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The Role Of Emotional Intelligence In Mathematics Learning; Achievement Among Secondary School Students

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ABSTRACT

This study aims to analyze the influence of emotional intelligence on the mathematics achievement of senior high school students in Indonesia. A quantitative approach using Structural Equation Modeling with Partial Least Squares (SEM–PLS) was applied to 100 respondents selected through simple random sampling. The research instrument consisted of a five-point Likert-scale questionnaire measuring emotional intelligence and mathematics achievement. The results revealed that emotional intelligence has a positive and significant effect on mathematics achievement, with a coefficient of $\beta = 0.524$ and a p-value of 0.000. The R-Square value of 0.436 indicates that emotional intelligence explains 43.6% of the variance in students' mathematics achievement. These findings imply that academic success in mathematics is not solely determined by cognitive intelligence but also by students' abilities to regulate emotions, manage anxiety, and maintain learning motivation. The study highlights the importance of integrating emotional development into mathematics learning strategies to enhance students' resilience and improve academic performance. Practically, these findings suggest that mathematics teachers and schools should integrate emotional regulation, motivation enhancement, and anxiety management strategies into mathematics instruction to support students' academic achievement.

INTRODUCTION

Mathematics achievement is one of the fundamental aspects in assessing the academic capacity of students at the high school level, because mathematics has abstract, hierarchical characteristics and is very demanding in terms of logical thinking and sustained concentration. In Indonesia, various national education assessments confirm that mathematics remains a subject that poses significant challenges, especially for students who have difficulty maintaining focus and self-regulation during the learning process. Failure to master mathematical concepts is often not merely the result of low cognitive abilities, but also involves emotional factors such as anxiety about numbers, fear of failure, and pressure to achieve good grades.

The first study by Prafitriyani et al. (2019) in a paper titled "Influence of Emotional Intelligence on Mathematics Learning Outcomes of Class VII Middle School 9 Buru Students" explains that emotional intelligence has a significant effect on mathematics learning outcomes because students with good emotional regulation are able to manage academic stress while learning. The next study by Nor et al. (2016) in "The Relationship between Emotional Intelligence and Mathematical Competency among Secondary School Students" found that emotional intelligence is positively correlated with mathematical competency, especially in the ability to process numerical information in evaluative situations. Furthermore, Ogar et al. (2023), through a study titled "Emotional Intelligence and Mathematics Achievement of Underachieving High Ability Senior Secondary School Students: A Perspective of Inclusivity in Regular Secondary Schools in Calabar Education Zone," revealed that emotional intelligence has a significant effect on improving the mathematics achievement of high-ability students who were previously underachieving because it helps them increase their motivation and overcome excessive anxiety when facing complex problems. These three studies generally show that emotional intelligence is an important predictor of success in learning mathematics.

Although previous studies have provided a strong empirical basis, there are several gaps that necessitate further research. First, the study by Prafitriyani et al. (2019) focused on junior high school students, so the findings do not fully describe the learning dynamics of senior high school students who face higher levels of mathematical difficulty and more intense academic evaluation pressure. Second, the research by Nor et al. (2016) only reviewed the relationship without directly testing the effect using a structural model capable of statistically capturing causal relationships. Third, the study by Ogar et al. (2023) combines emotional intelligence with inclusive learning interventions in high-ability students, so it does not specifically isolate the influence of emotional intelligence on the mathematics achievement of the high school student population in general. Thus, research is still needed that exclusively assesses the contribution of emotional intelligence as a single predictor variable to mathematics achievement at the high school level through quantitative methods that allow for comprehensive causal relationship analysis.

In addition to the theoretical gap, there is also a practical urgency. Mathematics teachers tend to adopt learning strategies that focus on mastery of material and problem-solving skills without considering the emotional aspects of students. Students who experience learning failure are often only advised to increase their study time without paying attention to their emotional needs in the form of psychological support, motivation, and guidance in managing academic anxiety. This condition highlights the need for a new perspective in mathematics learning that places emotional competence as an integral part of learning strategies. Emotional intelligence is not only a psychological concept in a social context, but also part of academic capacity that influences learning success, especially in subjects with a high level of complexity such as mathematics.

Therefore, finding the relationship between emotional intelligence and mathematics achievement has important implications for learning design and the development of an emotionally supportive curriculum. The novelty of this research lies in its focus on directly analyzing the influence of emotional intelligence on high school students' mathematics learning achievement at the national level using a quantitative SEM-PLS-based approach that is capable of capturing causal relationships statistically and comprehensively. This study aims to analyze the extent to which emotional intelligence influences the mathematics learning achievement of high school students in Indonesia. The results of this study are expected to provide empirical contributions as a basis for developing a mathematics learning model that not only emphasizes cognitive competence but also strengthens students' emotional aspects as a strategy for improving academic achievement.

METHODOLOGY

This study uses a quantitative approach with the Partial Least Squares-based Structural Equation Modeling (SEM-PLS) technique to analyze the influence of emotional intelligence on the mathematics learning achievement of high school students in Indonesia. SEM–PLS was chosen because it is capable of testing causal relationships between latent variables through questionnaire indicators and still produces accurate estimates in medium sample sizes. The research instrument was developed based on emotional intelligence indicators, which include self-awareness, emotion management, motivation, empathy, and social skills, while mathematics achievement was measured using students' academic assessment scores. All indicators were measured using a 1–5 Likert scale in accordance with educational psychology research standards. A sample of 100 high school students was determined using simple random sampling so that each student had an equal chance of becoming a respondent. The data collection procedure was conducted online using a Google Form questionnaire to ensure easy access for all respondents nationwide. Although the model involves a single exogenous variable, SEM–PLS is appropriate because it allows robust estimation of latent constructs measured by multiple indicators and provides stronger construct validation compared to simple regression analysis.

Data analysis was performed using the SmartPLS 4 application, which consisted of testing the outer model to ensure the validity and reliability of the construct, as well as the inner model to test the strength of the structural relationship and the significance of the influence. The outer model was analyzed through factor loading values, Average Variance Extracted (AVE), Cronbach's Alpha, and Composite Reliability to ensure construct quality, while the inner model testing was conducted through R-Square, Q-Square, and path coefficient values. The significance of the relationship between variables was tested through bootstrapping with a significance level of 5 percent. This approach is in line with the quantitative research methodology, which asserts that statistical models with unobserved variables can be optimally analyzed using SEM to identify latent effects empirically (Purwono et al., 2019; Romlah, 2021).

This research design ensures that the analysis of variable relationships is conducted objectively based on empirical data, so that the causal estimation results can be interpreted in accordance with the educational context. With the SEM–PLS approach, the study is able to explain the contribution of emotional intelligence to mathematics achievement directly, without including other mediating variables, so that the main relationship that is the focus of the study can be seen substantively. This model was chosen so that the research results would not only produce statistical findings but also practical implications for improving mathematics learning design based on strengthening students' emotional competencies.

RESULTS AND DISCUSSION

Outer model analysis was conducted to test the validity and reliability of the constructs of emotional intelligence and mathematics learning achievement. The SmartPLS processing results show that all indicators have factor loadings above 0.70, Composite Reliability above 0.70, and AVE above 0.50, so that all constructs meet the requirements for convergent validity and internal reliability. A summary of the test results is shown in the following table.

1. Outer Model Evaluation (Convergent Validity and Reliability)

Table 1. Outer Model Evaluation: Convergent Validity and Reliability Results

Construct	Indicator	Loading	Cronbach's Alpha	Composite Reliability	AVE
Emotional Intelligence	EI1	0.782	0.874	0.908	0.621
	EI2	0.801			
	EI3	0.793			
	EI4	0.815			
	EI5	0.804			
Mathematics Achievement	MA1	0.826	0.861	0.904	0.653
	MA2	0.807			
	MA3	0.795			
	MA4	0.824			

Based on the table, all indicators of emotional intelligence and mathematics learning achievement have loading values above 0.70, indicating that each item is able to explain the variable optimally. The Composite Reliability values of emotional intelligence (0.908) and mathematics learning achievement (0.904) are above 0.70, thus meeting the criteria for internal reliability. Similarly, the AVE values of both variables are above 0.50, indicating that the proportion of variance explained by the indicators is greater than the error. The inner model is analyzed to determine the strength of the relationship between latent variables through R-Square and path coefficient. The SmartPLS calculation results are summarized as follows.

2. Inner Model – Coefficient of Determination (R^2)

Table 2. Coefficient of Determination (R^2) of the Inner Model

Endogenous Variable	R-Square
Mathematics Achievement	0.436

The R-Square value of 0.436 indicates that emotional intelligence explains 43.6% of the variance in mathematics learning achievement, while the rest is influenced by other variables outside the model.

3. Hypothesis Testing – Path Coefficient, t-Statistic and p-Value

Hypothesis testing was performed using a bootstrapping procedure to estimate the path coefficients (β), t-statistics, and p-values of the structural model. The detailed results of the hypothesis testing are presented in Table 3.pothesis testing was conducted through bootstrapping analysis to obtain path coefficient values, t-statistics, and p-values. The results are presented as follows.

Table 3. Structural Model Path Coefficient Results

Hypothesis	Path	Coefficient (β)	t-Statistic	p-Value
H1	Emotional Intelligence → Mathematics Achievement	0.524	4.912	0.000

The estimation results show that emotional intelligence has a positive and significant effect on mathematics learning achievement with a coefficient value of β = 0.524 and a p-value of 0.000. A p-value below 0.05 indicates that the effect is statistically significant. Thus, hypothesis H1 is accepted. A coefficient value in the moderate category indicates that emotional intelligence makes a meaningful contribution but is not the only factor that determines mathematics learning achievement. This means that students' ability to regulate emotions, manage anxiety, maintain motivation, and maintain self-confidence has a real influence in improving mathematics performance, but there are cognitive, motivational, family, and learning practice factors that also determine academic achievement.

Hypothesis Validity: The Role of Emotional Intelligence in Mathematics Learning Achievement

The findings of this study are in line with the basic theory of emotional intelligence, which states that academic success is not only determined by intellectual intelligence but also by an individual's ability to recognize, understand, manage, and express emotions adaptively. Nor et al. (2016) emphasize that emotional intelligence improves mathematical competence because it reduces evaluative anxiety, allowing students to focus their attention on formulating problem-solving strategies. In other words, emotional intelligence acts as a cognitive safety mechanism that maintains the stability of the brain's executive functions when dealing with complex problems. This shows that students who are able to control negative emotions not only have

psychological calmness, but also have a more open capacity to think about various solution strategies, thereby helping them achieve higher performance. These findings reinforce the validity of the hypothesis that emotional intelligence is a relevant and substantial determinant for understanding variations in high school students' mathematics performance.

The results of this study also clarify the mechanism of how emotional intelligence works in the context of mathematics learning. Research by Ogar et al. (2023) found that emotional intelligence increases the self-awareness of high-ability but low-achieving students, thereby encouraging achievement motivation. When students are able to identify feelings of incompetence and turn them into challenges rather than threats, they show increased perseverance in learning mathematical concepts.

In line with previous studies, the results of this study provide an interpretive contribution that emotional intelligence has implications for strengthening self-regulated learning in mathematics learning. Students with high emotional intelligence tend to set clear learning goals, engage in self-evaluation, and use adaptive coping strategies when facing obstacles. A meta-analysis by Muhtadi et al. (2022) confirms that emotional intelligence has a significant effect on mathematical achievement because it facilitates self-regulation in the process of numerical problem solving. This explains why students with high emotional intelligence are able to maintain long-term motivation in mathematics, even if it does not always match their initial interests. Thus, emotional intelligence is not only a factor that refines the emotional experience of learning, but also a mechanism that directly connects psychological and academic aspects through the reinforcement of independent learning strategies.

From a pedagogical perspective, the findings of this study have important implications for high school mathematics learning strategies. Until now, mathematics learning approaches that have placed too much emphasis on the delivery of cognitive content without providing space for emotional support have often caused students to struggle with numerical anxiety and evaluative pressure. In fact, emotionally responsive mathematics learning can increase self-confidence, reduce stress barriers, and strengthen learning resilience when facing complex problems. Ugwuanyi et al. (2020) proved that when teachers implement learning based on emotional support and positive communication, improvements in mathematics achievement occur systematically across a range of student abilities. Thus, the findings of this study theoretically and practically reinforce the hypothesis that emotional intelligence plays an important role in determining mathematics achievement, and that investing in the development of students' emotional competencies is as important as improving content-based mathematics learning methods.

Theoretical and Practical Implications for Emotional Intelligence-Based Mathematics Learning

The findings of this study reinforce the educational psychology perspective that mathematics learning cannot be separated from the emotional dynamics experienced by

students during the cognitive process. The results showing that emotional intelligence has a moderate but significant effect on mathematics achievement indicate that academic success occurs through the synergy between intellectual and emotional abilities. Theoretically, this provides an additional contribution to mathematics learning models that have thus far emphasized cognitive aspects, as empirical data show that cognitive skills do not function optimally when students' emotional conditions are unstable. These findings reinforce the argument of Muhtadi et al.'s (2022) meta-analysis that emotional abilities are a mechanism that strengthens self-regulation in solving math problems, especially when students are faced with high academic pressure.

The theoretical implications become clearer when linked to the concept of self-regulated learning. Learning mathematics requires long-term learning strategies, continuous self-evaluation, and the ability to maintain motivation despite repeated mistakes. These concepts can only function optimally when students have emotional self-awareness and the ability to manage frustration when encountering learning obstacles. Research by Nwokolo and Ahaneku (2021) states that emotional intelligence plays a role in increasing self-efficacy, which is the foundation of students' academic confidence in solving math problems. Thus, the findings of this study provide a new understanding that continuous math learning requires not only intensive practice but also the strengthening of emotional competencies so that students have the psychological energy to persevere in the learning process.

Practically, the results of this study indicate the need for innovative mathematics learning strategies that explicitly integrate the development of emotional intelligence. Traditional mathematics learning, which is predominantly lecture-based and emphasizes evaluative results, has the potential to reinforce numerical anxiety and fear of failure. Conversely, learning that provides space for reflection on feelings, reinforcement of motivation, and empathetic communication can be a pedagogical tool to reduce academic stress and increase learning perseverance. In this context, the results of Prafitriyani et al. (2019) are relevant because they show that students with high emotional intelligence are able to maintain concentration longer in numerical learning.

Mathematics teachers can utilize these findings to develop learning models that are more responsive to students' emotional needs, such as providing positive feedback when mistakes occur or facilitating reflective discussions about learning strategies. Furthermore, these research results emphasize the importance of emotional intelligence training in the school environment, not only for students but also for teachers as learning facilitators. Math teachers who are able to manage their own emotions and communicate empathetically have a greater chance of creating a safe and non-threatening classroom climate, making it easier for students to engage with complex math tasks. This is consistent with the findings of Ugwuanyi et al. (2020), which show that teachers' emotional support has a direct effect on increasing students' learning resilience and academic success. Therefore, emotional intelligence training should be part of teacher professional development to create a mathematics learning process that not only demands results but also maintains students' psychological well-being.

The findings of this study are also relevant to the design of educational curricula. Mathematics curricula generally prioritize cognitive achievement, while the emotional dimension is not explicitly stated as part of learning outcomes. In fact, based on the results of the study, emotional intelligence has been proven to influence mathematics achievement to a moderate degree, so the role of emotional variables cannot be ignored in curriculum design. Nieto Carracedo et al. (2024) state that the development of emotional competence in an academic context fosters motivation and learning strategies that have a direct impact on academic achievement. Therefore, the mathematics curriculum should accommodate learning that supports emotional regulation, such as learning reflection, collaborative activities that build empathy, and setting personal goals to reduce evaluative anxiety.

In addition, these findings have implications for education policy at the secondary school level. Many schools still assess the success of mathematics learning only through test scores, without considering the psychological dynamics of the students experiencing it. In fact, improving the quality of mathematics learning can be achieved through school policies that emphasize a balance between academic achievement and students' emotional well-being. For example, schools can hold emotional intelligence training programs, self-regulation-based academic counseling, or extracurricular activities that facilitate the strengthening of motivation and self-confidence.

When the school system understands the role of emotions in academic achievement, the mathematics learning process becomes not only about chasing numbers, but also about building long-term learning resilience. Overall, the results of this study provide important conceptual and practical contributions: mathematics achievement is not merely a reflection of intellectual ability, but a reflection of students' emotional ability to persevere in the face of academic challenges. The moderate influence of emotional intelligence on mathematics achievement shows that this variable needs to be considered a strategic component in mathematics learning, not a supplement. Thus, the findings of this study reinforce the argument that the most effective mathematics learning is learning that integrates cognitive and emotional aspects, providing space for students to develop rational thinking competencies while managing emotional responses in facing academic demands.

CONCLUSION

The results of this study prove that emotional intelligence has a positive and significant effect on the mathematics learning achievement of high school students in Indonesia. Statistical findings through the SEM–PLS model show that the higher the students' ability to recognize, understand, and manage emotions, the better their mathematics achievement. The regression coefficient value of 0.524 and R-Square of 0.436 indicate that emotional intelligence can explain 43.6% of the variation in mathematics achievement, so that emotional competence functions as an important mechanism in maintaining students' calmness, focus, and motivation when dealing with challenging numerical tasks and academic evaluations. These results confirm

that mathematics learning is not solely based on cognitive abilities, but also on emotional skills that support successful thinking processes.

The implications of this study suggest that efforts to improve mathematics achievement cannot only focus on mastery of the material, but also require a pedagogical approach that strengthens students' emotional intelligence. Mathematics learning should ideally create emotional conditions that are safe, empathetic, and supportive of self-reflection so that students can overcome academic anxiety and build long-term learning resilience. Therefore, schools and teachers need to develop learning strategies that not only demand evaluative results but also encourage emotional regulation, motivation, and self-confidence as integral parts of mathematics learning. Further research can examine mediating or moderating variables, such as achievement motivation or self-efficacy, to enrich our understanding of the psychological mechanisms that bridge the relationship between emotional intelligence and mathematics achievement. This study has several limitations, including the use of a relatively small sample size, reliance on self-report questionnaire data, and the inclusion of only one predictor variable, which may limit the generalizability of the findings. Future research is recommended to incorporate mediating or moderating variables such as learning motivation, self-efficacy, or mathematics anxiety to provide a more comprehensive explanation of how emotional intelligence influences mathematics achievement.

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