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A CORRELATIONAL STUDY OF MATHEMATICAL DISPOSITION AND PROBLEM-SOLVING ABILITY IN TRIGONOMETRY

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Abstract

This study aims to describe the relationship between mathematical disposition and students' mathematical problem-solving ability in the topic of trigonometry. The research is grounded on the importance of integrating higher-order thinking skills and positive attitudes toward mathematics in 21st-century learning. A quantitative method with a correlational approach was employed. The research subjects consisted of 20 tenth-grade students from a Madrasah Aliyah in Cimahi City, selected through purposive sampling. The instruments used were a mathematical disposition questionnaire and contextual essay-based problem-solving tests in trigonometry. Data were analyzed descriptively and inferentially using the chi-square test. The results showed that the average students' problem-solving ability was in the low category with a percentage of 36.09%, while their mathematical disposition was in the moderate category with a percentage of 62.40%. The chi-square test yielded a significance value of 0.757 ($p > 0.05$), indicating no significant relationship between mathematical disposition and mathematical problem-solving ability. This finding suggests that a positive attitude toward mathematics does not necessarily align with students' ability to solve trigonometric problems. Other factors such as conceptual understanding and learning experiences also play a crucial role. Therefore, mathematics instruction must be holistically designed to foster both cognitive and affective development, supporting students in becoming critical and reflective thinkers.

Keywords: *mathematical disposition, problem-solving ability, trigonometry.*

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan hubungan antara disposisi matematik dan kemampuan pemecahan masalah matematik siswa pada materi trigonometri. Latar belakang penelitian ini adalah pentingnya integrasi kemampuan berpikir tingkat tinggi dan sikap positif terhadap matematika dalam pembelajaran abad ke-21. Metode yang digunakan adalah kuantitatif dengan pendekatan korelasional. Subjek penelitian adalah 20 siswa kelas X di salah satu Madrasah Aliyah di Kota Cimahi yang dipilih secara purposive. Instrumen yang digunakan meliputi angket disposisi matematik dan tes uraian pemecahan masalah berbasis konteks trigonometri. Data dianalisis secara deskriptif dan inferensial menggunakan uji chi-square. Hasil penelitian menunjukkan bahwa rata-rata kemampuan pemecahan masalah matematik siswa berada pada kategori rendah dengan persentase 36,09%, sedangkan disposisi matematik siswa tergolong sedang dengan persentase 62,40%. Uji chi-square menunjukkan nilai signifikansi sebesar 0,757 ($p > 0,05$), yang berarti tidak terdapat hubungan signifikan antara disposisi matematik dan kemampuan pemecahan masalah matematik. Temuan ini mengindikasikan bahwa sikap positif terhadap matematika tidak serta-merta berbanding lurus dengan kemampuan menyelesaikan soal trigonometri. Faktor lain seperti pemahaman konsep dan pengalaman belajar juga berperan penting. Oleh karena itu, pembelajaran matematika perlu dirancang secara menyeluruh, tidak hanya fokus pada peningkatan kognitif, tetapi juga afektif, untuk mendukung pengembangan kemampuan berpikir kritis dan reflektif siswa secara berimbang.

Kata Kunci: *disposisi matematik, kemampuan pemecahan masalah, trigonometri.*

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INTRODUCTION

The development of problem-solving skills is crucial in modern mathematics education, especially in the 21st century In the context of 21st-century learning, mathematics is not only viewed as a collection of formulas and procedures but also as a tool for effectively solving various real-world problems. One of the mathematical topics that integrates various high-level thinking skills is trigonometry. This topic requires students to understand the concept of side ratios in triangles, as well as the functions of sine, cosine, and tangent, and to apply them in solving contextual problems, such as determining the height of an object or distances that cannot be measured directly. Therefore, the development of mathematical problem-solving skills is a key focus in both national and international curricula, as reflected in global assessments like PISA (Programme for International Student Assessment) (OECD, 2019).

Mathematical problem-solving ability is defined as the ability to understand a problem, design a solution strategy, carry out procedures systematically, and logically evaluate the results (Al-Mutawah et al., 2019; Baroody, 1993; Häkkinen et al., 2017; Herawaty & Widada, 2017; Indriyani & Ruqoyyah, 2022; Maya & Ruqoyyah, 2018; Zhang et al., 2020). This ability requires more than just computational skills, as it involves high-level thinking processes reflecting conceptual understanding, decision-making, and mathematical reasoning (Gurat, 2018; Meryansumayeka et al., 2019). In mathematics learning, problem-solving is not only a learning goal but also a primary means for cultivating students' higher-order thinking skills.

However, students' success in solving mathematical problems does not rely solely on cognitive ability. Affective factors such as mathematical disposition also contribute significantly. Mathematical disposition refers to a student's tendency to develop positive attitudes toward mathematics, including confidence in problem-solving, perseverance in facing challenges, interest in mathematical activities, and the belief that mathematics is useful in everyday life (Kamid et al., 2021; Max, 2021; Setiawan & Surahmat, 2023). Students with good mathematical dispositions tend to be more persistent, open to new strategies, and less likely to give up when facing complex problems. Conversely, negative dispositionssuch as math anxiety or the belief that mathematics is inherently difficult can hinder learning and result in poor problem-solving ability. Thus, fostering positive mathematical dispositions must be a key focus in meaningful mathematics instruction.

Unfortunately, in practice, many classrooms still experience a lack of students' mathematical disposition. This is explained in a study conducted by Rivian & Hidayati (2023), which surveyed 30 students and found that 70% of students felt lacking in confidence when solving mathematical problems, and only 50% felt motivated to continue learning mathematics despite facing difficulties. This is further supported by research from (Fairus et al., 2023), which, based on observations and interviews with teachers, found that only 40% of students actively participated in mathematics class discussions. Additionally, 75% of students perceived mathematics as a challenging and unenjoyable subject. Sugilar (2013) states that the potential and mathematical disposition of students have not yet been fully realized. This indicates that students' attitudes toward developing a mathematical disposition are still lacking, and efforts must be made to improve their mathematical disposition. Teachers' main focus is often directed towards cognitive aspects, such as mastery of content or exam scores, while students' affective aspects, including attitudes, self-confidence, interest, and perceptions of mathematics, do not receive equal attention. Weak mathematical disposition, such as fear, low self-confidence, and disbelief in one's own abilities, can hinder student involvement in the learning process. This directly impacts the low problem-solving abilities, as students become reluctant to try new approaches, tend to be passive, and rely solely on strategies that have been previously taught (Aquino & Ibarra, 2024).

Mathematical problem-solving is a complex cognitive activity that requires open-mindedness, persistence, and the belief that a problem can be solved using various strategies. Without a positive disposition, students may easily give up when faced with non-routine problems that demand flexible thinking and deep understanding (Brookhart, 2010). In contrast, students with a good mathematical disposition exhibit persistence, willingness to try alternative solutions, and the ability to reflect on their strategies. These traits help them achieve better performance in mathematical problem-solving, including developing innovative solutions and evaluating their effectiveness (Setiawan & Surahmat, 2023). Hence, mathematics education should not only focus on content mastery but also intentionally design learning experiences that foster positive attitudes toward mathematics. This is essential to nurturing students who are cognitively competent, resilient, and reflective in facing mathematical challenges in real life.

Over the past decade, there has been growing attention toward mathematical disposition as a critical factor in learning, particularly in relation to developing mathematical problem-solving skills. Studies by (Lomri & Dasari, 2024; Muflihatusubriyah et al., 2021; Rezita & Rahmat, 2022) revealed a strong positive correlation between mathematical disposition and problem-solving ability among secondary students. Learners who

demonstrate positive attitudes such as perseverance, self-efficacy, and belief in the usefulness of mathematics are more likely to apply diverse strategies to tackle challenging problems. This aligns with (Hutajulu et al., 2019), who emphasized that mathematical disposition significantly contributes to problem-solving, especially in situations requiring critical thinking and non-routine solutions. Furthermore, Setiawan & Surahmat (2023) provided evidence that disposition also plays a role in developing basic mathematical abilities, particularly in online learning contexts.

However, despite the evidence supporting the importance of mathematical disposition in learning, research that specifically examines the relationship between mathematical disposition and mathematical problem-solving ability is still limited, especially in the context of secondary school students learning trigonometry. A study by (Lomri & Dasari, 2024) examines the importance of mathematical disposition in improving problem-solving abilities in junior high school students. Another study by (Dewi et al., 2021) shows that conceptual understanding and productive disposition can influence students' ability to solve trigonometry problems. However, none of these studies specifically address the relationship between mathematical problem-solving ability and mathematical disposition in the context of trigonometry. Therefore, this study is novel in three main aspects: (1) it specifically analyzes the relationship between mathematical disposition and problem-solving ability in trigonometry; (2) it focuses on secondary school students; and (3) it uses a correlational approach to identify the strength of the relationship between the variables as a basis for formulating more holistic mathematics learning strategies. Based on this, the aim of this study is to describe the correlation between secondary school students' mathematical problem-solving ability and mathematical disposition.

RESEARCH METHOD

This research uses a quantitative approach with a correlational design. The population in this study consists of all 10th-grade students from a Madrasah Aliyah in Cimahi City. The sample used includes 20 students, selected through purposive sampling, which involves choosing samples based on specific criteria relevant to the research objectives (Sugiyono, 2019). The selection of 20 samples was based on the consideration that this number is sufficient for correlational analysis and provides adequate representation of the existing population. The instrument used in this study is a mathematical disposition questionnaire with a 4 point Likert scale, consisting of 26 statements. This instrument has been validated using content validity tests by subject matter experts and psychometric experts to ensure its alignment with the concept of mathematical disposition being measured (DeVellis, 2017). Another instrument is a mathematical problem-solving test, consisting of 4 contextual essay questions related to trigonometry. This test instrument also underwent validation through field trials, including tests for validity, reliability, discriminating power, and difficulty level, to measure the question difficulty and the test's ability to differentiate between students' levels of ability.

Data analysis was performed using both descriptive and inferential approaches. To examine the relationship between variables, a chi-square association test was conducted using SPSS software. The criteria for grouping each variable refer to the criteria proposed by (Maya, 2011), which have been modified to fit the context of this study.

Table 1. Score Qualification Criteria

Criteria	Category
High $\geq 70\% \times$ SMI	1
$55\% \times$ SMI $\leq$ Moderate $< 70\% \times$ SMI	2
Low $< 55\% \times$ SMI	3

Note:
SMI : Score Maximum Ideal

The following table shows the qualification criteria for mathematical problem-solving skills and mathematical disposition.

Table 2. Qualification Criteria for Mathematical Problem-Solving Skills and Mathematical Disposition

Ability	SMI	Qualification	Criteria
Mathematical Problem-Solving	55	Score $\geq$ 38	High (1)
		30 $\leq$ Score $<$ 38	Moderate (2)
		Score $<$ 30	Low (3)
Mathematical Disposition	104	Score $\geq$ 74	High (1)
		58 $\leq$ Score $<$ 74	Moderate (2)
		Score $<$ 58	Low (3)

RESULT AND DISCUSSION

This research was conducted in one of the tenth-grade classes at a Madrasah Aliyah (Islamic Senior High School) in Cimahi City, involving a total of 20 students. The data were collected through students' learning outcomes using a test instrument consisting of four open-ended questions. These questions were developed to assess mathematical problem-solving abilities, particularly in the context of trigonometry. The indicators assessed included understanding the problem, planning a solution, performing calculations, and checking all steps taken.

Table 3. Blueprint and Items of Mathematical Problem-Solving Test

Mathematical Problem-Solving Indicator	No.	Test Item Description	Score
1. Understanding the problem 2. Planning the solution 3. Performing calculations 4. Checking all steps taken	1	In triangle ABC, which is right-angled at B, the length of AC is $2\sqrt{5}$ cm and BC is $2\sqrt{3}$ cm. Point D lies on line AC such that ∠BAD = ∠DBC. Explain how you find the lengths of BD and AD? Check if your answer is correct?	14
	2	To shorten the path from A to C via B, a shortcut is made from A directly to C. If AB = a and BC = 3a, and ∠ABC = 120°, then: a. Sketch the situation. b. What is the length of AC? Check if your answer is correct.	8
	3	Two students are assigned to calculate the height of the school flagpole using trigonometry. Both have a height of 150 cm. The first student stands exactly 10 meters in front of the second. If the angle of elevation for the first student is 60° and for the second is 30°. a. Help them calculate the height of the flagpole (in meters). b. Also calculate the distance from the first student to the flagpole. c. Verify your answers!	17
	4	Two ships, A and B, are 10 km apart. Ship B is at a bearing of 100° from A. Ship C is at a bearing of 160° from A, and at a bearing of 200° from B. a. Sketch the scenario. b. Estimate the distance from Ship C to A and from C to B. c. Check if your answers are correct. (Hint: Sin 40°=0,6428; Sin 80°=0,9848; Sin 60°=0,866)	16
		Total Score	**55**

The following are the results of the mathematical problem-solving test as presented in Table 4.

Table 4. Results of Mathematical Problem-Solving Test

Student Code	Question 1	Question 2	Question 3	Question 4	Total	Criteria
S1	7	5	3	15	30	Moderate
S2	4	5	4	3	16	Low
S3	6	8	2	0	16	Low
S4	6	8	3	4	21	Low
S5	5	8	3	3	19	Low
S6	6	8	3	2	19	Low
S7	5	8	3	3	19	Low
S8	12	8	3	3	26	Low
S9	6	7	6	4	23	Low
S10	7	8	7	8	30	Moderate
S11	6	8	3	1	18	Low
S12	7	4	3	3	17	Low
S13	6	8	3	3	20	Low
S14	6	8	2	1	17	Low
S15	3	8	4	3	18	Low
S16	6	5	3	5	19	Low
S17	4	8	2	0	14	Low
S18	7	8	6	3	24	Low
S19	8	4	4	4	20	Low
S20	4	2	2	3	11	Low
Total Score	121	136	69	71	397	
Average	6.05	6.80	3.45	3.55	19.85	
Percentage	43,21%	85%	20,29%	22,18%	36,09%	Low

Based on Table 4, the percentage of students who were able to answer question number 1 correctly was 43.21%. The majority of students experienced difficulty particularly in performing calculations and rechecking all the steps they had completed. This difficulty was primarily due to a lack of conceptual understanding. For question

number 2, the achievement percentage reached 85%, which can be categorized as very good. Most students did not encounter significant difficulties, although a few struggled. In contrast, question number 3 had a low achievement percentage of 20,29%. Nearly all students struggled with this item. Upon analysis, it was found that students generally failed to understand the problem, which hindered their ability to plan a solution, perform calculations, and recheck the steps they had taken. This again reflects a deficiency in conceptual understanding. Similarly, question number 4 had a low achievement rate of 22,18%. Students struggled for the same reasons: failure to comprehend the problem and difficulties in executing and verifying their solutions. Overall, Table 4 indicates that students' mathematical problem-solving skills are still at a low level, particularly on items 1, 3, and 4.

Subsequently, the analysis of students' mathematical disposition was conducted using a questionnaire. The mathematical disposition questionnaire was distributed to students in the same class. It was designed to assess students' attitudes toward mathematics learning, particularly in the context of a contextual teaching approach. The questionnaire consisted of 26 items, comprising 13 positive and 13 negative statements. The following section presents the results of the mathematical disposition questionnaire.

Tabel 5. Hasil Angket Disposisi Matematik Siswa

Student Code	Score	Criteria
S1	63	Moderate
S2	50	Low
S3	61	Moderate
S4	59	Moderate
S5	68	Moderate
S6	59	Moderate
S7	75	Moderate
S8	69	Moderate
S9	62	Moderate
S10	61	Moderate
S11	67	Moderate
S12	73	Moderate
S13	74	Moderate
S14	72	Moderate
S15	59	Moderate
S16	60	Moderate
S17	66	Moderate
S18	74	Moderate
S19	61	Moderate
S20	65	Moderate
Total	1298	
Average	64,90	
Percentage	62,40%	Moderate

Based on Table 5, the percentage score of students' mathematical disposition is 62.40%, which falls into the moderate category. Furthermore, to examine the relationship between mathematical problem-solving ability and mathematical disposition, the data are presented in Table 6.

Table 6. Statistical Description of the Association Between Mathematical Problem-Solving Ability and Mathematical Disposition

		Mathematical Disposition			Total
		High	Moderate	Low	
Mathematical Problem-Solving Ability	Moderate	0	2	0	2
	Low	3	14	1	18
Total		3	16	1	20

Based on the data presented in Table 6, a notable distribution pattern emerges between students' mathematical problem-solving abilities and their level of mathematical disposition. Students classified under the "moderate" category for problem-solving ability generally also demonstrated a "moderate" level of mathematical disposition. This suggests a parallel tendency between cognitive abilities and affective attitudes within this group, where the ability to solve trigonometric problems in contextual situations is aligned with moderate levels of confidence, persistence, and interest in mathematics. However, a different pattern appears among students with low problem-solving ability. This group was not dominated by students with low mathematical disposition; rather, it included those with moderate and even high disposition levels. In other words, some students who possessed positive attitudes towards mathematics such as high interest and the belief that mathematics is useful were still unable to perform well in solving trigonometric problems. This finding indicates a mismatch or inconsistency

between affective and cognitive aspects, which may be influenced by other factors, such as inadequate conceptual understanding, ineffective learning strategies, or limited experience in problem-solving activities.

This phenomenon reinforces the view that a high mathematical disposition does not necessarily translate directly into strong problem-solving abilities unless it is accompanied by adequate conceptual and procedural skills (Lomri & Dasari, 2024). Thus, in the learning process, teachers not only need to foster students' positive dispositions toward mathematics but also must ensure the simultaneous development of their conceptual understanding and logical thinking skills.

Subsequently, a Chi-Square (χ^2) test was conducted to determine whether there is an association between students' mathematical problem-solving ability and their mathematical disposition at a 95% confidence level or a significance level of $\propto = 0.05$. The statistical hypotheses are as follows:

H_0 : There is no association between mathematical problem-solving ability and mathematical disposition.

H_1 : There is an association between mathematical problem-solving ability and mathematical disposition.

The criteria for hypothesis testing are as follows:

If Sig. > 0,05, then H_0 is accepted.

If Sig. ≤ 0,05, then H_0 is rejected.

The Chi-Square (χ^2) test results for the association between mathematical problem-solving ability and mathematical disposition are presented in the following table.

Table 7. Chi-Square (χ^2) Test of Mathematical Problem-Solving Ability and Mathematical Disposition

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.556[a]	2	.757
Likelihood Ratio	.947	2	.623
Linear-by-Linear Association	.111	1	.739
N of Valid Cases	20		

Based on the data in Table 7, the Pearson Chi-Square value is 0,556 with a significance level (Sig.) of 0,757. Since the significance value exceeds 0.05, H_0 is accepted, which indicates that there is no significant association between students' mathematical problem-solving ability and their mathematical disposition. This finding suggests that a student's performance in solving mathematical problems does not necessarily influence their disposition toward mathematics.

The results of this study indicate that there is no significant association between students' mathematical problem-solving ability and their mathematical disposition, as evidenced by the chi-square significance value of 0,757 (> 0,05). This implies that students' cognitive ability in solving trigonometry problems does not always align with their affective or attitudinal aspects toward mathematics, such as interest, self-confidence, or perseverance.

These findings are supported by a study by (Yuliani et al., 2021), which found that students with low mathematical disposition were still able to complete problems effectively at a procedural level. However, they showed limited curiosity or reflection on the problem-solving process. This suggests that students can achieve strong cognitive performance even without strong affective support particularly in learning environments that place too much emphasis on outcomes rather than the learning process itself. Furthermore, research by (Mahmudi, 2010) evealed no significant relationship between mathematical problem-solving ability and students' mathematical disposition. His correlational analysis indicated that high cognitive achievement does not always coincide with high affective qualities. In other words, students who are capable of solving mathematical problems effectively may not necessarily exhibit positive attitudes such as confidence, perseverance, or interest in mathematics.

However, contrasting findings were reported by Razak et al. (2022), who found that students with high mathematical disposition were able to meet all of Polya's problem-solving indicators, while students with low disposition struggled to fulfill them. Similarly, studies by(Dinia et al., 2019; Husna & Hanggara, 2022) indicated that students with strong dispositions demonstrated better problem-solving performance than those with weaker dispositions. A more recent study by Lomri & Dasari (2024) emphasized that mathematical disposition has a significant positive correlation with problem solving ability among secondary school students, especially when learning is focused on reflective activities and real-life contextual problems. This pattern was also observed by Setiawan & Surahmat (2023) in the context of online learning, where students with high disposition were more adaptive to challenges and exhibited greater perseverance in tackling high-order thinking problems.

These findings suggest that the relationship between mathematical disposition and problem-solving ability is not always consistent, as it is greatly influenced by various external factors, such as the instructional approach,

learning experiences, and emotional classroom environment. Therefore, it is essential for teachers not only to focus on improving academic outcomes through cognitive drills but also to explicitly foster an environment that strengthens mathematical disposition. This includes providing space for reflection, building students' self efficacy, and presenting challenges that encourage exploration. Teachers must also ensure that learning promotes both confidence and logical thinking simultaneously, so that students are not only able to answer problems but also develop resilience in complex mathematical reasoning processes.

CONCLUSION

The results of this study indicate that students' mathematical problem-solving abilities are generally low, while their mathematical dispositions fall within the moderate category. The chi-square test revealed no significant relationship between mathematical disposition and problem-solving ability ($p = 0{,}757 > 0{,}05$). This means that a positive disposition toward mathematics does not necessarily align with the ability to solve trigonometry problems. These findings highlight that affective and cognitive aspects of students do not always correlate directly, and thus, both must be developed simultaneously in the learning process.

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