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Learning Motivation, Learning Discipline, and Mathematics Achievement: Evidence from Grade 8 Students in Indonesia

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Abstract

Mathematics achievement is shaped not only by students' cognitive development but also by affective and behavioral dimensions of learning. However, the relative roles of learning motivation and learning discipline in mathematics achievement remain insufficiently clear when examined simultaneously, particularly in Indonesian junior high school contexts. This study investigated the joint and individual associations of learning motivation and learning discipline with mathematics achievement among 87 Grade 8 students at a junior high school in Wajo, Indonesia. A quantitative ex post facto design was employed, with data collected through five-point Likert questionnaires measuring learning motivation and learning discipline and school documentation of mathematics achievement. Descriptive statistics, Pearson correlations, and multiple linear regression were conducted using JASP. The regression model was statistically significant, $F(2, 84) = 8.152$, $p < .001$, explaining 16.3% of the variance in mathematics achievement ($R^2 = .163$; adjusted $R^2 = .143$). Learning motivation was not significantly associated with achievement after controlling for learning discipline ($B = .003$, $\beta = .0117$, $p = .911$), whereas learning discipline showed a positive and significant association ($B = .076$, $\beta = .3996$, $p < .001$). Learning discipline also had the larger standardized coefficient. These findings contribute evidence that motivational orientation and behavioral regularity may play different roles in mathematics achievement. The study highlights the value of examining motivation and learning discipline simultaneously and suggests that mathematics education should connect students' motivation with consistent and sustained learning behaviors.

Keywords: Mathematics achievement; learning motivation; learning discipline; junior high school students; multiple linear regression.

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1. Introduction

Mathematics achievement is an important indicator of students' progress in learning mathematics because it reflects the extent to which learners develop and demonstrate mathematical knowledge and competencies. Contemporary mathematics education places emphasis not only on procedural proficiency but also on reasoning, problem solving, communication, connections, and representation (National Council of Teachers of Mathematics [NCTM], 2020). These expectations make mathematics achievement a multidimensional educational concern that cannot be understood solely through students' cognitive abilities. Research in mathematics education has increasingly recognized the importance of affective and behavioral dimensions of learning, including students' attitudes, emotions, engagement, motivation, and regulation of their learning (Campbell, 2026;

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Hannula et al., 2014; Schukajlow et al., 2023; Zan et al., 2006). This growing attention reflects a broader view that students' experiences in mathematics are connected with how they participate in learning and how persistently they respond to mathematical demands. Recent research continues to examine these relationships across different educational settings and populations, including secondary-school students (Alija et al., 2026; Kang & Leung, 2026; Wang, 2026). Accordingly, factors associated with mathematics achievement need to be considered in terms of both what students know and how they engage in learning.

Learning motivation has long been a prominent affective factor in mathematics education research. Motivation refers to the forces that initiate, direct, and sustain students' engagement in learning. Earlier reviews of mathematics education research identified motivation as an important dimension of students' achievement-related behavior while also highlighting the complexity of the relationships among motivational beliefs, classroom contexts, and mathematical performance (Middleton & Spanias, 1999). More recent scholarship continues to position motivation within a broader network of emotions, values, beliefs, and learning experiences rather than treating it as an isolated characteristic (Schukajlow et al., 2023). Empirical research has likewise associated students' motivational characteristics with mathematics performance, although the nature and strength of these relationships vary across constructs and contexts (Berger et al., 2020; Fadda et al., 2022). For example, research on digital learning environments has shown that instructional approaches can influence both mathematics performance and students' motivation, suggesting that motivational engagement is sensitive to the learning conditions in which mathematics is experienced (Byun & Joung, 2018). Recent studies involving secondary students have similarly examined motivation alongside mathematics interest, self-efficacy, and other affective characteristics when explaining differences in mathematics performance (Alija et al., 2026). These findings support the relevance of motivation while also indicating that its relationship with achievement may depend on other student and contextual factors.

An important related issue is that motivation does not always translate into sustained learning behavior. Students may express positive motivational orientations but differ in how consistently they organize their study activities, complete assignments, manage learning time, and regulate their engagement. This distinction matters in mathematics, where learning often depends on repeated practice, persistence, and continued engagement with challenging tasks. Research on affect in mathematics education has consequently emphasized that affective experiences should be considered in relation to students' actual learning processes (Zan et al., 2006). Studies of self-regulated learning provide a complementary perspective by showing that students' capacity to regulate their learning is connected with mathematics learning and academic achievement (Cai et al., 2026). Self-regulated learning involves students' active management of their learning processes, while

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related constructs such as effort regulation and study behavior capture the extent to which learners sustain appropriate behaviors when learning becomes demanding. In this sense, the behavioral dimension represented in the present study by learning discipline is conceptually important because disciplined learning can provide the behavioral conditions through which students' intentions and motivation are translated into regular academic activity.

The links among motivation, behavioral regulation, and mathematics achievement are not uniform across studies. Mathematics-related affect has been shown to encompass multiple dimensions, and relationships between affective characteristics and achievement can vary according to the specific construct examined and the educational context (Campbell, 2026; Hannula et al., 2014). The role of motivational factors may also be intertwined with self-efficacy, interest, emotions, and classroom experiences (Alija et al., 2026; Kang & Leung, 2026; Schukajlow et al., 2023). Similarly, recent research on self-regulated learning in mathematics indicates that learning regulation is shaped by classroom social conditions and students' self-efficacy rather than operating independently of the learning environment (Cai et al., 2026). Research on learning environments has also demonstrated relationships among learning environment, motivation, and self-regulated learning, indicating that students' motivational dispositions and learning behaviors may be interconnected (Ariani, 2017). Taken together, these findings indicate that motivation alone may provide only a partial account of mathematics achievement. A student who is motivated to learn mathematics may not necessarily maintain the routines and behaviors required for sustained learning, while disciplined learning behavior may contribute to achievement even when motivational orientations do not show a strong independent association.

Previous studies have examined these issues through a range of designs and analytical approaches. Research has examined mathematics performance through motivational constructs such as interest, self-efficacy, and academic buoyancy, including studies involving high school students (Alija et al., 2026). Other work has investigated self-regulated learning using structural models in which classroom social environment and self-efficacy are considered alongside learning regulation (Cai et al., 2026). Studies of mathematics-related affect have also used longitudinal approaches to examine how affect and achievement are related over time (Hannula et al., 2014). At a broader level, systematic reviews and meta-analyses have synthesized evidence concerning affective and motivational factors in mathematics learning (Campbell, 2026; Fadda et al., 2022; Schukajlow et al., 2023). Such approaches demonstrate that student-related factors can be investigated through different conceptualizations and analytical models. At the same time, differences in constructs and methods make direct comparisons difficult. The term motivation, for example, may encompass different forms of motivational regulation, whereas behavioral constructs may be operationalized as self-regulation, effort regulation, study habits, or

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discipline. Evidence for one construct therefore cannot be assumed to apply directly to another.

The available evidence points to the relevance of both motivation and learning behavior, but their relative relationships with mathematics achievement remain less clear when the two are examined together. Studies have reported positive relationships between mathematics-related affect and achievement (Berger et al., 2020; Grootenboer & Hemmings, 2007), while other research emphasizes the importance of self-regulation for mathematics learning and academic achievement (Cai et al., 2026). Research focusing specifically on motivation has likewise documented its relevance to mathematics learning and achievement, but has also identified theoretical and empirical complexities in interpreting motivational effects (Middleton & Spanias, 1999; Schukajlow et al., 2023). Evidence from intervention and technology-supported learning further suggests that motivation and performance can respond differently to instructional conditions (Byun & Joung, 2018; Fadda et al., 2022). In the Indonesian literature included in the manuscript, motivation has been reported as positively associated with mathematics learning outcomes, whereas learning discipline has also been identified as a contributor to mathematics achievement (Nurfadillah et al., 2023; Pratiwi & Arifin, 2023; Rahmawati & Suryadi, 2022; Wulandari & Fitriani, 2023). Rosita et al. (2024) further examined motivation and discipline simultaneously and reported that discipline made a larger contribution than motivation. However, the existing evidence remains context-dependent, and there is limited evidence from Indonesian junior high school settings that simultaneously estimates the independent associations of learning motivation and learning discipline with mathematics achievement while also comparing their standardized regression coefficients. This study addresses that gap by examining the two predictors together in a multiple-regression model involving Grade 8 students. This approach distinguishes each factor's bivariate relationship from its partial association with mathematics achievement after accounting for the other predictor.

Accordingly, this study investigates the relationships of learning motivation and learning discipline with mathematics achievement among Grade 8 students at SMP Negeri 1 Tanasitolo, Kabupaten Wajo, Indonesia. The study has three objectives: (1) to examine the joint association of learning motivation and learning discipline with mathematics achievement; (2) to determine the partial association of each predictor with mathematics achievement when the other predictor is statistically controlled; and (3) to identify which predictor has the larger standardized regression coefficient within the fitted model. These objectives lead to three research questions: (1) Are learning motivation and learning discipline jointly associated with students' mathematics achievement? (2) Is each predictor individually associated with mathematics achievement after controlling for the other predictor? and (3) Which of the two predictors has the larger standardized regression

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coefficient in predicting mathematics achievement? By addressing these questions, the study adds evidence on the different roles of motivational and behavioral dimensions of learning in an Indonesian junior high school mathematics context that remains underrepresented internationally.

2. Methodology

Research Design and Context

This study employed a quantitative approach using an ex post facto design. An ex post facto design was appropriate because the study examined naturally occurring differences among students without introducing a treatment or manipulating the independent variables. The analysis examined the relationships of learning motivation and learning discipline with mathematics achievement under conditions that had already occurred during learning. This approach is consistent with the use of ex post facto research to examine existing conditions and investigate factors that may be associated with observed outcomes (Sugiyono, 2023).

The study was conducted at SMP Negeri 1 Tanasitolo, Kecamatan Tanasitolo, Kabupaten Wajo, Indonesia. The study focused on Grade 8 students because preliminary observations indicated variation in mathematics achievement among students in this grade. The research examined whether differences in learning motivation and learning discipline were statistically associated with differences in mathematics achievement.

Participants and Sampling

The population comprised all Grade 8 students enrolled at SMP Negeri 1 Tanasitolo during the academic year in which the study was conducted. The study involved 87 students. Because the population was relatively limited, all members of the population were included as research participants using a saturated sampling technique. Thus, the sample consisted of the entire Grade 8 population rather than a subset selected from it (Sugiyono, 2023).

Three variables were examined. Learning motivation was specified as the first independent variable (X_1), learning discipline as the second independent variable (X_2), and mathematics achievement as the dependent variable (Y). Learning motivation referred to students' internal and external drives to engage in learning activities and pursue learning goals. Learning discipline referred to students' adherence to learning rules, routines, and responsibilities in a consistent manner. Mathematics achievement was operationalized through students' mathematics scores recorded by the school.

Data Collection and Instruments

The data came from questionnaires and school documentation. Questionnaires were administered to obtain data on students' learning motivation and learning discipline. Both

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instruments employed a five-point Likert response scale consisting of strongly agree, agree, undecided, disagree, and strongly disagree. These questionnaires yielded quantitative scores for the two independent variables.

Before administration, the questionnaires were subjected to validity and reliability testing. Validity testing was intended to assess whether the instruments adequately measured the constructs under investigation, whereas reliability testing was conducted to assess the consistency of the measurements. The available manuscript confirms that these procedures were conducted but does not report the resulting validity coefficients, reliability coefficients, number of items, or detailed indicators of each instrument. Accordingly, these details are not inferred in the present description. Mathematics achievement data were obtained through documentation of mathematics scores maintained by the school. The use of school documentation provided the outcome measure independently of the two self-reported questionnaire measures.

Data Analysis

Data analysis was conducted using JASP. The analysis proceeded from descriptive examination of the study variables to correlational and regression analyses. Descriptive statistics were calculated to summarize the distribution of learning motivation, learning discipline, and mathematics achievement using measures including the mean, median, minimum, and maximum scores.

Pearson product–moment correlation analysis was subsequently used to examine the bivariate relationships among learning motivation, learning discipline, and mathematics achievement. This analysis provided information about the direction and strength of the associations between the study variables before the predictors were entered simultaneously into the regression model.

Multiple linear regression was then used to examine the joint and individual associations of learning motivation and learning discipline with mathematics achievement. The regression model was specified as:

$$Y = a + b_1X_1 + b_2X_2 + e$$

where Y represents mathematics achievement, a represents the intercept, b_1 and b_2 represent the regression coefficients for learning motivation and learning discipline, respectively, X_1 represents learning motivation, X_2 represents learning discipline, and e represents the error term.

Before interpreting the regression model, the analysis checked multicollinearity between the two independent variables using tolerance and variance inflation factor (VIF) statistics. These diagnostics were used to assess whether the predictors exhibited excessive overlap that could compromise the estimation of their individual regression coefficients. The

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manuscript reports tolerance and VIF values for both predictors.

The overall regression model was evaluated with the F statistic. This analysis addressed the first research objective concerning the simultaneous relationship of learning motivation and learning discipline with mathematics achievement. Individual regression coefficients were evaluated with t tests to examine each predictor's partial relationship with mathematics achievement. Statistical significance was evaluated at $\alpha = .05$.

The coefficient of determination (R^2) and adjusted R^2 were also examined to quantify the proportion of variance in mathematics achievement accounted for by the regression model. Finally, the standardized regression coefficients (β) were compared to determine which predictor had the larger relative coefficient in the fitted model, corresponding to the study's third objective concerning the comparatively dominant predictor. Because the study used an ex post facto design, the regression findings were interpreted as statistical relationships within the observed sample rather than as evidence generated by an experimental manipulation.

3. Results and Discussion

Descriptive Statistics

The analysis included 87 Grade 8 students. Descriptive statistics for learning motivation, learning discipline, and mathematics achievement are presented in Table 1. The mean score was 82.62 for learning motivation, 84.00 for learning discipline, and 81.00 for mathematics achievement. The observed scores ranged from 65 to 100 for learning motivation, 60 to 100 for learning discipline, and 78 to 86 for mathematics achievement.

Table 1. Descriptive statistics of the study variables

Variable	Mean	Median	Minimum	Maximum
Learning motivation	82.62	83.00	65.00	100.00
Learning discipline	84.00	84.00	60.00	100.00
Mathematics achievement	81.00	81.00	78.00	86.00

Preliminary Analysis

Pearson correlations were examined before the multiple regression model was estimated. As shown in Table 2, learning motivation was positively correlated with learning discipline ($r = .294$, $p = .006$). The correlation between learning motivation and mathematics achievement was positive but not statistically significant ($r = .129$, $p = .234$), whereas learning discipline was positively correlated with mathematics achievement ($r = .403$, $p < .001$).

Table 2. Pearson correlations among study variables

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Variables	Learning motivation	Learning discipline	Mathematics achievement
Learning motivation	—	.294*	.129
Learning discipline	.294*	—	.403***
Mathematics achievement	.129	.403***	—

Note. $p = .006$; **$p < .001$.

Multicollinearity diagnostics indicated no substantial collinearity between the two predictors. Both learning motivation and learning discipline had a tolerance value of .914 and a variance inflation factor (VIF) of 1.094.

The manuscript also reports a Shapiro–Wilk statistic of W = .9685 with p = .032. However, the available output does not clearly identify whether this test was applied to the regression residuals or to the observed variables. Therefore, no further conclusion regarding the normality of the regression residuals is drawn from this result.

Multiple Regression Analysis

A multiple linear regression model was estimated to examine the associations of learning motivation and learning discipline with mathematics achievement. The estimated regression equation was:

$$Y = 74.72 + 0.003X_1 + 0.076X_2$$

where Y represents mathematics achievement, X_1 represents learning motivation, and X_2 represents learning discipline. The overall model was statistically significant, $F(2, 84) = 8.152$, $p < .001$. The model accounted for 16.3% of the variance in mathematics achievement ($R^2 = .163$), with an adjusted R^2 of .143.

Table 3 presents the partial regression results for the two predictors. Learning motivation was not a statistically significant predictor of mathematics achievement ($t = 0.112$, $p = .911$). In contrast, learning discipline was positively and significantly associated with mathematics achievement ($t = 3.825$, $p < .001$), with an unstandardized regression coefficient of B = 0.076.

Table 3. Multiple regression results for mathematics achievement

Predictor	B	β	t	p
Learning motivation	0.003	0.0117	0.112	.911
Learning discipline	0.076	0.3996	3.825	< .001

Note. Model: $F(2, 84) = 8.152$, $p < .001$; $R^2 = .163$; adjusted $R^2 = .143$.

Among the two predictors, learning discipline had the larger standardized regression coefficient (β = .3996), compared with learning motivation (β = .0117).

Discussion

This study examined how learning motivation and learning discipline were related to

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mathematics achievement, both jointly and individually, among Grade 8 students. The results offer a more nuanced picture of these two student-related factors than an analysis of either factor alone would provide. The overall model was statistically significant, indicating that learning motivation and learning discipline, considered together, were associated with differences in mathematics achievement. However, the model accounted for 16.3% of the observed variance in achievement (R^2 = .163; adjusted R^2 = .143), indicating that the two variables represent only part of the set of factors related to students' mathematics performance. This result is consistent with the broader literature in mathematics education, which conceptualizes achievement as emerging from interactions among cognitive, affective, behavioral, instructional, and contextual conditions rather than from a single student characteristic (Grootenboer & Hemmings, 2007; Schukajlow et al., 2023; Zan et al., 2006). The result supports considering motivational and behavioral dimensions together, while also indicating that they do not by themselves explain mathematics achievement.

The significant overall model is also informative because the two predictors were not redundant. Learning motivation and learning discipline were positively correlated but only moderately so (r = .294), while the multicollinearity diagnostics indicated no substantial overlap between them (tolerance = .914; VIF = 1.094). This pattern suggests that motivation and discipline capture related, but distinct, aspects of students' engagement with learning. This interpretation is compatible with research that treats motivation as part of a broader system involving students' emotions, beliefs, values, engagement, and regulation of learning (Schukajlow et al., 2023). Motivation provides reasons and energy for engaging in learning, whereas disciplined learning behavior concerns the consistency with which students organize and sustain their academic activities. Ariani (2017), for example, identified relationships among learning environment, motivation, and self-regulated learning, reinforcing the view that motivational dispositions and learning behaviors should not be treated as interchangeable constructs. The current results add to this perspective by showing that the two dimensions can relate quite differently to mathematics achievement when examined in the same regression model.

The nonsignificant relationship between learning motivation and mathematics achievement warrants careful interpretation. The bivariate correlation between motivation and achievement was positive but weak and nonsignificant (r = .129, p = .234), and the partial regression coefficient remained nonsignificant after learning discipline was controlled (B = .003, β = .0117, p = .911). Thus, the data do not support an independent association between higher self-reported learning motivation and mathematics achievement in this sample. This result differs from studies that have reported positive relationships between motivational or affective characteristics and mathematics performance (Berger et al., 2020; Grootenboer & Hemmings, 2007; Rahmawati & Suryadi, 2022). This difference matters because the role

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of motivation may vary across populations, operationalizations, and learning conditions.

One possibility is that motivation supports sustained engagement but is not, by itself, sufficient to produce measurable differences in achievement. Motivation can initiate and direct learning activity, but its influence may depend on whether it is translated into effective learning behaviors, appropriate strategies, persistence, and opportunities for meaningful mathematical engagement. Middleton and Spanias (1999) emphasized the complexity of motivational research in mathematics and cautioned against treating motivation as a simple, uniform determinant of achievement. Similarly, Schukajlow et al. (2023) argued that emotions and motivation in mathematics are embedded within broader learning processes and should be investigated using constructs and methods sensitive to the particular features of mathematics. The result is therefore better understood as showing that the measured form of motivation did not account for unique variance in mathematics achievement once learning discipline was considered, rather than showing that motivation is unimportant in mathematics learning.

The result may also reflect a distinction between students' reported motivational orientations and their actual learning behavior. The motivation questionnaire captured students' responses to statements concerning their willingness and drive to learn, whereas mathematics achievement was obtained from school records. A student may report a positive orientation toward mathematics without consistently allocating time to study, completing tasks, reviewing material, or persisting with difficult problems. Research on self-regulated learning supports the importance of this behavioral translation. Cai et al. (2026) found that self-regulated learning in mathematics is related to classroom social conditions and self-efficacy, while Guo et al. (2023) examined self-regulated learning as an important dimension of students' mathematics learning. In this context, the nonsignificant motivation coefficient may indicate that motivational disposition alone does not distinguish students' achievement when concrete learning behaviors are considered at the same time.

The clearest result concerns the positive and statistically significant relationship between learning discipline and mathematics achievement. Learning discipline was positively correlated with achievement ($r = .403$, $p < .001$) and remained significant in the multiple regression model ($B = .076$, $\beta = .3996$, $p < .001$). This pattern indicates that students reporting more consistent and disciplined learning behavior tended to have higher mathematics achievement, even after learning motivation was statistically accounted for. The finding is consistent with the Indonesian studies included in the manuscript. Nurfadillah et al. (2023) identified learning discipline as a contributor to mathematics achievement among junior high school students, while Pratiwi and Arifin (2023) reported evidence linking learning discipline with mathematics achievement. Wulandari and Fitriani (2023) likewise found a positive relationship between discipline and mathematics learning

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outcomes. The consistency of these findings across Indonesian junior high school contexts provides further support for viewing disciplined learning behavior as a relevant correlate of mathematics achievement.

The association with learning discipline can also be considered in light of the demands of mathematics learning. Mathematics often requires cumulative understanding, repeated practice, attention to procedures and concepts, and persistence when students encounter unfamiliar or complex problems. Disciplined learning behaviors can create regular opportunities for these processes to occur. Tu'u (2020) conceptualizes discipline as adherence to rules and learning routines that supports responsible behavior, while Sardiman (2021) emphasizes that motivation functions as an important driver of learning activity but does not operate independently of other learning conditions. From this perspective, discipline may be one behavioral pathway through which learning intentions are expressed in repeated academic actions. The present finding does not establish that discipline causes higher achievement, but it does indicate that disciplined learning behavior was more closely associated with achievement than self-reported motivation within the observed sample.

Comparing the standardized coefficients offers an additional perspective. Learning discipline had a substantially larger standardized coefficient ($\beta = .3996$) than learning motivation ($\beta = .0117$). Within this model, learning discipline therefore showed the stronger relative statistical association with mathematics achievement. This finding is consistent with Rosita et al. (2024), who examined motivation and discipline simultaneously and similarly identified a stronger contribution from discipline. This result should not, however, be taken to mean that discipline is universally more important than motivation. The standardized coefficient is conditional on the variables, measurement procedures, sample, and model used in this study. It indicates relative predictive weight within this particular regression model rather than a general hierarchy of determinants of mathematics achievement. This distinction is especially important because mathematics achievement is influenced by multiple dimensions, including affect, self-efficacy, learning environment, instructional quality, and prior achievement (Berger et al., 2020; Cai et al., 2026; Grootenboer & Hemmings, 2007).

The modest R^2 also supports this interpretation. Although the regression model was statistically significant, 83.7% of the variance in mathematics achievement was not accounted for by the two predictors included in the model. This unexplained variance should not be interpreted as evidence that particular unmeasured factors "caused" the remaining variation. Rather, it indicates that the model is incomplete as an account of students' achievement. The broader literature points to several other relevant dimensions, including mathematics-related emotions and attitudes (Campbell, 2026; Wen & Dube, 2022), self-

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regulated learning and self-efficacy (Cai et al., 2026), and classroom and instructional conditions (Ariani, 2017; Schukajlow et al., 2023). The restricted range of mathematics achievement in the present sample, which extended only from 78 to 86, may also have limited the extent to which achievement differences could be statistically related to variation in the predictors. This characteristic should be considered when interpreting the relatively small correlation between motivation and achievement.

The findings have implications for mathematics education practice, although these implications should be interpreted in light of the study's observational design. The stronger statistical association of learning discipline with achievement suggests that classroom practices that support consistent learning routines may be relevant to students' mathematics learning. These practices may include clear expectations for completing mathematical tasks, regular opportunities for practice, structured monitoring of learning activities, and support for students as they develop responsibility for their own learning. However, the findings do not justify replacing motivational support with disciplinary approaches. Rather, they suggest that motivational encouragement may need to be connected with concrete opportunities for students to enact productive learning behaviors. This interpretation is compatible with research emphasizing the interaction between motivation, affect, self-regulation, and learning environments (Ariani, 2017; Cai et al., 2026; Schukajlow et al., 2023).

The study also offers a methodological implication for research on student-related factors in mathematics education. Much of the literature examines motivation, affect, self-regulation, or learning environment using different conceptualizations and analytical frameworks (Campbell, 2026; Hannula et al., 2014; Schukajlow et al., 2023). The study adds a focused regression analysis in which motivation and discipline are examined simultaneously, making it possible to distinguish their bivariate and partial relationships with mathematics achievement. The finding that motivation was nonsignificant after discipline was entered into the model illustrates why examining predictors independently may provide a different interpretation from examining them together. Future studies could extend this work with larger and more diverse samples, longitudinal designs, broader measures of motivation and self-regulated learning, and achievement measures with greater variability. Such approaches would help determine whether the pattern observed here is stable across schools and student populations and whether motivational processes operate indirectly through learning behaviors.

Taken together, the findings show that the relationship between student characteristics and mathematics achievement is more nuanced than the assumption that higher motivation necessarily corresponds to higher achievement. In the present sample, motivation and discipline were jointly related to mathematics achievement, but their

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individual relationships differed substantially: learning motivation showed no significant independent association, whereas learning discipline showed a positive and statistically significant association and the larger standardized coefficient. This pattern adds to existing evidence by highlighting the importance of distinguishing students' motivational orientations from the consistency of their learning behavior. At the same time, the modest explanatory power of the model and the ex post facto design require the findings to be interpreted as context-specific statistical relationships rather than causal effects. The main contribution is therefore not to identify a universal determinant of mathematics achievement, but to show empirically that behavioral regularity and motivational orientation can play different roles when examined together in junior high school mathematics learning.

4. Conclusion

This study examined the joint and individual relationships of learning motivation and learning discipline with mathematics achievement among Grade 8 students at SMP Negeri 1 Tanasitolo, Kabupaten Wajo, Indonesia. The findings indicate that learning motivation and learning discipline were jointly associated with mathematics achievement, with the multiple regression model reaching statistical significance, $F(2, 84) = 8.152$, $p < .001$. However, their individual relationships with achievement differed substantially. Learning motivation was not significantly associated with mathematics achievement, either at the bivariate level ($r = .129$, $p = .234$) or after learning discipline was statistically controlled ($B = .003$, $\beta = .0117$, $p = .911$). In contrast, learning discipline showed a positive and statistically significant association with mathematics achievement ($r = .403$, $p < .001$; $B = .076$, $\beta = .3996$, $p < .001$). The model accounted for 16.3% of the variance in mathematics achievement ($R^2 = .163$; adjusted $R^2 = .143$), indicating that motivation and discipline capture only a limited part of the factors associated with students' mathematics performance. Within the fitted model, learning discipline had the larger standardized regression coefficient, suggesting a stronger relative statistical association with achievement than learning motivation in this particular sample.

These findings should be considered in light of several limitations. The study used an ex post facto design and a relatively small, context-specific sample of 87 Grade 8 students from one school; therefore, the findings should not be interpreted as evidence of causal effects or assumed to generalize broadly across schools and student populations. In addition, learning motivation and learning discipline were measured through self-report questionnaires, while mathematics achievement was based on school-recorded scores, and the achievement scores showed a relatively restricted range (78–86). Future research should examine these relationships in larger and more diverse samples, longitudinal or other

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designs capable of examining temporal relationships, and more comprehensive measures of motivation, learning behavior, self-regulation, and mathematics achievement. Despite these limitations, the study provides empirical evidence by examining learning motivation and learning discipline simultaneously in a single regression framework, thereby distinguishing their bivariate and partial relationships with mathematics achievement. The findings underscore the need to distinguish students' motivational orientations from the consistency of their learning behavior rather than assuming that motivation alone translates directly into higher achievement. For mathematics education practice, the results support attention to structured and consistent learning behaviors while maintaining motivational support, providing a basis for approaches that connect students' willingness to learn with sustained engagement in mathematical learning activities.

5. References

National Council of Teachers of Mathematics. (2020). Principles to actions: Ensuring mathematical success for all. National Council of Teachers of Mathematics.

Nurfadillah, S., Kurniawan, A., & Sari, D. (2023). The contribution of learning discipline toward mathematics achievement among junior high school students. *s*, 8(1), 55–64.

Pratiwi, N., & Arifin, Z. (2023). Learning discipline and mathematics achievement: Evidence from junior high school students. *Jurnal Pendidikan Matematika*, 17(2), 101–112.

Rahmawati, R., & Suryadi, D. (2022). The effect of learning motivation on mathematics learning outcomes of junior high school students. *Jurnal Pendidikan Matematika*, 16(1), 67–78.

Rosita, E., Hidayat, T., & Nurhayati, S. (2024). Learning motivation, learning discipline, and student achievement in mathematics learning. *Jurnal Pendidikan Matematika Indonesia*, 9(1), 34–45.

Sardiman, A. M. (2021). Interaksi dan motivasi belajar mengajar (25th ed.). Rajawali Pers.

Sugiyono. (2023). Metode penelitian kuantitatif (3rd ed.). Alfabeta.

Tu'u, T. (2020). Peran disiplin pada perilaku dan prestasi siswa. Grasindo.

Wulandari, N., & Fitriani, Y. (2023). Pengaruh disiplin belajar terhadap hasil belajar matematika siswa SMP. *Jurnal Pendidikan Matematika Indonesia*, 8(2), 115–124.

Alija, S., Asare, B., Orhani, S., & Dissou Arthur, Y. (2026). Examining the nexus between high school students' mathematics performance and their mathematics self-efficacy: The role of mathematics interest and academic buoyancy. *Research in Mathematics*, 13(1), Article 2657077. https://doi.org/10.1080/27684830.2026.2657077

Ariani, D. W. (2017). Relationship model among learning environment, learning motivation, and self-regulated learning. *Asian Social Science*, 13(9).

Berger, N., Mackenzie, E., & Holmes, K. (2020). Positive attitudes towards mathematics and science are mutually beneficial for student achievement: A latent profile analysis of TIMSS 2015. The Australian Educational Researcher, 47(3), 409–444.

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Byun, J., & Joung, E. (2018). Digital game-based learning for K–12 mathematics education: A meta-analysis. *School Science and Mathematics*, 118(3–4), 113–126. https://doi.org/10.1111/ssm.12271

Cai, J., De Backer, F., Vandermeersche, G., Li, S., & Lombaerts, K. (2026). Unpacking the effect of classroom social environment on self-regulated learning in mathematical education: The mediation of self-efficacy. *Educational Studies in Mathematics*, 123(1), 1–23. https://doi.org/10.1007/s10649-026-10486-5

Campbell, T. (2026). Mathematical wellbeing: An emerging construct with exciting potential. *Mathematics Education Research Journal*, 38(2), 381–404. https://doi.org/10.1007/s13394-025-00532-5

Fadda, D., Pellegrini, M., Vivanet, G., & Callegher, C. Z. (2022). Effects of digital games on student motivation in mathematics: A meta-analysis in K–12 education. *Journal of Computer Assisted Learning*, 38(1), 304–325.

Grootenboer, P., & Hemmings, B. (2007). Mathematics performance and the role played by affective and background factors. *Mathematics Education Research Journal*, 19(3), 3–20.

Hannula, M. S., Bofah, E. A., Tuohilampi, L., & Metsämuuronen, J. (2014). A longitudinal analysis of the relationship between mathematics-related affect and achievement in Finland. *Proceedings of the Joint Meeting of PME 38 and PME-NA* 36, 249–256.

Kang, X., & Leung, F. K. S. (2026). The impact of ethnic cultures on achievement emotions in mathematics: A control-value approach. *Educational Studies in Mathematics*, 121(3), 401–421. https://doi.org/10.1007/s10649-025-10444-7

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education*, 30(1), 65–88. https://doi.org/10.2307/749630

Schukajlow, S., Rakoczy, K., & Pekrun, R. (2023). Emotions and motivation in mathematics education: Where we are today and where we need to go. *ZDM–Mathematics Education*, 55(2), 249–267. https://doi.org/10.1007/s11858-022-01463-2

Wang, Y. (2026). Psychological mechanisms of emotion-cognition interactions in secondary mathematics learning: An empirical study based on large-scale educational behavioral data. *International Journal of Science and Mathematics Education*, 24(6), Article 85. https://doi.org/10.1007/s10763-026-10700-z

Wen, R., & Dube, A. K. (2022). A systematic review of secondary students' attitudes towards mathematics and its relations with mathematics achievement. *Journal of Numerical Cognition*, 8(2), 295–325.

Zan, R., Brown, L., Evans, J., & Hannula, M. S. (2006). Affect in mathematics education: An introduction. *Educational Studies in Mathematics*, 63(2), 113–121. https://doi.org/10.1007/s10649-006-9028-2

Guo, W., Lau, K. L., Wei, J., & Bai, B. (2023). Academic subject and gender differences in high school students' self-regulated learning of language and mathematics. *Current Psychology*, 42(10), 7965–7980.

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