintifik. Quasi experimental digunakan sebagai metode penelitian dengan rancangan *Posttest – only control design with nonequivalent groups*. Lembar tes yang mengukur kemampuan siswa untuk memahami konsep dan memecahkan masalah berfungsi sebagai instrumennya. Adapun uji multivariat beda rerata digunakan untuk analisis data. Hasil dari uji multivariat beda rerata yaitu tolak $H_0$ karena nilai Sig. $(0{,}010) < 0{,}05$. Artinya, kemampuan matematika yang dihasilkan oleh pendekatan RME tidak sama dengan kemampuan matematika yang dihasilkan oleh pendekatan saintifik. Nilai rerata diperoleh bahwa (1) pendekatan RME memberikan kemampuan pemahaman konsep yang lebih baik dibandingkan dengan pendekatan saintifik dan (2) pendekatan RME memberikan kemampuan pemecahan masalah yang lebih baik dibandingkan dengan pendekatan saintifik. Penerapan pendekatan RME dapat dijadikan sebagai salah satu alternatif guru dalam mengembangkan kemampuan pemahaman konsep dan pemecahan masalah matematis siswa.

*RME, Conceptual Understanding, Problem Solving*

*Learning objectives can be achieved if the teaching and learning. The purpose of this study is to (1) determine whether the mathematical ability produced by the RME approach is the same or not as the mathematical ability produced by the scientific approach; (2) determine whether the RME approach provides a better understanding of concepts compared to the scientific approach; and (3) determine whether the RME approach provides better problem-solving ability compared to the scientific approach. Quasi-experimental is used as a research method with Posttest – only control design with nonequivalent groups. A test sheet that measures the student's ability to understand concepts and solve problems serves as his instrument. The multivariate mean difference test was used for data analysis. The results of multivariate test mean difference are rejected* $H_0$ *because of the sig value.* $(0{,}010) < 0{,}05$. *That is, the mathematical ability produced by the RME approach is not the same as the mathematical ability produced by the scientific approach. The average value obtained that (1) the RME approach provides the ability to understand concepts better than the scientific approach and (2) the RME approach provides the ability to solve problems better than the scientific approach. The application of the RME approach can be used as an alternative for teachers in developing the ability to understand concepts and solve mathematical problems of students.*

## INTRODUCTION

In life, mathematics plays an important role in it (Sari et al., 2020) and is closely related to the educational aspect. Through mathematics, students can develop concepts to apply them to solve problems appropriately (Wati et al., 2020). According to Lase (2020) mathematics plays an important role in the advancement of education and the basis of technological development that is beneficial to humans. Mathematics not only plays a role in calculation ability but also plays a role in structuring the way of thinking to solve a problem. Learning mathematics requires the ability to understand and solve mathematical problems. Therefore, understanding a concept and developing the ability to solve problems is important in learning mathematics.

Understanding the concept is inseparable from the mastery of the material in school. The ability to identify,

relate, define ideas in solving problem solving is the meaning of understanding concepts (Firdaus et al., 2022). This is commensurate with Depdiknas (2006) about the purpose of learning mathematics. The purpose in question is to understand mathematical concepts, be able to explain the relationship between concepts, to apply concepts well and be able to find solutions in solving problems. Understanding concepts is not always obtained in the classroom but can be obtained in everyday life (Radiusman, 2020). Understanding of a concept is done alone so it is not easy for students to achieve it. Each student's ability to understand the concept must be different. Through a good understanding of the concept, students will be easy to understand the next mathematical concept (Annisa et al., 2023). In addition, the understanding of concepts becomes an important basis when solving a problem. This is because when determining a plan in solving a problem, mastery of the concept is required. Meanwhile, in learning mathematics, one of the focuses is the ability to solve problems.

Learning will run better also can't be separated from problem solving. Determining and understanding the problem, making the right mathematical model, solving the model is the meaning of problem solving according to (Md, 2019). Problem solving means a human activity in solving problems where most in life must deal with problems. This is commensurate with the research (Fachis et al., 2020) that problem solving is the ability to find solutions to problems faced by students. In addition, according Nurfauziah & Zanthy (2019) problem solving refers to the ability to read, understand the language of the problem, present it in mathematical form, plan a solution, and solve the solution of non-routine problems. Non-routine problems are broader problems and to solve them cannot arise directly (Putri, 2018). These problems require a degree of creativity in solving or solving them. Solving such problems requires the ability to solve mathematical problems. Solving this problem a solution of the difficulty to achieve the goal with a few steps. According to Polya (Purba et al., 2021), there are 4 steps in solving problems, including (1) understanding the problem means determining what is known and asked, (2) planning a solution means identifying the problem to find a strategy to solve the problem appropriately, (3) Implementing problem solving means solving according to the strategy that has been made, and (4) re-examining the

results which means checking the correctness of the answers. Thus, developing problem-solving skills is essential for students (Domu et al., 2022). However, developing this problem-solving ability is not only important for students but also important for others (Wulan, 2019).

Teachers at SMK Gondang have applied a scientific approach in their learning. However, when the implementation is still less than the maximum. Learning is running, the teacher is still dominant. This is evidenced by teachers providing students with material but not actively involving students in their learning. As a result, it also causes the learning process to become monotonous because the student does not have the stimulus to follow the learning. In the learning process conducted by the teacher starts from the definition, giving formulas, and examples of problems. Furthermore, students are given similar exercises and get good grades. Mastery of concepts in learning is not only examples and how students need to know the steps in solving problems. As a result, learning is only unidirectional and the concepts given are poorly understood by students so that mistakes occur in solving problems. In addition, judging from the results of student work on the implementation of odd mid-semester assessment showed low students when understanding concepts and solving problems. This is evidenced by the number of students who have not been able to understand the concept and solve the problem to the fullest.

In the ability to understand concepts, the stage of restating concepts and applying formulas that are in accordance with problem solving students are still many who have not been able to. This is evidenced by the fact that there are still many students who actually do not understand the problems in the problem and students are still confused about the strategy to solve the problem. As a result, students experience errors in solving problems. Meanwhile, on the problem-solving skills of students have not been able to write what is known and asked about the description given. This is in line with Dewi & Zuroidah (2023) research that sometimes students are incomplete in writing down what information is known and asked from the questions. They also still have difficulty in solving correctly and there is no checking of the process and results obtained. In the process of checking can be done by matching the results

obtained with the things asked or identify through other ways to get a solution to a problem. That way, it can help students in understanding what has been learned (Susanto et al., 2023).

In addition, according to some students of Class X SMK Gondang, when solving the problem there are still difficulties. They do not understand the meaning of the problem, do not understand the solution, and are not able to implement the concept correctly. Based on the problems that occur, to develop an understanding of the concept and problem solving the need for solutions. One solution is to use the RME approach. The RME approach is essentially from Freudenthal's understanding of mathematics as the activity of finding, organizing, and solving problems (Gravemeijer, 1999). The approach that focuses on the beginning of a real problem with the aim of finding a concept instead of accepting a ready-made concept from the teacher is called the RME approach. This is commensurate with Freudenthal's thought that students independently rediscover a concept from the problem presented (Alani et al., 2020). In the learning process using the RME approach, students will rebuild concepts and solve problems using their own ways and words (Fauzan et al., 2018). As a result, students will have a strong concept. This is in accordance with one of the advantages of RME, students will not quickly forget the concepts and materials that have been learned (Jarmita & Hazami, 2013). Thus, the problem-solving ability of students will also increase. The purpose of this study is (1) to determine whether the mathematical ability produced by the RME approach is the same or not with the mathematical ability produced by the scientific approach; (2) to determine whether the RME approach provides the ability to understand concepts better than the scientific approach; and (3) find out if the RME approach provides better problem solving capabilities compared to the scientific approach.

## METHODS

Quasi-Experimental methods were used in this study. The design used in this study is Posttest – only control design with nonequivalent groups. The plan has two classes. The first class is given treatment (X) and the second class is not given treatment. The class that is given treatment is called the experimental class while the class that is not given treatment is called the control class. The design of Posttest-only control

design with nonequivalent groups, can be seen in Table 1.

**Table 1.**
**Research Design**

| | | | |
|---|---|---|---|
| Experimental Class | R | X | $O_1$ |
| Control Class | R | | $O_2$ |

Source: (Hastjarjo, 2019)

With:

$O_1$ = experimental class posttest value

$O_2$ = control class posttest value

X = *treatment (learning using the RME approach)*

Table 1 illustrates that this study will provide two types of treatment using the RME approach and scientific approach. RME approach is used for experimental class while scientific approach for control class. Implementation of posttest for experimental class and control class.

These research procedures include the following.

1. Determine the study population. In this study, class X students of SMK Gondang for the 2022/2023 academic year were used as the population.
2. Simple random sampling technique is used to take samples and selected experimental class is Class X TKJ 4 and control class is Class X TKJ 1.
3. Taking and analyzing the initial data from the value of the odd mid-semester assessment of Class X SMK Gondang to determine the normality, homogeneity, and similarity of the average.
4. Develop learning steps that will be done with the RME approach as outlined in the teaching module.
5. Create test grids and define test classes.
6. Determine the form of the test in the form of a question description consists of 10 Questions. The number of questions contains the ability to understand concepts and problem solving.
7. Questions are tested to determine the validity, reliability, level of difficulty, and discriminating power. Validity testing using Gregory formula and obtained the value of the validity of the ability to understand the concept of equal to the ability to solve the problem is 1. The formula to test the

reliability of using Cronbach's Alpha technique and obtained the reliability coefficient of the ability to understand the concept is $0{,}644$ is said reliable. Meanwhile, for the reliability coefficient of mathematical problem-solving ability is $0{,}548$ then the problem is said to be reliable. Furthermore, for the discriminant power using the correlation coefficient formula between item scores and obtained 7 questions about the ability to understand the concept and 8 questions about the ability to solve mathematical problems in accordance with the criteria of discriminant power. Meanwhile, at the level of difficulty obtained 6 questions about the ability to understand concepts and 6 questions about the ability to solve problems in accordance with the criteria of difficulty level. Thus, the questions that are worth using only consist of 6 questions. Meanwhile, for questions that are not feasible then discarded because they do not meet the criteria. Problems that are not feasible are not revised because there are time constraints when the study.

8. After the analysis of the instrument, then perform the experiment by using the RME approach.
9. At the end of the meeting, conducted posttest for experimental class and control class.
10. Posttest results are then analyzed. Analysis of test data using multivariate test of mean difference with the help of SPSS 26 software to determine whether the mathematical ability generated by the RME approach is not the same as the mathematical ability generated by the scientific approach. Before performing the test, it is necessary to test the normality and homogeneity. Then, related to the univariate test is done if the multivariate test mean difference States are not the same. If the univariate test on each variable produces a difference then to see the difference is seen from the average value of each dependent variable.
11. Compile research results.
12. Summing up the results.

## RESULT AND DISCUSSION

The results of the analysis of the initial data obtained variance and the average of the two classes do not differ. That is, the initial conditions of both classes are the same. Meanwhile, related to the normality test of the final experimental class data can be seen in Figure 1.

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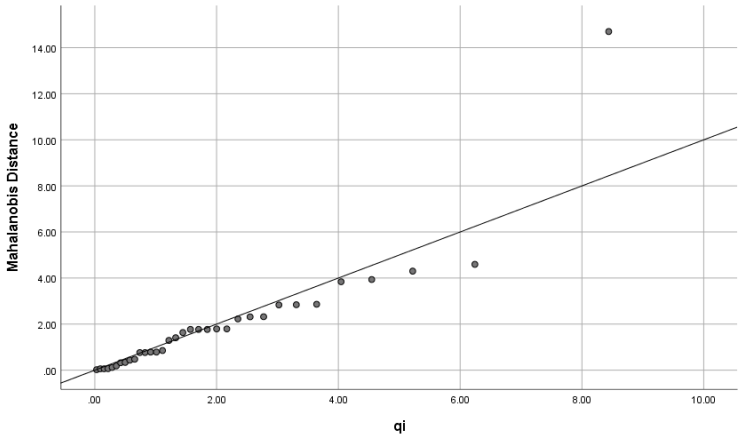


**Figure 1. Scatterplot Multivariate Normality Test Final Data Experimental Class**

Based on Figure 1 shows the results of the scatterplot approached with a straight line. It can be concluded that thank $H_0$. That is, the data come from a population with a bivariate normal distribution. Multivariate normality test results can also be seen from the value of pearson correlation. The calculation results seen in Table 2.

**Table 2.**
**Multivariate Normality Test Calculation Results Experimental Class Final Data**

| | | Mahalanobis Distance | qi |
|---|---|---|---|
| **Mahalanobis Distance** | Pearson Correlation | 1 | .910** |
| | Sig. (2-tailed) | | .000 |
| | N | 34 | 34 |
| **qi** | Pearson Correlation | .910** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 34 | 34 |

Based on Table 2 obtained pearson correlation value is 0,910. This shows that a pearson correlation value close to 1 means accept $H_0$. That is, the data come from a population with a bivariate normal distribution. Meanwhile, the results of the normality of the final control class data seen in Figure 2.

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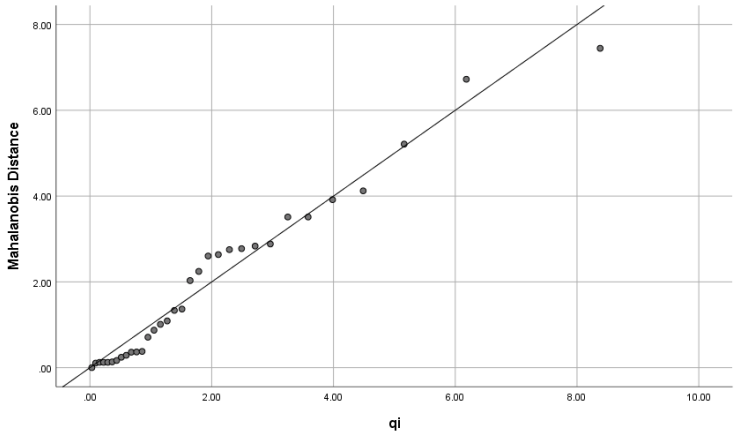


**Figure 2. Scatterplot Multivariate Normality Test Final Data Control Class**

Based on Figure 2 shows the results of the scatterplot can be approached with a straight line. It can be concluded that thank $H_0$. That is, the data come from a population with a bivariate normal distribution. Multivariate normality test results can also be seen from the value of pearson correlation. The calculation results seen in Table 3.

**Table 3.**
**Results Of Multivariate Normality Test Calculation Of Control Class Final Data**

| | | Mahalanobis Distance | qi |
|---|---|---|---|
| **Mahalanobis Distance** | Pearson Correlation | 1 | 0,985** |
| | Sig. (2-tailed) | | 0,000 |
| | N | 33 | 33 |
| **qi** | Pearson Correlation | 0,985** | 1 |
| | Sig. (2-tailed) | 0,000 | |
| | N | 33 | 33 |

Based on Table 3 obtained pearson correlation value is 0,985. This shows that a pearson correlation value close to 1 means accept $H_0$. That is, the data come from a population with a bivariate normal distribution. Meanwhile, the results of homogeneity Matrix variance-covariance seen in Table 4.

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**Table 4.**
**Result of Homogeneity Test Calculation of Variance and Covariance Matrix**

| Box's Test of Equality of Covariance Matricesa | |
|---|---|
| Box's M | 6,055 |
| F | 1,951 |
| df1 | 3 |
| df2 | 783759,150 |
| Sig. | 0,119 |

Based on Table 4 obtained that the sig value $(0{,}119) > 0{,}05$ then accept $H_0$. That is, the variance-and-covariance matrix in the first population is the same as the variance-covariance matrix in the second population.

At the end of the meeting, do a posttest with the number of questions is 6 items. The Posttest was attended by 67 students, 34 students from the experimental class and 33 students from the control class. Multivariate test of mean difference shows the results according to Table 5.

**Table 5.**
**Results of Multivariate Test Calculation of Mean Differences**

| | | Sig | Description |
|---|---|---|---|
| Approach | Pillai's Trace | 0,010 | $H_0$ rejected |
| | Wilks' Lambda | 0,010 | |
| | Hotelling's Trace | 0,010 | |
| | Roy's Largest Root | 0,010 | |

Based on Table 5, reject $H_0$ as the Sig value $(0{,}010) < 0{,}05$. That is, the mathematical ability produced by the RME approach is not the same as the mathematical ability produced by the scientific approach. If so, then it is necessary to carry out a univariate test. The test is carried out separately for each dependent variable. The results of the calculation of univariate Test ability to understand the concept seen in Table 6.

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**Table 6.**
**Calculation Results of Univariate Test of Concept Comprehension Ability**

| Source | Dependent Variable | Type III Sum of Square | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Approach | Concept Understanding | 1544,139 | 1 | 1544,139 | 5,029 | 0,028 |

Based on Table 6, reject $H_0$ as the Sig value $(0{,}028) < 0{,}05$. That is, the ability to understand concepts is not the same between the experimental class and the control class. Meanwhile, the results of univariate test of mathematical problem-solving ability seen from Table 7.

**Table 7.**
**Calculation Results of Univariate Test of Mathematical Problem-Solving Ability**

| Source | Dependent Variable | Type III Sum of Square | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Approach | Problem Solving | 1848,471 | 1 | 1848,471 | 9,956 | 0,002 |

Based on Table 7 obtained that the Sig value $(0{,}002) < 0{,}05)$. Thus, it means reject $H_0$. That is, the ability to solve mathematical problems is not the same between the experimental class and the control class. Furthermore, to find out if the RME approach provides better conceptual understanding ability compared to the scientific approach and to find out if the RME approach provides better problem-solving ability compared to the scientific approach, it can be seen from its average value. The average value can be seen in Table 8.

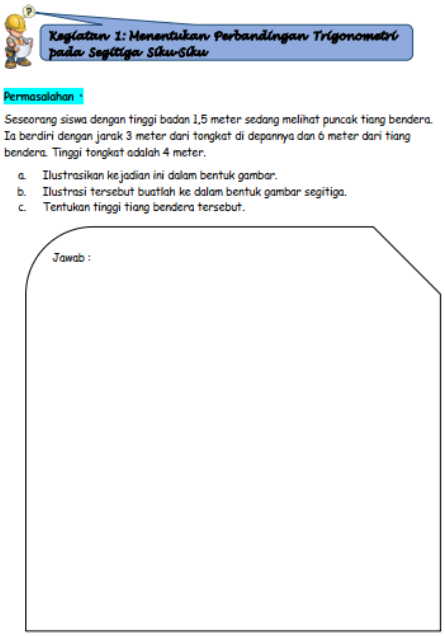
**Table 8.**
**The Average Value of The Ability to Understand Concepts and Problem Solving**

| Variable | Approach | Mean |
|---|---|---|
| Concept Undertanding | RME Approach | 69,118 |
| | Scientific Approach | 59,515 |
| Problem Solving | RME Approach | 67,294 |
| | Scientific Approach | 56,788 |

Based on Table 8, it is obtained that the average value of the ability to understand the concept of students who use the RME approach is $69.118$ while those who use the scientific approach is $59.515$. This means that the RME approach provides the ability to understand concepts better than the scientific approach. The results of the study are commensurate with Cendekiawaty & Sugiman (2020), the use of

the RME approach is able to improve students ' concept understanding abilities. Meanwhile, for the average value of problem-solving ability of students who use the RME approach of 67.294 while using the scientific approach of 56.788. That is, the RME approach provides better problem-solving capabilities compared to the scientific approach. The results of the study are commensurate with Nur'aini (2020), the RME approach has an effect on students ' problem-solving abilities.

The use of the RME approach in the learning process, real problems are given by teachers so that students can rediscover a concept themselves (Febriana, 2021) instead of accepting a ready-made concept. The learning process begins by presenting or understanding contextual problems to students. Contextual problems are presented in everyday life (Yilmaz, 2020), where teachers provide a contextual problem on student worksheets.


Kegiatan 1: Menentukan Perbandingan Trigonometri pada Segitiga Siku-Siku

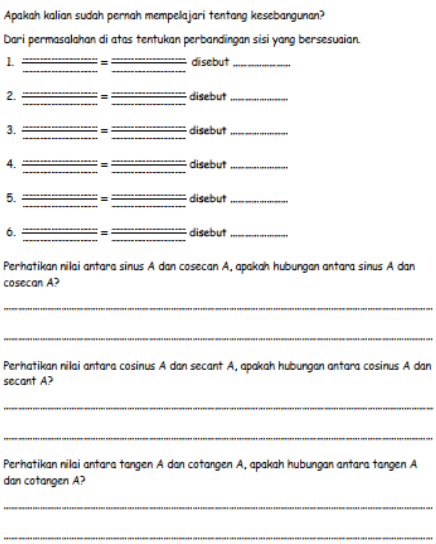
Permasalahan :

Seseorang siswa dengan tinggi badan 1,5 meter sedang melihat puncak tiang bendera. Ia berdiri dengan jarak 3 meter dari tongkat di depannya dan 6 meter dari tiang bendera. Tinggi tongkat adalah 4 meter.

a. Ilustrasikan kejadian ini dalam bentuk gambar.
b. Ilustrasi tersebut buatlah ke dalam bentuk gambar segitiga.
c. Tentukan tinggi tiang bendera tersebut.

Jawab :

**Figure 3. Student Meeting Worksheet 1**



Apakah kalian sudah pernah mempelajari tentang kesebangunan?

Dari permasalahan di atas tentukan perbandingan sisi yang bersesuaian.

1. ____ = ____ disebut .....
2. ____ = ____ disebut .....
3. ____ = ____ disebut .....
4. ____ = ____ disebut .....
5. ____ = ____ disebut .....
6. ____ = ____ disebut .....

Perhatikan nilai antara sinus *A* dan cosecan *A*, apakah hubungan antara sinus *A* dan cosecan *A*?

.....

.....

Perhatikan nilai antara cosinus *A* dan secant *A*, apakah hubungan antara cosinus *A* dan secant *A*?

.....

.....

Perhatikan nilai antara tangen *A* dan cotangen *A*, apakah hubungan antara tangen *A* dan cotangen *A*?

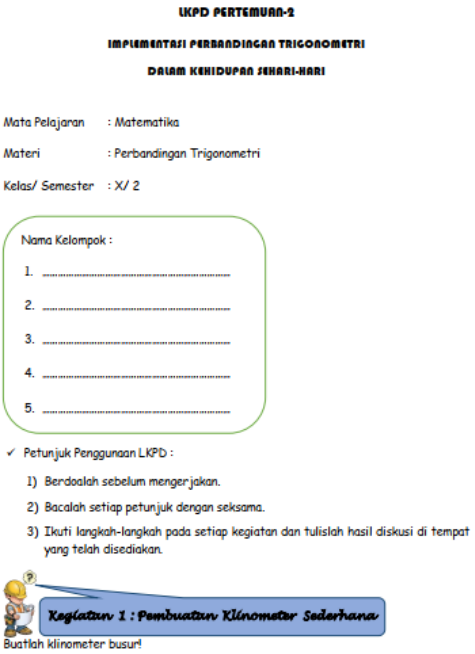
.....

.....

**Figure 4. Student Meeting Worksheet 1**

In Figure 3 and Figure 4, students are directed to solve the problems contained in the LKPD. Students can explore their knowledge based on real objects so that they can help them build knowledge on their own or in groups. Thus, students will be more awakened to the ability of understanding the concept. In problem solving activities carried out through group discussions, where students are directed to illustrate the problems presented to form a right triangle. It is commensurate with the characteristics of RME that this RME learning begins using the context in real life, emphasizing the skills of process of doing mathematics, collaborate, discuss, argue (Zulkardi, 2013) so that students are able to find concepts and solve problems well. Next, Students measure and compare the lengths of each side of a right triangle. This activity is carried out so that students can explore the prerequisite material on trigonometric comparison material because basically this RME approach connects previous understanding with new knowledge so as to obtain an understanding of new concepts. Then, students are given the opportunity to dare to issue ideas and ideas through activities that build concepts from trigonometric comparisons. The purpose of this activity is to train students ' understanding of concepts. The next stage is to conclude on the terms of trigonometric comparison of sine, cosine, tangent, cosecan, secan, and cotangent in a right triangle. After solving the problem and discussing, students are given the opportunity to boldly convey the results of the discussion. The other group is given the

opportunity to respond or ask questions. Then, at the end of the lesson the teacher gives an affirmation related to the material learned.



**LKPD PERTEMUAN-2**

**IMPLEMENTASI PERBANDINGAN TRIGONOMETRI**

**DALAM KEHIDUPAN SEHARI-HARI**

Mata Pelajaran : Matematika

Materi : Perbandingan Trigonometri

Kelas/ Semester : X/ 2

Nama Kelompok :

1. .....
2. .....
3. .....
4. .....
5. .....

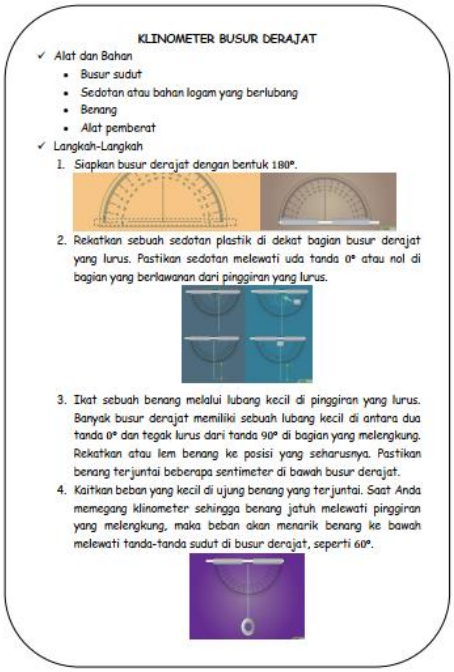
✓ Petunjuk Penggunaan LKPD :

1) Berdoalah sebelum mengerjakan.
2) Bacalah setiap petunjuk dengan seksama.
3) Ikuti langkah-langkah pada setiap kegiatan dan tulislah hasil diskusi di tempat yang telah disediakan.

**Kegiatan 1 : Pembuatan Klinometer Sederhana**

Buatlah klinometer busur!

**Figure 5. Student Meeting Worksheet 2**



KLINOMETER BUSUR DERAJAT

✓ Alat dan Bahan
- Busur sudut
- Sedotan atau bahan logam yang berlubang
- Benang
- Alat pemberat

✓ Langkah-Langkah

1. Siapkan busur derajat dengan bentuk 180°.
2. Rekatkan sebuah sedotan plastik di dekat bagian busur derajat yang lurus. Pastikan sedotan melewati uda tanda 0° atau nol di bagian yang berlawanan dari pinggiran yang lurus.
3. Ikat sebuah benang melalui lubang kecil di pinggiran yang lurus. Banyak busur derajat memiliki sebuah lubang kecil di antara dua tanda 0° dan tegak lurus dari tanda 90° di bagian yang melengkung. Rekatkan atau lem benang ke posisi yang seharusnya. Pastikan benang terjuntai beberapa sentimeter di bawah busur derajat.
4. Kaitkan beban yang kecil di ujung benang yang terjuntai. Saat Anda memegang klinometer sehingga benang jatuh melewati pinggiran yang melengkung, maka beban akan menarik benang ke bawah melewati tanda-tanda sudut di busur derajat, seperti 60°.

**Figure 6. Student Meeting Worksheet 2**


**Figure 7. Student Meeting Worksheet 2**

In Figure 5, Figure 6, and Figure 7 students are asked to make a simple clinometer props in accordance with the guidelines that have been presented. The tool is used to practice measuring the height of an object that is around the school. This activity is in accordance with the learning steps using the RME approach, namely solving contextual problems and as a form of understanding student concepts. Each group member determines the object to be measured, makes props, observes each other, and compares with other groups through presentation activities. This practice helps students to use concepts that have been understood about trigonometric comparisons to solve existing problems. In addition, in this student worksheet also presented some contextual problems of trigonometric comparison contained in Figure 8 and Figure 9. Through the concepts that have been obtained previously, the hope is that students can solve new problems. The more practice, students are expected to maximize the ability to understand the concept of trigonometric comparison material and be able to solve mathematical problems well.

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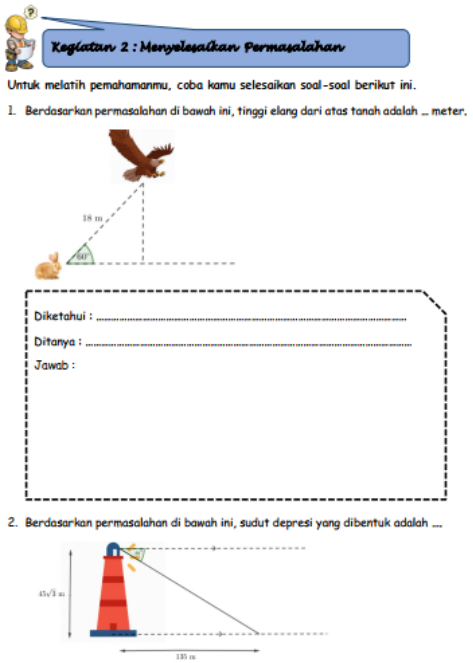


**Figure 8. Student Meeting Worksheet 2**

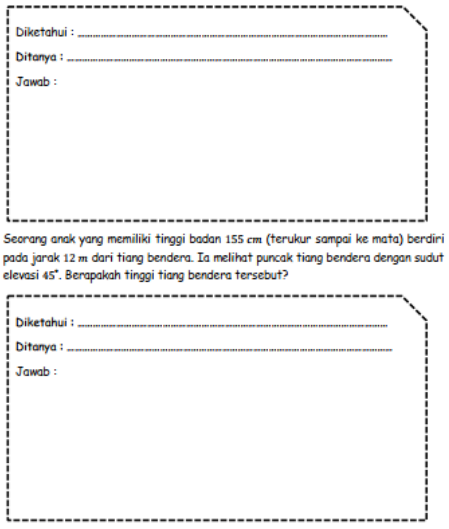


**Figure 9. Student Meeting Worksheet 2**

Learning that applies the RME approach, pay attention to student involvement that can be seen from the stages of learning. This can make it easier for students to develop concepts and problem solving (Rahayu & Muhtadi, 2022). In addition, an understanding of mathematics and the usefulness of mathematics in life will also be easier to understand.

The use of the RME approach in the learning process also learns about problem solving, where the teacher gives questions in the LKPD. The problem is related to real problems so that students will be easier when solving problems.

The use of the RME approach in learning makes a fun learning environment because learning uses concrete problems and students can share knowledge with others so that problems can be resolved easily. This is in accordance with the advantages of RME according to Jarmita & Hazami (2013), through learning using the RME approach, the learning atmosphere becomes fun. On the other hand, the purpose of this activity is to give students the opportunity to dare to argue and conclude from the material being studied.

## CONCLUSION

The conclusion of this study is (1) the mathematical ability produced by the RME approach is not the same as the mathematical ability produced by the scientific approach, (2) the RME approach provides the ability to understand concepts better than the scientific approach, and (3) the RME approach provides the ability to solve problems better than the scientific approach. The application of the RME approach can be used as an alternative for teachers in developing the ability to understand concepts and solve mathematical problems of students. In addition, future research may apply the RME approach to developing other mathematical abilities.

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