



Analysis Of Students' Mathematical Reasoning Abilities In Solving Trigonometry Problems In Grade X

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Abstract

This study aims to analyze the mathematical reasoning ability of tenth-grade students at SMA Free Methodist Medan in solving trigonometry problems. The research employed a sequential mixed-methods design by combining quantitative and qualitative approaches, with a saturated sampling technique involving all tenth-grade students. The research instrument consisted of essay tests covering four indicators of mathematical reasoning ability: proposing conjectures, performing mathematical manipulations, providing proof and justification of solutions, and drawing conclusions. The results revealed that students' mathematical reasoning ability was categorized as high. The most mastered indicator was proposing conjectures, while the least mastered was drawing conclusions. Overall, the distribution of students' abilities falls into the categories of very high, high, medium, low, and very low. These findings indicate that students' mathematical reasoning ability still needs improvement, particularly in providing evidence and justification as well as drawing valid conclusions.

Keywords: mathematics, reasoning, ability, trigonometry, students.

INTRODUCTION

Education is a learning process that aims to develop knowledge, skills, attitudes, and values within a person. According to Law No. 12 of 2012 concerning higher education in Siahaan, et al (2023) that "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential." Education will enrich human life through learning activities. Mathematics learning is one effort to improve the education process in Indonesia (Shabrina, Eliza, & Khaidir, 2021).. According to the Big Indonesian Dictionary (KBBI) in Rohmah (2021) that "Mathematics is the science of numbers, relationships between numbers, and operational procedures used in solving problems regarding numbers." Mathematics is needed by students as a basis for understanding the concept of counting, making it easier to learn other subjects, and understanding the application of mathematics in everyday life (Siswondo & Agustina, 2021) . Mathematics learning can help students to construct mathematical concepts through their

own abilities, with an internalization process so that the concept is rebuilt (Gusteti & Neviyarni, 2022).

However, in reality, mathematics learning in Indonesia is still problematic as seen from *the Trends in International Mathematics and Science Study (TIMSS)* in 2019 Indonesia was ranked 45th out of 58 countries with an average score of 397 (Siregar et al, 2024). According to Hendrayana in Hutauruk (2020) that "The process of learning mathematics will encounter various difficulties in its learning activities, especially in efforts to improve the mathematical abilities that are desired to be achieved". Currently mathematics is still considered a difficult and unpleasant subject for students, so that many students do not like mathematics lessons and even mathematics is considered something scary (Prasasti et al., 2020) , students have difficulty in understanding the mathematical concepts taught and have difficulty in calculating (Ayu et al., 2021).

Mathematical reasoning ability is one of the abilities that need to be developed in mathematics learning. Mathematical reasoning ability is a student's skill in the thinking process to make conclusions regarding a proof of its truth (Oktaviana & Aini, 2021) . According to Sofyana & Kusuma (in Oktaviana & Aini, 2021) that "Reasoning ability has a relationship between mathematical material and mathematical reasoning ability so that the two cannot be separated, because material related to mathematics can be understood with reasoning ability while reasoning ability will be trained with mathematical material." Mathematical reasoning ability can make someone have a logical way of thinking in drawing general or specific conclusions in the learning process activities (Oktaviana & Aini, 2021) . However, in reality, students' mathematical reasoning abilities vary. According to Oktaviana & Aini (2021) that "students' mathematical reasoning abilities vary due to obstacles in carrying out the process of working on problems." (Hasanah & Hakim, 2022).

Indonesian students' mathematical reasoning abilities are still relatively low (Husniah & Azka, 2022). This is supported by research by Aprilianti & Zanhya in Husniah & Azka (2022), which states that students' mathematical reasoning abilities are low due to students easily forgetting material, students lacking ideas for solving problems, students being less thorough, and students not understanding the formulas to be used (Afri & Rahmadani, 2020).

Trigonometry is one of the mathematics topics in the current independent curriculum for grade 10 MA/SMA. Trigonometry is a branch of mathematics that studies the comparison of the dimensions of the sides of a triangle when viewed through one of its angles (Teguh, 2004) . Trigonometry can be useful in everyday life (Gradini, Yustinaningrum, & Safitri 2022). With trigonometry applications, we can measure distances in the sky without having to use physical measuring instruments (Taufiq & Agustito, 2021). Trigonometry can also be used to measure the height of a cliff without having to climb it (Setiawan & Prihatnani, 2020).

However, trigonometry learning still experiences several difficulties for students, including students not writing down the information they have obtained from the problem, what is known and what is asked (Novianti & Riajanto, 2021) , difficulty in performing calculations (Adhim & Amin, 2019), and students misinterpreting the problem resulting in incorrect use of formulas (Pratiwi et al, 2021) . This is in accordance with research by Fauziah

& Puspitasari (2022) in Pasanggrahan Village, with subjects namely high school students who stated "The difficulties in learning mathematics for students on the subject of trigonometric equations are that students do not correctly understand how to determine basic equations, special angles, root equations, multiplication, division". Students also experience difficulties in solving problems related to story problems. Some students also have difficulty distinguishing intervals with the special angles used. The causal factors include errors in understanding questions due to not reviewing the material that has been taught (Rachman & Amelia, 2020) , students are not careful in calculating (Cahyani & Aini, 2021).

Mathematical reasoning skills are also needed in trigonometry learning. According to Fatin et al. (2023) , "Students' mathematical reasoning skills are still low, especially in trigonometry mathematics. On average, students are only able to present mathematical statements in writing." This difficulty will be a challenge that must be overcome to achieve student success in trigonometry learning (Sri Kusuma Dewi Alfiah, Suharti Kadar, & Ahmad Hatip, 2021).

Based on interviews conducted by researchers with mathematics teachers at Medan's Free Methodist High School, low mathematical reasoning skills contribute to suboptimal mathematics learning. On average, students are only able to present mathematical statements in writing and tend to immediately attempt calculations without fully understanding the context of the problem. Furthermore, students are less able to draw conclusions from statements or solve problems they have worked on.

This research is important to conduct. According to Sundari et al (in Sari, et al, 2023) that "Mathematical reasoning is the main factor in building mathematical knowledge." With good reasoning, students are able to understand concepts and can solve problems, not only in mathematics learning but also contribute to solving problems faced in everyday life (Lengga et al, 2025) . According to Latifa (in Bayramov et al, 2024) trigonometry learning requires students' ability to reason and prove to develop critical, methodical, and logical thinking skills. In solving trigonometry problems, students are required to use logic, think systematically, and draw valid conclusions based on available information. These abilities are part of mathematical reasoning, which is a crucial competency for students (Marfu'ah, Zaenuri, Masrukan, & Walid, 2022).

Based on the description above, mathematical reasoning ability is an important thing that students must have in solving problems in mathematics learning, so the researcher is interested in conducting this research with the title "Analysis of Students' Mathematical Reasoning Ability in Solving Trigonometry Problems in Class X SMA Free Methodist Medan TA 2025/2026".

METHOD

The type of research used is a combination research (*mixed methods*). The method in this study is *sequential* (sequential combination) by combining quantitative and qualitative methods. The stages used in this study are collecting and analyzing quantitative and qualitative data which are explained descriptively from student test results (Farida, Caswita, & Gunowibowo, 2018). Descriptive research is research with a method to describe a research result that provides a description, explanation, and validation of the phenomenon

being studied (Ramdhan, 2021). According to Sugiyono in Waruwu (2023) that "The combination research method is a research method that combines or combines quantitative and qualitative methods to be used together in a study". This research was conducted in class X SMA Free Methodist Medan odd semester 2025/2026 academic year located at Jl. Beringin No. 152 E, Helvetia, Kec. Medan Helvetia (Rosyidah, Setyawati, & Qomariyah, 2021).

A population is a generalized group consisting of objects and subjects with a certain number and characteristics that have been determined by researchers to be studied and used as a basis for their conclusions (Aksara, 2021) . The population used includes all 10th grade students of SMA Free Methodist Medan, totaling 3 classes.

A sample is a portion of the number and characteristics of a population (Sugiyono, 2013). The sampling technique in this study is a saturated sample with the entire population class as the sample.

A research variable is something that is measured or observed to draw conclusions. A research variable is anything, in any form, that the researcher determines to be studied to obtain information about it and then draw conclusions (Sugiyono, 2013). In this study, the variable is mathematical reasoning ability.

Data analysis is an activity after data from all respondents or other data sources are collected, data analysis activities are grouping data based on variables and types of respondents, tabulating data based on variables from all respondents, presenting data for each variable studied, performing calculations to answer the problem formulation and performing calculations to test the hypothesis that has been proposed (Sugiyono, 2013). Data analysis is used to solve the problem formulation in this study. The data analysis used is descriptive statistics. Descriptive statistics are used to describe data obtained from the results of students' mathematical reasoning abilities such as average values (mean) and standard deviation.

RESULTS AND DISCUSSION

Time and Place of Research

This research was conducted on July 31, 2025 - August 2, 2025 in the 2025/2026 Academic Year in classes XA, X-B and XC of SMA Free Methodist Medan located at JL. Beringin Raya 152 -E Helvetia Medan, Helvetia, Medan Helvetia District, Medan City, North Sumatra Province.

Instrument Trial Results

Before collecting data, the questions were first tested in class XII MIPA-1. The goal was to determine the validity, reliability, discriminatory power, and difficulty level of the questions. From the results of the trial, the validity, reliability, difficulty level, and discriminatory power of the questions were calculated using the following analysis (Tambunan, Sinaga, & Hutauruk, 2021):

The validity testing of this research test was carried out using the product moment correlation formula to process the researcher's data with the help of the SPSS program with the provision that $r_{(calculated)} > r_{table}$, then the question item is valid at the $\alpha = 0.05$ level with $n = 42$.

From the results of the validity test calculations using the IBM Statistic SPSS 31.1 for Windows program in (attachment 5), the results of the test item validity test were obtained in table 4.1. A total of 4 questions were valid and will be used in data collection.

Based on table 4.1, it is obtained that questions number 1, 3, 4, and 5 are valid, with the provision that $r_{(count)} > r_{table}$ at the level of $\alpha = 0.05$ and $n = 42$. Meanwhile, for questions number 2 and 6, $r_{(count)} < r_{table}$ is obtained, so the questions are declared invalid. Thus, the questions that have been tested can be used in research are questions number 1, 3, 4, and 5 (Hamsiah, Masjudin, & Kurniawan, 2017).

Analysis Results

This research was conducted at Free Methodist High School Medan, which is a combination study with the aim of describing students' mathematical reasoning abilities in solving problems on trigonometric comparisons using quantitative and qualitative methods. Sampling in this study used a saturated sampling technique, where all populations were sampled. The sample of this study was classes XA, XB, and XC with a total of 93 students. Students will be given a test consisting of 4 essay questions that have been tested previously. The questions are given based on indicators of students' mathematical reasoning abilities (Burais, Ikhsan, & Duskri, 2023).

1. The results of the indicator analysis put forward a hypothesis

In the first question of the indicator of proposing a conjecture, students are expected to be able to propose an initial conjecture as a reference for solving the problem with calculations that will be carried out directly. The question in the indicator of proposing a conjecture is a story problem, where it is said that Doni stands 10 m and observes the top of the pole with an elevation angle of 60° , while Rido sees at an angle of 45° . With what is known, students will be invited to provide an initial opinion about what is known in the problem, then rewrite the results of the observations. All students are able to propose conjectures quite well (Andriyani, Setiawan, & Wawan, 2024).

2. The results of the indicator analysis carry out mathematical manipulation.

In the second question of the indicator of performing mathematical manipulation, students are expected to be able to think about how to manipulate formulas that can be used to find the required final result without changing the formula rules. This question is about right triangle ABC and the right angle at C. In addition, the lengths of sides AC and BC are 6 cm and 8 cm, respectively. Students first solve the existing triangle then continue by finding the value of $\tan A$ and $\cot B$ respectively, with these values they will be able to add up the final result.

3. The results of the indicator analysis provide evidence and reasons for the correctness of the solution.

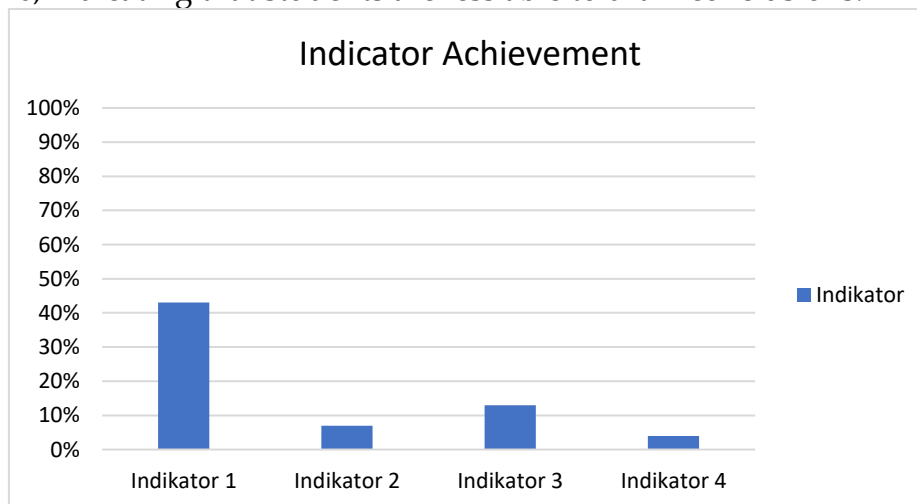
In the third question, which provides evidence and reasons for the correctness of the solution, students are expected to be able to provide the correctness of the solution, supported by reasons for their answer. This question is a story problem where a ladder is leaning against a wall, with a length of 10 m and a height of 6 m from the top of the ladder to the ground. Then, students find the sine value between the ladder and the ground. Using trigonometric ratio formulas, students will prove the value of the sine they are looking for, then provide a simple reason to support their answer (Samad, Ali P, & Assaibin, 2021).

Based on Table 4.8, the results of solving problem number 3 show that overall, students are less able to provide evidence and reasons for the correctness of the solution in solving trigonometric comparison problems. This is indicated by 66 students obtaining a score of less than 7 and 27 students obtaining a score of more than 6, which means that students provide evidence and reasons for the correctness of the solution is not good.

4. The results of the indicator analysis draw conclusions

In the fourth question, the drawing conclusion indicator, students are expected to be able to provide a final conclusion from the problem they have done. This question is a story problem observing the top of a building. In the question, it is known that the distance from the officer to the base of the building is 30 meters and the angle of elevation formed from the officer's eyes to the top of the building is 45° . Then, students will find the height of the building, but with the stipulation that the officer's eyes are 1.5 m above the ground. With these stipulations, students must be careful in drawing conclusions on the question (Julaeha & Kadarisma, 2020).

Based on Table 4.9, the results of solving problem number 4 indicate that students are generally less able to draw conclusions when solving trigonometric ratio problems. This is indicated by 73 students obtaining scores of less than 7 and only 20 students obtaining scores of more than 6, indicating that students are less able to draw conclusions.



Graph 1. Indicator Achievement Histogram

Based on the data in Table 4.12, only a portion of students mastered each indicator of mathematical reasoning ability. From the table, the students with the most mastery of the indicator were in the first indicator, namely submitting a conjecture, where 40 students (43%) had a good grasp of this indicator. Meanwhile, the understanding of the indicator that was least mastered by students in mathematical reasoning was in the fourth indicator, namely drawing conclusions, where only 4 students (4%) had a good grasp of this indicator.

The following is a discussion of students' mathematical reasoning abilities based on Table 4.12. In question number 1, which is related to the first indicator, namely making a guess, 43% or 40 students were recorded as being able to write down the information known and sought from the problem, and translate the problem into mathematical language. However, there were 53 students or 57% who were not able to make a guess that was

appropriate to the problem in the problem. Students tended to know how to solve problems using formulas without determining what guess would be obtained from the problem, so they could not be said to have mastered the first indicator (Mulyawati, 2022).

The second indicator of mathematical reasoning ability is performing mathematical manipulations, which is found in question number 2. Of this indicator, only 7% or 6 students were able to understand well. Meanwhile, 93% or 87 students had not succeeded in completing trigonometric ratios and still had difficulty manipulating existing formulas. In working on problems, students tended to focus more on the basic formulas, so when faced with different problems, students experienced confusion in manipulating the basic formulas, which resulted in calculation errors. This is evident from students' answers to question number 1, which indicates that students have not mastered the second indicator.

The third indicator of students' mathematical reasoning ability is providing evidence and reasons for the correctness of the solution, as found in question number 3. Only 13% (12 students) understood this indicator well. Meanwhile, 87% (81 students) failed to provide evidence and reasons correctly. Students tended to be able to provide evidence but were unable to provide reasons for the final result of the solution. Students felt that the answer only reached the final result without including an explanation of the reasons to support the answer. This is evident from students' answers to question number 3, which indicates that students have not yet mastered the third indicator.

The fourth indicator of students' mathematical reasoning ability is drawing conclusions, which is found in question number 4. For this indicator, only 4%, or 4 students, were able to solve the trigonometric ratio problem correctly. Meanwhile, 96%, or 89 students, were unable to complete the problem to the end. Students were able to follow the existing formula and obtain results, but did not include everything needed to complete the problem. This is evident in students' answers to question number 4, which indicates that students have not yet mastered the fourth indicator (Oktaviana & Aini, 2021).

Based on the interval calculations used for the frequency distribution of student test results in (attachment 12) are presented in the following test score distribution table:

Table 1. Mathematical Reasoning Ability Test Results Data

Class	Interval Class	Frequency	Cumulative Frequency
1	39 - 46	2	2%
2	47 - 54	12	13%
3	55 - 62	13	14%
4	63 - 70	14	15%
5	71 - 78	43	46%
6	79 - 86	8	9%
7	87 - 94	1	1%
Total		93	100%

Based on the table above, the highest frequency of mathematical reasoning ability test results is in the 71-78 interval, with 43 students, or 46%, compared to other class intervals. This indicates that the mathematical reasoning ability test scores are dominated

by the 71-78 range. These values were obtained from students' mathematical reasoning ability using descriptive questions on trigonometric ratios.

To determine the level of students' mathematical reasoning ability, the results were grouped into 5 categories: very high, high, medium, low, and very low. The determination of these categories was based on the average value (*mean*) and standard deviation, which were used to classify the level of mathematical reasoning ability based on the results of the tests administered to students. Before determining the criteria for mathematical reasoning ability, the mean and standard deviation were calculated (Benjamin, 2023). Descriptive analysis was conducted using *Microsoft Excel*, with the following results:

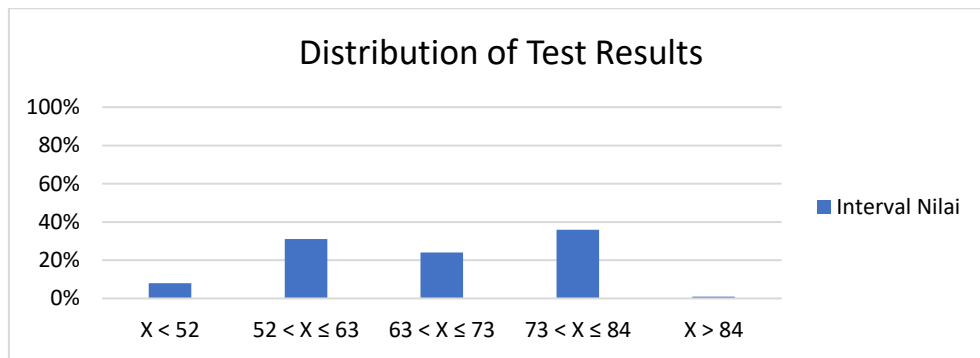
Table 3. Descriptive Statistics of Test Results

Minimum Value	39
Maximum Value	90
Mean	68
Standard Deviation	10.52
N (Number of Students)	93
Total Amount of Value	6321

Based on table 4.14 above, a test has been conducted on students with a minimum score of 39 and a maximum of 90. The average score (*mean*) is 68, which shows that out of 93 students, the average score is 68. The standard deviation (SD) is 10.52, indicating that the average distance of deviations from the value points can be measured from the average value, with the possibility of deviation below the average of 10.52. The average score of 68 and the standard deviation of 10.52 are then converted to determine the category of students' mathematical reasoning ability. The frequency distribution and categories of students' mathematical reasoning ability are presented in the following table:

Table 4. Frequency Distribution of Test Results

Interval	Frequency (f)	Percentage (%)	Ability Category
$X < 52$	7	8%	Very Low
$52 < X \leq 63$	29	31%	Low
$63 < X \leq 73$	22	24%	Currently
$73 < X \leq 84$	34	36%	Tall
$X > 84$	1	1%	Very high
Total	93	100%	



Graph 2. Distribution of Test Results

The table can be explained that the students' mathematical reasoning ability shows 7 students or 8% in the very low category, 29 students or 31% in the low category, 22 students or 24% in the medium category, 34 students or 36% in the high category, and 1 student 1% in the very high category. Thus, the students' mathematical reasoning ability is in the high category, with the number of students 34 or 36%.

Discussion of Research Results

Based on the results of student data analysis, the mathematical reasoning ability of students in grade X of SMA Free Methodist Medan is in the high category. This is known based on the mathematical reasoning indicator with the highest number of student scores in which category. In the first indicator, namely submitting a conjecture, most students are able to formulate conjectures or make initial predictions based on what is observed before further proof or calculations are carried out. In the second indicator, namely manipulating data, some students are also able to use trigonometric identities to simplify trigonometric forms or solutions but have difficulty transforming trigonometric forms in the problem solving process. In the third indicator, namely providing evidence and reasons for the truth of the solution, students are able to prove the statements that have been in the problem, but are unable to provide reasons for the proof that has been given. Furthermore, in the fourth indicator, namely providing conclusions, students are able to understand how to solve the problem so they are able to summarize the results of the problem solving process.

The image shows that students have mastered the first indicator, where they can accurately write down known information and also make predictions about the problem, even without writing down the question itself. Students are also able to effectively solve problems using trigonometric ratio formulas, achieving the final result required by the problem (Kusuma, Nur, & Ningsih, 2023).

Meanwhile, in it can be seen that in question number 1, the student did not write the information in the question completely. In the answer, it is clear that the student immediately started with the applicable formula, namely the $\tan \theta$ formula. In addition, in the calculations carried out, the student experienced difficulties in operating it so that the results were different from what was expected. The student should have directly compared the elevation angles between Rido and Doni, and then proposed a conjecture about what would happen if applied directly. Thus, the student would know that the larger the elevation angle, the closer the distance, conversely, the smaller the elevation angle, the

further the distance. This is the conjecture that the student was looking for in the first problem (Fatin et al., 2023).

In this study, the first indicator, "posing a conjecture," was the one most mastered by students. The "posing a conjecture" indicator is shown in question number 1, and on average, students were able to complete this question well. Meanwhile, the fourth indicator, "drawing a conclusion," was the least mastered by students. Many students were unable to understand what was required in the question, tending to only complete calculations without paying attention to other aspects. The fourth indicator is shown in question number 4.

Based on the research results, the mathematical reasoning ability of tenth-grade students at Medan Free Methodist High School is still in the high category. The test results show that most students are able to propose initial conjectures and perform simple mathematical manipulations, but still have difficulty providing evidence and reasons for the correctness of the solution, and tend to be less able to draw correct conclusions. This condition shows that the learning process that has been taking place is more oriented towards the final result and procedures, so that students are accustomed to memorizing formulas without understanding the meaning of the concept in depth. Other factors that contribute to the low mathematical reasoning ability of students are the lack of variety of questions that require proof and argumentation, as well as the minimal opportunity for students to practice critical and logical thinking in trigonometry learning. However, this study also found differences in ability between students, where a small number of students in the high category are able to propose conjectures, provide logical reasons, and compile evidence well, while the majority of students are still in the medium to low category.

To improve students' mathematical reasoning skills, providing non-routine and contextual problems is essential so that students become accustomed to facing problems that require critical thinking, not just procedural calculations. Furthermore, group discussions and presentations of work results also need to be made a habit so that students are trained in communicating mathematical reasoning and learning from various alternative solutions proposed by their peers. Through these efforts, it is hoped that students' mathematical reasoning skills in solving trigonometry problems can improve, especially in the aspects of providing evidence and reasons, and drawing conclusions, which have been major weaknesses.

CONCLUSION

Based on the formulation of the problem and the research results obtained through data analysis that has been carried out, it can be concluded that:

1. Students' mathematical reasoning ability in solving problems on trigonometry material in class X of SMA Free Methodist Medan in the 2025/2026 academic year is in the "high" category 36%.
2. Students' reasoning errors in trigonometry material questions are:
 - a. Incorrect operation of the formula

- b. Students tend not to understand the meaning of the questions, so the final goal of the questions is not achieved.

Suggestion

Based on the conclusions obtained in this study, the researcher provides several suggestions as follows:

1. Students with high ability are expected to maintain learning consistency, students with high ability are expected to practice their skills with a variety of other questions, students with medium ability are expected to focus on improving basic concepts with practice questions, students with low ability are expected to pay more attention to what is desired in the questions so that errors do not occur, and students with very low ability are expected to focus more on emphasizing their understanding of basic concepts so that they are able to write down whatever is desired in the questions and what formulas are used in the questions.
2. Students are expected to pay more attention to what is required in the questions, so that there are no more errors in working on the questions, apart from that, they are also expected to be careful in using the existing formulas.
3. This research is limited only to students' mathematical reasoning abilities in solving trigonometry problems, so it is recommended that there be further research that examines this more broadly.

REFERENCE

- Afri, L. D., & Rahmadani, R. (2020). Perbedaan Kemampuan Penalaran Dan Pemecahan Masalah Matematis Siswa Yang Diajar Dengan Pembelajaran Tps Dan Gi. *Axiom : Jurnal Pendidikan Dan Matematika*, 9(1), 35. <https://doi.org/10.30821/Axiom.V9i1.7234>
- Aksara, P. T. B. (2021). *Metodologi Penelitian Kuantitatif*. Bumi Aksara.
- Andriyani, F. A., Setiawan, A., & Wawan, W. (2024). Model Probing-Prompting Terintegrasi Etnomatematika Batik Lampung Pada Materi Transformasi Geometri Terhadap Kemampuan Penalaran Matematis Siswa. *Assyfa Journal Of Multidisciplinary Education*, 1(1), 19-27. <https://doi.org/10.61650/Ajme.V1i1.529>
- Benjamin, N. (2023). Implementasi Model Pembelajaran Inkuiri Terbimbing Untuk Meningkatkan Kemampuan Penalaran Matematis Mahasiswa. *Jurnal Dunia Ilmu*, 3(1), 1-13.
- Burais, L., Ikhsan, M., & Duskri, M. (2023). Peningkatan Kemampuan Penalaran Matematis Siswa Melalui Model Discovery Learning. *Pendidikan Matematika*, 5(1656-6540), 12-13.
- Cahyani, A., & Aini, I. N. (2021). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Trigonometri Berdasarkan Kriteria Watson. *Jurnal Pembelajaran Matematika Inovatif*, 4(2), 365-372. <https://doi.org/10.22460/Jpmi.V4i2.365-372>
- Farida, A. R., Caswita, C., & Gunowibowo, P. (2018). Pengaruh Model Problem Based

- Learning Terhadap Kemampuan Penalaran Matematis Siswa. *Jurnal Pendidikan Matematika Universitas Lampung*, 6(7).
- Fatin, A., Harahap, M. S., & Lubis, R. (2023). Pengembangan E-Modul Trigonometri Berbasis Android untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Jurnal Mathedu (Mathematic Education Journal)*, 6(1), 6–14.
- Fauziah, R., & Puspitasari, N. (2022). Kesulitan Belajar Matematika Siswa Sma Pada Pokok Bahasan Persamaan Trigonometri Di Kampung Pasanggrahan. *Plusminus: Jurnal Pendidikan Matematika*, 2(2), 325–334. <https://doi.org/10.31980/Plusminus.V2i2.1876>
- Gusteti, M. U., & Neviyarni, N. (2022). Pembelajaran Berdiferensiasi Pada Pembelajaran Matematika Di Kurikulum Merdeka. *Jurnal Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, 3(3), 636–646. <https://doi.org/10.46306/Lb.V3i3.180>
- Hamsiah, H., Masjudin, M., & Kurniawan, A. (2017). Analisis Kemampuan Penalaran Matematis Siswa Smpn 13 Mataram Pada Materi Bangun Ruang. *Media Pendidikan Matematika*, 5(2), 115. <https://doi.org/10.33394/Mpm.V5i2.1462>
- Hasanah, M., & Hakim, D. L. (2022). Kemampuan Literasi Matematis Pada Soal Matematika Pisa Konten Quantity Dan Konten Change And Relationship. *Juring (Journal For Research In Mathematics Learning)*, 5(2), 157. <https://doi.org/10.24014/Juring.V5i2.13785>
- Hutauruk, A. J. B. (2020). Indikator Pembentuk Resiliensi Matematis Mahasiswa Prodi Pendidikan Matematika Fkip. *Sepren*, 1(02), 78–91. <https://doi.org/10.36655/Sepren.V1i02.227>
- Julaeha, S., & Kadarisma, G. (2020). Analisis Kemampuan Penalaran Matematis Siswa Smp Pada Materi Fungsi Kuadrat. *Jurnal Pembelajaran Matematika Inovatif*, 3(6), 663–670. <https://doi.org/10.22460/Jpmi.V3i6.663-670>
- Kusuma, J. W., Nur, M., & Ningsih, E. C. (2023). Pengaruh Model Penemuan Terbimbing (Guided Discovery) Terhadap Kemampuan Penalaran Matematis Siswa Pada Materi Bilangan Di Mts Al-Khairiyah Pontang *Journal On Education*, 05(03), 9734–9740.
- Lengga, M. J., Samo, D. D., Karlina, I., & Blegur, S. (2025). Analisis Kemampuan Penalaran Dalam Menyelesaikan Masalah Trigonometri Ditinjau Dari Gaya Berpikir Model Gregorc Siswa Sma. 5(1), 77–88.
- Marfu'ah, S., Zaenuri, Masrukan, & Walid. (2022). Model Pembelajaran Matematika Untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Prosiding Seminar Nasional Matematika*, 5, 50–54.
- Mulyawati, A. T. (2022). *Komparasi Penalaran Matematis Berdasarkan Penerapan Metode Pembelajaran Mind Mapping Berbasis Problem Solving Pada Siswa Kelas Iv Di Min 6 Ponorogo*. Iain Ponorogo.
- Novianti, V., & Riajanto, M. L. E. J. (2021). Analisis Kesulitan Siswa Smk Dalam Menyelesaikan Soal Materi Trigonometri. *Jurnal Pembelajaran Matematika Inovatif*, 4(1),

161–168. <https://doi.org/10.22460/jpmi.v4i1.161-168>

- Oktaviana, V., & Aini, I. N. (2021). Deskripsi Kemampuan Penalaran Matematis Siswa Smp Pada Materi Aritmatika Sosial. *Delta: Jurnal Ilmiah Pendidikan Matematika*, 9(2), 157. <https://doi.org/10.31941/delta.v9i2.1334>
- Prasasti, D., Awalina, F. M., & Hasana, U. U. (2020). Permasalahan Pemahaman Konsep Siswa Pada Pelajaran Matematika Kelas 3 Semester 1. *Manazhim*, 2(1), 45–53. <https://doi.org/10.36088/manazhim.v2i1.659>
- Pratiwi, I. D., Aritsya, A., & Yanti, Y. (2021). Analisis Kesalahan Siswa Dalam Mengerjakan Soal Cerita Trigonometri. *Jurnal Pendidikan Matematika*, 5.
- Rachman, A. F., & Amelia, R. (2020). Analisis Kemampuan Berpikir Kreatif Matematis Siswa Sma Di Kabupaten Bandung Barat Dalam Menyelesaikan Soal Pada Materi Trigonometri. *Maju*, 7(1), 83–88.
- Rosyidah, U., Setyawati, A., & Qomariyah, S. (2021). Analisis Kemampuan Penalaran Dan Kemampuan Pemahaman Konsep Matematis Mahasiswa Pendidikan Matematika Pada Mata Kuliah Aljabar Dasar. *Sjme (Supremum Journal Of Mathematics Education)*, 5(1). <https://doi.org/10.35706/sjme.v5i1.4488>
- Samad, I., Ali P, M., & Assaibin, M. (2021). Pengaruh Kemampuan Penalaran Matematis Dengan Model Pembelajaran Double Loop Problem Solving Terhadap Hasil Belajar Siswa. *Indonesian Journal Of Educational Science (Ijes)*, 4(1), 43–50. <https://doi.org/10.31605/ijes.v4i1.1202>
- Shabrina, R., Eliza, R., & Khaidir, C. (2021). Pengaruh Model Pembelajaran Auditory Intellectually Repetition (Air) Terhadap Kemampuan Pemahaman Konsep Dan Penalaran Matematis Peserta Didik Kelas Vii Mtsn 2 Pesisir Selatan Ta 2020/2021. *Journal Cerdas Mahasiswa*, 3(2), 210–224. <https://doi.org/10.15548/jcm.v3i2.3521>
- Siahaan, R. L. M., Juli Arianti, & Thalib, N. (2023). Perkembangan Pendidikan Berkualitas Di Indonesia: Analisis Sdgs 4. *Indo-Mathedu Intellectuals Journal*, 4(2), 975–985. <https://doi.org/10.54373/imeij.v4i2.316>
- Siswondo, R., & Agustina, L. (2021). Penerapan Strategi Pembelajaran Ekspositori Untuk Mencapai Tujuan Pembelajaran Matematika. *Himpunan: Jurnal Ilmiah Mahasiswa Pendidikan Matematika*, 1(1), 33–40.
- Sri Kusuma Dewi Alfiah, Suharti Kadar, & Ahmad Hatip. (2021). Pengaruh Problem Based Solving Terhadap Kemampuan Penalaran Matematis Dan Kemampuan Pemecahan Masalah. *Gauss: Jurnal Pendidikan Matematika*, 4(2), 51–61. <https://doi.org/10.30656/gauss.v4i2.3950>
- Tambunan, L., Sinaga, S. J., & Hutauruk, A. J. B. (2021). Perbedaan Kemampuan Penalaran Matematis Menggunakan Model Pembelajaran Problem Based Learning Dengan Discovery Learning Pada Materi Aritmatika Sosial. *Attractive: Innovative Education Journal*, 4(2), 271–280.

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Teguh, M. (2004). Mat. 09. Trigonometri 1. *Tan, S. S. C. Trigonometri.*, 1-77.