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How Can Learning Motivation and Problem-Solving Predict the Mathematical Disposition of Primary Students?

Uswatin Anggraeni, Mohammad Faizal Amir*, Mahardika Darmawan Kusuma Wardana
Department of Primary Education, Universitas Negeri Semarang
Raya Beringin Street No.15, Wonosari, Ngaliyan, Semarang City, Central Java, Indonesia
*Corresponding Author. E-mail: faizal.amir@umsida.ac.id

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Abstract: This study aims to analyse the simultaneous impact of learning motivation (affective aspect) and problem-solving (cognitive aspect) on the mathematical disposition of primary students. Using a quantitative survey with a cross-sectional design, data were collected from 81 fourth-grade students through validated questionnaires and problem-solving tests. Multiple linear regression was applied after verifying the classical assumptions. The results indicated that both variables significantly affect mathematical disposition when analysed together. However, only problem-solving showed a significant partial effect. This suggests that cognitive skills are more dominant than affective factors in shaping students' mathematical disposition. These findings highlight the importance of strengthening problem-solving skills from an early age as a foundation for developing positive attitudes toward mathematics. The study contributes to theoretical development by integrating cognitive and affective dimensions and offers practical implications for enhancing learning strategies in primary education.
Keywords: mathematical disposition, learning motivation, problem-solving, primary students

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Introduction

Mathematical disposition is recognised as a key component in mathematics learning, encompassing perseverance, flexible thinking, and an interest in exploring mathematical problems (Fitriya et al., 2023). It also relates to students' beliefs in their skill to think strategically (Ab et al., 2019). Furthermore, mathematical disposition serves as a foundational element in fostering positive attitudes, interest, and confidence in mathematics learning (Inram & Islamiati, 2018). In problem-solving, it supports students in exploring various strategies and deepening mathematical understanding. A strong mathematical disposition encourages students to be more explorative and willing to try innovative approaches (Tong et al., 2021). Therefore, mathematical disposition is a fundamental factor contributing to students' success and enhanced understanding of mathematics, particularly when supported by effective learning components such as contextual problem-solving tasks, interactive media, and collaborative learning (Arifin et al., 2020; Firdaus et al., 2022).

Identifying mathematical disposition in students is particularly important at the primary school level, as this stage marks the formation of foundational knowledge and attitudes toward learning (Hayat et al., 2024). At this age, students are in the early stages of cognitive and emotional development (Sugianto & Darmayanti, 2022) and begin to explore basic logical and mathematical reasoning (Hidayat et al., 2022). The development of mathematical disposition at this stage contributes to establishing cognitive foundations that will influence future learning (Elsayed, 2022; Klang et al., 2021). Therefore, cultivating a positive attitude and foundational understanding of mathematics early on is essential for long-term academic growth.

Problems with primary students' mathematical disposition can be observed from two aspects: attitude, which encompasses attention and self-efficacy, and knowledge, which encompasses understanding and application of mathematics (Fitriya et al., 2023; Kamid et al., 2021). Low self-

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efficacy and poor mathematical skills often lead to math anxiety—characterised by nervousness, fear, and a general dislike for mathematics—negatively impacting learning outcomes (Hussein & Csíkos, 2023; Sholichah & Aini, 2022). International assessments also reflect this condition. The 2018 PISA results show that Indonesia ranked 73rd out of 78 countries, with a mean score of 379, which is well below the OECD average of 489 (OECD, 2019). In 2022, only 18% of Indonesian students could solve Level 2 PISA tasks, compared to the OECD average of 69% (OECD, 2023). Similarly, Indonesia's average scores in the TIMSS assessments from 2003 to 2015 remained below the international average (Hamzah, 2023). Moreover, primary students struggle with narrative-type problems, even when the context is familiar in daily life (Nurharyanto & Retnawati, 2020). These findings underscore the urgency of enhancing mathematical disposition through targeted efforts and understanding the factors that influence it.

Learning motivation has been shown to influence mathematical disposition. Schukajlow et al. (2017) found that emotions and motivation play a role in developing positive attitudes toward mathematics. Hutajulu et al. (2019) also confirmed a positive correlation between learning motivation and mathematical disposition. Motivated students are more likely to embrace mathematical challenges and strengthen their disposition. High learning motivation fosters positive attitudes and better academic outcomes in mathematics (Hwang & Son, 2021). It also provides internal drive, helping students persist and overcome challenges in mathematics learning (Diponegoro et al., 2024).

Problem-solving skills also show a strong positive correlation with mathematical disposition (Islamiati et al., 2021; Lomri & Dasari, 2024; Tampa et al., 2024). Students with better problem-solving skills often exhibit higher self-efficacy and curiosity, which leads to a more favourable disposition toward mathematics. Mathematical disposition is linked to specific steps in problem-solving processes (Lomri & Dasari, 2024), and strong problem-solving skills are often found in students with positive mathematical dispositions (Tampa et al., 2024). In contrast, students with good mathematical dispositions tend to perform better in solving mathematical problems (Islamiati et al., 2021). Additionally, learning motivation contributes to the development of problem-solving skills (Alim et al., 2021), and strong problem-solving skills can, in turn, boost students' motivation to learn mathematics (Pangestu et al., 2024). These connections suggest that learning motivation and problem-solving may be predictors of mathematical disposition.

Previous studies have acknowledged the contribution of learning motivation and problem-solving to mathematical disposition. However, most studies have examined these variables separately, rather than within an integrated framework. Studies focusing solely on learning motivation, such as Arnidha and Maulani (2022), emphasise the role of intrapersonal and interpersonal intelligence in shaping motivation and disposition. Sari and Darhim (2020) highlight learning strategies such as relating, experiencing, applying, cooperating, and transferring to enhance motivation and disposition. Meanwhile, Schukajlow et al. (2017) underline the impact of emotion on academic performance. On the other hand, studies on problem-solving, such as those by Lomri and Dasari (2024), demonstrate a strong link to mathematical disposition. Meanwhile, Fadillah and Wahyudin (2022) find that students with a high disposition tend to be more systematic in solving problems. Nonetheless, these studies rarely investigate the joint impact of learning motivation and problem-solving on mathematical disposition, particularly among primary students (Aini & Khuzaini, 2024; Hutajulu et al., 2019; Kamid et al., 2021; Tong et al., 2021). This highlights a gap in the study of integrating cognitive and affective aspects to understand how mathematical disposition forms in primary learners.

This study seeks to address the need for a learning approach that supports the holistic development of mathematical disposition by integrating learning motivation (affective dimension) and problem-solving (cognitive dimension), particularly in primary students. The study aims to develop a more comprehensive understanding of the interaction between these two dimensions, which are often studied in isolation. Practically, the findings are expected to support efforts to enhance the quality of mathematics education in Indonesia. The study addresses three key questions: 1) Do learning motivation and problem-solving simultaneously affect mathematical disposition? 2) Does learning motivation impact mathematical disposition? and 3) Does problem-solving impact mathematical disposition? The results are expected to help primary teachers implement more effective and contextually relevant strategies to foster motivation, enhance problem-solving skills, and build positive mathematical dispositions. This is especially important in the Indonesian context, where students often show low interest in learning and hold negative perceptions of mathematics (Irawan & Iasha, 2021). Thus, this study aims to contribute to the theoretical development of mathematical disposition research and the practical enhancement of mathematics learning outcomes at the primary level.

Methods

This study used a quantitative survey method to examine the relationship between variables. A survey was employed as a method of collecting primary data by asking questions to respondents to gather information and responses from groups representing a population (Creswell & Creswell, 2018). The study was designed to determine the relationships between the variables, as illustrated in Figure 1. Several hypotheses were then proposed to be tested through the data analysis process.

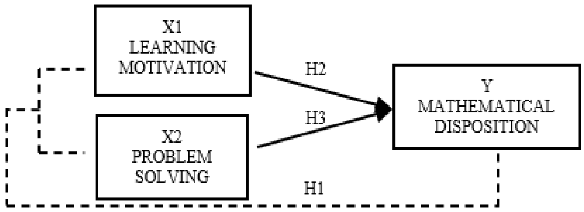


Figure 1. Research Design

Figure 1 illustrates the relationship between learning motivation and problem-solving as independent variables, which were hypothesised to correlate with mathematical disposition as the dependent variable. The first type of correlation was partial, referring to the individual correlation of each independent variable with the dependent variable. In contrast, the simultaneous correlation referred to the combined effect of both independent variables on the dependent variable. Based on Figure 1, the relationship among the variables aligned with the study's objective: to analyse the impact of learning motivation and problem-solving on students' mathematical disposition and to determine whether the two independent variables could simultaneously influence the dependent variable. Accordingly, the study proposed the following hypotheses:

H1: Learning motivation and problem-solving affect mathematical disposition
H2: Learning motivation affects the mathematical disposition
H3: Problem-solving affects the mathematical disposition

The population in this study consisted of 123 fourth-grade students, with a sample of 81 students. The sampling technique employed was total sampling, in which the entire population was included as the sample. This technique was chosen because the entire relevant population met the criteria needed to obtain the expected data (Creswell & Creswell, 2018). Moreover, total sampling was expected to yield more representative and accurate data. The population selection was based on the alignment between students' characteristics and the variables under study, as well as their eligibility to complete the study instrument.

The study instrument consisted of questionnaires and written tests designed to measure three primary variables: learning motivation, problem-solving ability, and mathematical disposition. Questionnaires assessed learning motivation and mathematical disposition, while written tests measured students' problem-solving skills. Prior to use, the instruments underwent a content validation process by experts and a reliability test using Cronbach Alpha, with a threshold value of $\alpha \geq 0.70$ to be considered reliable. The test results indicated that the learning motivation instrument had an alpha value of $\alpha = 0.849$, the problem-solving instrument had an alpha value of $\alpha = 0.741$, and the mathematical disposition instrument had an alpha value of $\alpha = 0.749$. Based on these results, all instruments were deemed valid and reliable for use in the study. The indicators for mathematical disposition are presented in Table 1, while those for learning motivation are shown in Table 2.

Table 1. Indicator of Mathematical Disposition

Aspect	Indicator
Confidence	Solving the given problems easily (+) Can't solve the problem given (-) Feeling excited try to solve problems using various methods (+)

Flexible and try different alternatives in solving problems	Find it difficult to answer questions without using the method modeled by the teacher (-)
Diligently working on mathematical problems	Enjoying working problems and always study mathematic materials out of school hours (+) Working mathematical problem only at school (-)
Interest and curiosity	Interesting in learning and want to ask about the materials that will be delivered in class (+) Feeling afraid to ask about the material presented (-)
Monitor and reflect on mathematic performance or learning	Paying attention to the delivery of material in class so that I can solve the problems given (+) studying mathematics without focusing because I think about other things, so I cannot solve the problems properly (-)
Assessing mathematic application (benefits of learning)	Studying the material presented so that I could solve daily life problems related to mathematics (+) Don't feel any benefit from mathematics learning for daily life (-)
Appreciation of the role of mathematics (appreciation toward mathematics)	Thinking about mathematics as fun and easy to learn if we are diligent in teaching it (+) Thinking about mathematics is a difficult learning (-)

Table 1 presents the indicators used to measure students' mathematical disposition. These indicators were adapted from Hutajulu et al. (2019) and comprised seven main aspects: 1) self-efficacy, 2) flexibility, 3) perseverance in solving mathematical problems, 4) interest and curiosity toward mathematical learning, 5) the skill to monitor and reflect on learning, 6) assessment of the benefits of applying mathematics in real life, and 7) appreciation of the role of mathematics in life. Each indicator was developed into two positive and one negative statements, resulting in 14 statements. Student responses to each statement were measured using a 4-point Likert scale: 1) strongly disagree, 2) disagree, 3) agree, and 4) strongly agree.

Table 2. Indicator of Learning Motivation

Aspect	**Indicator**
Desire to try to succeed	Enjoying and solving mathematic problems easily (+) Feeling difficulty solving the mathematic problems (-)
Have the motivation to fulfill learning needs	Studying mathematics in class and review it at home (+) Studying mathematics during class (-)
Hopes and aspirations for the future	Feeling that learning mathematics is an easy and helpful thing to solve problems in daily life (+) Feeling that learning about mathematics has no impact and no benefit to my daily life (-)
Appreciation in learning	Appreciated (verbal, gift) when I can perform mathematic tasks well (+) Don't care about rewards (verbal, gift) in mathematic learning (-)
Interesting activities in learning	Enjoying mathematic learning is also implemented with games (+) Don't like mathematical learning that only contains material explanations (-)
There is a supportive environment to create a good learning situation	Studying in a comfortable and clean classroom makes me more motivated to learn (+) Studying in uncomfortable places, so I do not feel excited (-)

Table 2 outlines the indicators employed to assess students' learning motivation within the context of mathematics education. These indicators, adapted from Hutajulu et al. (2019), comprise six dimensions: 1) the aspiration and effort to achieve success, 2) the internal drive to satisfy learning needs, 3) future-oriented hopes and ambitions, 4) appreciation for the learning process, 5) active engagement in learning activities, and 6) the presence of a conducive learning environment. Each dimension is operationalised through two statements—one positively worded and one negatively worded—yielding a total of 12 items. All items are measured using a four-point Likert scale, consistent with the instrument used to assess students' mathematical disposition.

The problem-solving instrument is structured as a written test comprising five questions, adapted to the fourth-grade primary school curriculum as shown in Table 3. The purpose of the test is to evaluate students' critical thinking and analytical skills through the four stages of problem-solving proposed by Polya, namely: 1) understanding the problem, 2) devising a plan, 3) carrying out the plan, and 4) reviewing the solution (Daryanes et al., 2023). The content of the questions is detailed in Table 3, while Table 4 presents an assessment rubric based on five indicators derived from Polya's stages. Each indicator is scored on a scale of 0 to 4 for each aspect.

Table 3. Problem-Solving Test

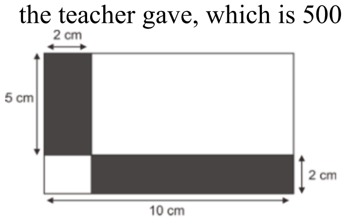
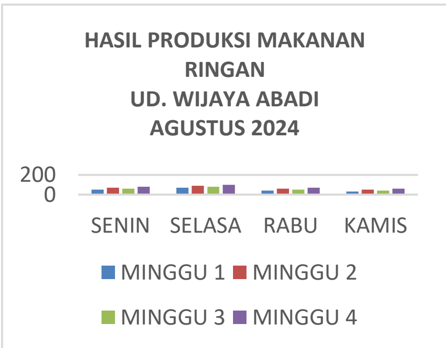
No.	Contents	Items
1	Numbers	Ari visits the dance training center every 4 days, while Ria visits the dance training center every 8 days. They practiced dancing together on August 18, 2028. They will practice dancing together again on?
2	Algebra	A bookshelf can store up to 15 books of the same size. Lala has books of 4 different colors and the same size as her bookshelf. Suppose Lala has 5 red books, 2 more yellow books than red books, 5 less green books than yellow books, and 1 blue book. Can all Lala's books fit into the bookshelf and what is the pattern of numbers in the arrangement of Lala's books on the shelf when sorted from the least number of books?
3	Measurement	A school has a field with a length of 4000 cm and a width of 1000 cm. When sports lessons, students are asked to run around the field until they reach the target the teacher gave, which is 500 m. how many running laps should they do?
4	Geometry	 Find the area ratio between the shaded and unshaded areas!
5	Data analysis and Probability	The results of snack food production at UD are known. Wijaya Abadi in August as follows.  So, what is the result of the total production of UD Wijaya Abadi snacks in September, week two?

Table 4. Rubric for Problem-Solving Test Assessment

Aspects assessed	Reaction toward a problem or issue	Score
Understanding the Problem	No understanding of the problem/no answer	0
	Does not heed the requirements of the problem/interpretation of the problem is incorrect	1
	Formulating the problem into required information ("known")	2
	Understanding the problem in the test	3

	There are no wrong answers	4
Planning for Solution	There is no plan for a solution strategy	0
	Making irrelevant strategy	1
	Using one particular strategy but cannot continue/missteps	2
	Using one particular strategy but aiming for the correct answer	3
	Using several correct strategies that aim to the correct answer.	4
Implementing Solution	There is no solution at all	0
	There is a solution, but the procedure is not clear	1
	Using one specific procedure that aims to find the correct answer	2
	Using one specific correct procedure but getting the calculation wrong	3
	Using specific correct procedures and correct results	4
Rechecking Answers	No checking of the answer	0
	Checking only on earlier knowledge (known, asked)	1
	Checking only on the answer (calculation)	2
	Checking only on the process	3
	Checking toward process and answer	4

The procedure of this study follows the stages of the survey method as outlined by Creswell and Creswell (2018), encompassing several steps. First, the problem was identified and formulated, focusing on the low mathematical disposition of primary students, which was then developed into the study problem, objectives, and hypotheses. Second, the population and sample were determined, consisting of all fourth-grade students, using a total sampling technique involving 81 participants. Third, a cross-sectional survey design was adopted, where data collection occurred at a specific point during the mathematics learning process. Fourth, study instruments in questionnaires and written tests were developed and validated to measure learning motivation, problem-solving skills, and mathematical disposition, with expert validation and reliability testing conducted using Cronbach Alpha. Fifth, data were collected by distributing questionnaires and administering tests to all participants under direct supervision. Sixth, data analysis was conducted using multiple linear regression, employing the F-test to assess simultaneous effects and the t-test for partial effects, preceded by classical assumption tests, including normality, multicollinearity, and heteroscedasticity. Finally, the results were concluded, and theoretical and practical recommendations were provided to support efforts to enhance the quality of mathematics learning in primary schools.

The data analysis technique in this study involved four main stages. First, a descriptive analysis was conducted to determine each variable's mean, standard deviation, minimum, and maximum. Second, a classical assumption test was performed to validate the regression model, including: a) a normality test using the Kolmogorov–Smirnov method, b) a multicollinearity test using the variance inflation factor (VIF $\leq$ 10) and tolerance ($\geq$ 0.1), and c) a heteroscedasticity test using a scatterplot of standardised predicted values (ZPRED) against studentised residuals (SRESID). Third, a multiple linear regression analysis was conducted to examine the influence of learning motivation and problem-solving skills on mathematical disposition, as well as their functional relationships. Fourth, hypothesis testing included: a) an F-test to assess the simultaneous effect of the independent variables, and b) a t-test to examine their partial effects. A coefficient of determination (R^2) test was also conducted to determine the proportion of variance in the dependent variable explained by the model.

Results and Discussion

Results

Descriptive Analysis Test

Based on the descriptive analysis results, the three variables have minimum values of 34 and maximum values of 48. The mean of learning motivation is 42.7654, with a standard deviation of 3.89959. Since the mean is greater than the standard deviation, the data tends to cluster around the mean with relatively low variability. The problem-solving variable has a slightly higher mean of 42.8519 and a standard deviation of 4.21340, suggesting a relatively uniform distribution. The mathematical disposition variable has the highest mean value of 42.9383 and a standard deviation of 4.09373, indicating that its data variation falls between learning motivation and problem-solving. All three variables tend toward high values, with means close to the maximum and no significant differences between individual respondents. This suggests that students generally demonstrate good learning motivation, problem-solving skills, and mathematical disposition.

Table 5. Descriptive Analysis Test Result

	n	Minimum	Maximum	Mean	Std. Deviation
Learning motivation	81	34.00	48.00	42.7654	3.89959
Problem-solving	81	34.00	48.00	42.8519	4.21340
Mathematical disposition	81	34.00	48.00	42.9383	4.09373
Valid n (listwise)	81				

Normality Test

The normality test determines whether the data come from a normally distributed population. In this study, the Kolmogorov-Smirnov test was used via SPSS. A significance value (sig.) greater than 0.05 indicates that the data are normally distributed, while a value less than 0.05 indicates non-normality. Based on the SPSS output, the significance value obtained is 0.021 (> 0.05). Thus, it can be concluded that the data in this study are normally distributed.

Table 6. Normality Test Result

Kolmogorov-Simirnov	
N	81
Asymp. Sig (2-tailed)[c]	0.21

Multicollinearity Test

The multicollinearity test evaluates whether the independent variables in a multiple regression model are highly correlated. A good regression model should not correlate with independent variables. Tolerance measures the proportion of variability in an independent variable that is not explained by other independent variables. In general, the criteria used to detect multicollinearity are Tolerance (> 0.1) or VIF (< 10).

Table 7. Multicollinearity Test Result

Variable	Collinearity Statistic	
	Tolerance	VIF
Learning Motivation	0.975	1.025
Problem-Solving	0.975	1.025

Based on the SPSS output in Table 7, the Tolerance value is 0.975 (>0.1), and the VIF value is 1.025 (<10). These values indicate that there is no multicollinearity between the independent variables, meaning that each variable uniquely contributes to the model. This confirms that the regression model is valid and reliable for identifying learning motivations and problem-solving effects on mathematical disposition.

Heteroscedasticity Test

The heteroscedasticity test detects whether the variance of residuals in a regression model remains constant across all levels of the independent variables. A good model should exhibit homoscedasticity. This test used a residual scatterplot. If the data points form a clear pattern, heteroscedasticity is present.

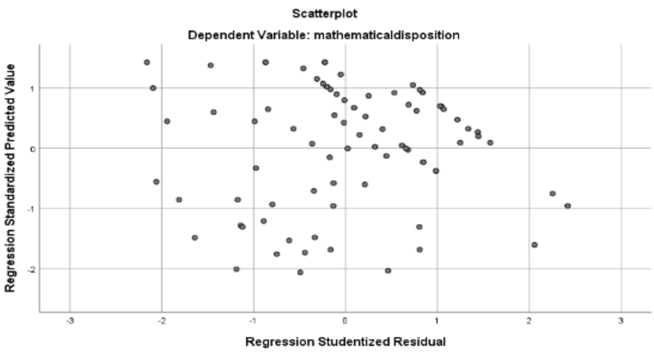


Figure 2. Heteroscedasticity Test

Figure 2 shows that the residuals are randomly dispersed above and below the zero line on the Y-axis without forming a specific pattern. This suggests that the residuals are evenly spread (homoscedastic), indicating that the model meets the classical assumption of no heteroscedasticity. As a result, the regression analysis results can be considered applicable to the broader population of primary students.

Multiple Regression Analysis

Multiple regression analysis determines whether a functional relationship exists between two or more independent variables and a dependent variable. The test results shown in Table 8 indicate a constant value of 11.774. If learning motivation (X1) increases while problem-solving (X2) remains constant, mathematical disposition (Y) increases by 0.133. Conversely, if problem-solving (X2) increases while learning motivation (X1) remains constant, mathematical disposition (Y) increases by 0.594.

Table 8. Multiple Linear Regression Analysis Test Result

Model	Variable	Unstandardised B	Coefficients Std. Error	Standardised Coefficient Beta
1	(Constant)	11.774	4.964	
	Learning motivation	0.133	0.092	0.127
	Problem-solving	0.594	0.085	0.611

The test results of multiple linear analysis are shown in equation (1)

$$\boldsymbol{Y} = 11.774 + \mathbf{0}.133\boldsymbol{X}_{\mathbf{1}} + \mathbf{0}.594\boldsymbol{X}_{\mathbf{2}} + \boldsymbol{\varepsilon} \qquad (1)$$

Description:
Y: mathematical disposition
$X1$: learning motivation
$X2$: problem solving

This analysis indicates that problem-solving strongly influences mathematical disposition than learning motivation. Students with higher problem-solving skills tend to exhibit better mathematical dispositions. Therefore, both problem-solving and learning motivation should be emphasised in primary education. Encouraging active learning can effectively boost students' motivation and overall mathematical disposition (Zuo et al., 2024).

Simultaneous Test (F-Test)

The F-test is used to determine whether all independent variables collectively have a significant effect on the dependent variable. According to the decision criteria, the effect is considered significant if the p-value is less than 0.05. Based on Table 9, the significance value is 0.000 (< 0.05), indicating that learning motivation (X1) and problem-solving (X2) have a significant effect on mathematical disposition simultaneously.

Table 9. F-test Result

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	555.617	2	277.809	27.601	0.000[b]
	Residual	785.074	78	10.065		
	Total	1340.691	80			

Partial Test (T-Test)

The T-test examines the individual effect of each independent variable on the dependent variable as shown onTable 10. The variable has a significant effect if the p-value is less than 0.05. For learning motivation (X1), the p-value is 0.151 (>0.05), indicating it does not significantly affect mathematical disposition (Y). However, for problem-solving (X2), the p-value is 0.000 (< 0.05), meaning it significantly influences mathematical disposition.

Table 10. T-test Result

Model	Variable	Unstandardised B	Coefficients Std. Error	Standardised Coefficient Beta	t	Sig.
1	(Contstant)	11.774	4.946		2.380	0.020
	Learning motivation	0.133	0.092	0.127	1.449	0.151
	Problem-solving	0.594	0.085	0.611	6.970	0.000

Coefficient of Determination Test (R^2)

The coefficient of determination test measures how much the independent variables can explain the variation in the dependent variable. The R^2 value indicates the strength of the linear relationship between the independent and dependent variables and reflects the predictive accuracy of the statistical model. Based on Table 11, the R Square value is 0.414, which means that learning motivation (X1) and problem-solving (X2) collectively explain 41.4% of the variation in mathematical disposition. The remaining 58.6% is influenced by other factors not examined in this study. Therefore, while learning motivation and problem solving play a significant role in shaping mathematical disposition, they are not the only contributing factors.

Table 11. Coefficient of Determination Test Result

Model	R	R Square	Adjusted R Square	Std.Error of the Estimate
1	0.644	0.414	0.399	3.173

Discussion

The results of this study revealed that two out of three hypotheses were accepted. First, learning motivation and problem-solving together significantly affect mathematical disposition. This supports the findings of Hutajulu et al. (2019), who noted a positive relationship between these variables. Students with strong learning motivation typically demonstrate perseverance and a positive attitude toward mathematics (Hutajulu et al., 2019; Wahyudin et al., 2024). While learning motivation contributes, it appears less influential than problem-solving. When combined, both factors promote not only a positive attitude but also increased self-efficacy in solving complex mathematical problems (Szabo et al., 2020). Strategies that integrate learning motivation and problem-solving are effective in enhancing students' mathematical disposition and fostering a more structured and analytical mindset (Yustikarinda et al., 2024). Additionally, learning motivation has been shown to influence problem-solving (Arili et al., 2024; Supriadi et al., 2024).

Second, the study found that learning motivation does not significantly impact mathematical disposition. This contrasts with previous studies by Schukajlow et al. (2017) and Kusmaryono et al. (2020), which linked motivation to disposition development. One possible explanation is that students are driven by extrinsic factors, such as the pressure to achieve high scores. Oktavia and Yulia (2024) emphasised the role of self-enhancement in learning achievement, suggesting that motivation alone is insufficient. Nasution et al. (2021) argued that motivation must be supported by appreciation and guidance to enhance perseverance and self-efficacy. Therefore, this study suggests that other factors, like teaching strategies or cognitive skills, may play a more critical role than motivation in shaping mathematical disposition (Atma et al., 2021). Holistic approaches are needed to address various factors such as anxiety, self-efficacy, and instructional methods to enhance mathematics learning (Zuo et al., 2024).

Third, the findings confirm that problem-solving significantly influences mathematical disposition, in line with previous studies (Lomri & Dasari, 2024). A high mathematical disposition allows students to approach problems systematically and with confidence. A study by Islamiati et al. (2021) and Nurlela et al. (2025) supports the notion that students with strong mathematical dispositions tend to solve problems more successfully. However, Wahyuningrum et al. (2024) reported inconsistent findings, which could be attributed to differences in students' dispositions and problem-solving skills. Despite this, the current study emphasises that problem-solving is a stronger predictor of mathematical disposition than motivation. Thus, enhancing students' problem-solving skills should be prioritised to foster logical and systematic thinking in mathematics learning.

Problem-solving and mathematical disposition mutually reinforce building a productive learning environment. Learning strategies that focus on these aspects have proven effective across educational levels (Hutajulu et al., 2019). Encouraging self-efficacy and relevant learning approaches helps students recognise the value of mathematics in real life. Media and instructional methods that emphasise problem-solving enhance students' skills (Damayanti & Mawardi, 2018; Suryatin & Sugiman, 2019). Effective strategies enhance disposition and enhance academic achievement, particularly in primary education. Kamid et al. (2021) found that students' mathematical disposition includes affective components linked to cognitive performance (Arifin, 2024; Kamid et al., 2021). Successful mathematics learning thus depends on students' attitudes as much as on concept mastery (Hollenstein et al., 2024). A comprehensive approach should target both academic results and character development (Wakhata et al., 2024).

Students' mathematical disposition development is closely tied to the teacher's role in fostering motivation and enhancing problem-solving. Teachers can create supportive environments by presenting appropriate challenges, employing interactive methods, and providing constructive feedback. These practices help students develop their potential. Teachers must also consider (1) students' mathematical knowledge and disposition awareness, (2) maximising cognitive, affective, and conative disposition functions, and (3) promoting positive dispositions through social and communication skills (Kusmaryono et al., 2019; Yang & Kaiser, 2022). Moreover, selecting and adapting learning media to meet students' needs and goals is essential. Engaging media can significantly enhance student outcomes (Firdaus et al., 2024; Triwahyuningtyas et al., 2022).

This study contributes theoretically by integrating learning motivation (an affective aspect) and problem-solving (a cognitive aspect) as predictors of mathematical disposition in primary students. The findings highlight that strong problem-solving skills are associated with a more positive disposition, indicating the importance of cognitive development for long-term attitudes toward mathematics. Methodologically, the study employed a quantitative approach using validated instruments, thereby enabling reliable and generalizable results. This model can be replicated in future studies to examine interactions between cognitive and affective variables. However, this study did not examine the individual contributions of each indicator to learning motivation and problem-solving. Future studies should analyse these components in more detail to better understand their role in shaping mathematical disposition.

Conclusion

The study concludes that problem-solving has a stronger influence on primary students' mathematical disposition than learning motivation. Although learning motivation does not significantly affect disposition, its combination with problem-solving contributes positively. Students with strong problem-solving skills tend to exhibit more positive mathematical dispositions, as this skill aligns with the logical and structured nature of mathematical thinking. While motivation does not have a significant partial effect, it remains a vital supporting factor. Therefore, developing both aspects in tandem is essential to enhance students' mathematical disposition and enhance learning outcomes in mathematics.

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