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Emotional Intelligence and Mathematics Learning Achievement among Senior High School Students

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ABSTRACT

Mathematics learning achievement remains a significant challenge in secondary education, as many students continue to experience difficulties in understanding mathematical concepts and solving complex problems. Recent studies have suggested that, besides cognitive ability, emotional intelligence plays an important role in determining students' academic success. This study aimed to examine the relationship between emotional intelligence and mathematics learning achievement among senior high school students. A quantitative correlational research design was employed involving 38 tenth-grade students of SMA Swasta Dwiwarna Medan selected through simple random sampling. Primary data were collected using a 30-item emotional intelligence questionnaire covering self-awareness, self-regulation, self-motivation, empathy, and social skills, as well as a mathematics achievement test on the topic of Systems of Linear Equations in Three Variables. The instruments were validated through expert judgment and empirical testing, while data were analyzed using descriptive statistics, the Kolmogorov–Smirnov normality test, and Pearson Product–Moment correlation analysis with IBM SPSS Statistics 27. The results revealed a statistically significant moderate positive relationship between emotional intelligence and mathematics learning achievement ($r = 0.518$, $p = 0.001$). Emotional intelligence explained 26.8% of the variance in mathematics learning achievement, indicating that students with higher emotional intelligence tended to achieve better learning outcomes. These findings highlight the importance of integrating emotional intelligence development into mathematics instruction to enhance students' academic achievement and support holistic educational practices.

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INTRODUCTION

Mathematics plays a fundamental role in developing logical reasoning, analytical thinking, creativity, and problem-solving abilities that are essential for students to succeed in the twenty-first century. Consequently, mathematics achievement has become one of the most important indicators of educational quality worldwide. However, international large-scale assessments continue to show that mathematics achievement remains unsatisfactory in many developing countries. According to the Programme for International Student Assessment (PISA) 2022, Indonesian students continue to perform below the OECD average in mathematics, indicating that many learners still experience difficulties in conceptual understanding, mathematical reasoning, and problem solving. These

findings suggest that improving mathematics achievement remains a critical issue requiring comprehensive attention from both educational researchers and practitioners.

Recent educational studies have demonstrated that students' mathematics achievement is determined not only by cognitive ability but also by various non-cognitive factors. Among these factors, emotional intelligence (EI) has received increasing scholarly attention because it influences how students regulate emotions, maintain motivation, respond to academic challenges, and interact with others during learning. Students possessing high emotional intelligence generally demonstrate greater resilience, better emotional regulation, stronger learning motivation, and more adaptive learning behaviors, enabling them to persist when facing challenging mathematical tasks. Besides emotional intelligence, learning concentration and healthy learning habits have also been identified as important predictors of mathematics achievement. For instance, Apriani and Irvan (2025) reported that students with better learning concentration achieved higher mathematics performance, emphasizing that psychological and behavioral factors jointly contribute to academic success. Likewise, Siregar and Irvan (2025) demonstrated that constructivist learning significantly improved students' critical thinking skills, highlighting the importance of integrating psychological readiness with effective instructional practices.

The contribution of emotional intelligence to academic achievement has been extensively supported by recent empirical evidence. MacCann et al. (2020) conducted a meta-analysis involving more than 42,000 students from 158 independent studies and concluded that emotional intelligence consistently predicts academic achievement across different educational levels and cultural contexts. Similarly, Sánchez-Álvarez et al. (2020) found that emotional intelligence exhibits a positive and significant relationship with students' academic performance regardless of the measurement model employed. Furthermore, Quílez-Robres et al. (2023) demonstrated through a systematic review and meta-analysis that emotional intelligence contributes moderately to students' academic success and should be considered one of the most influential non-cognitive factors in education. Collectively, these findings suggest that emotional intelligence provides substantial support for students' academic development beyond intellectual ability alone.

Within mathematics education, emotional intelligence plays a particularly important role because mathematics learning frequently involves cognitive challenges accompanied by emotional responses such as anxiety, frustration, fear of failure, and low self-confidence. Students with limited emotional regulation tend to avoid difficult mathematical problems, lose motivation quickly, and experience mathematics anxiety, all of which negatively affect academic achievement. Conversely, emotionally intelligent students are generally better able to regulate frustration, maintain concentration, seek appropriate learning strategies, and collaborate effectively with peers during mathematical problem-solving activities. Previous studies have also shown that innovative learning environments contribute significantly to students' academic achievement. For example, Irvan et al. (2025) demonstrated that the implementation of B-TUBE learning media significantly improved students' learning outcomes in statistics, whereas Hasanah and Irvan (2025) reported that problem-based mathematics comic media effectively enhanced students' motivation and mathematics learning outcomes. These findings indicate that emotional and instructional factors complement one another in supporting successful mathematics learning.

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Despite the growing body of literature concerning emotional intelligence and academic achievement, several important research gaps remain. Most previous studies have investigated emotional intelligence in relation to overall academic performance rather than specifically focusing on mathematics learning achievement. Moreover, empirical studies involving Indonesian senior high school students remain relatively limited despite differences in educational systems, classroom environments, and socio-cultural contexts that may influence students' emotional competencies. Recent Bayesian regression analysis conducted by Magdalena and Irvan (2025) also revealed that study duration, gender, and task completion time explained only part of students' mathematics achievement, suggesting that additional psychological variables should be considered to obtain a more comprehensive understanding of mathematics learning outcomes. These findings indicate the necessity of investigating emotional intelligence as a potential predictor of mathematics achievement within the Indonesian educational context.

Another important consideration is that educational policies increasingly encourage holistic student development by integrating cognitive, affective, and social competencies into classroom instruction. Mathematics learning should therefore not merely emphasize procedural competence but also cultivate emotional resilience, self-confidence, empathy, and self-regulated learning. Developing these competencies may improve students' willingness to engage in complex mathematical reasoning while simultaneously fostering positive learning experiences. Consequently, investigating emotional intelligence within mathematics education provides both theoretical and practical contributions for improving learning quality and students' academic success.

Based on the theoretical considerations, empirical evidence, and research gaps discussed above, this study aims to examine the relationship between emotional intelligence and mathematics learning achievement among senior high school students. The study is guided by the hypothesis that students with higher emotional intelligence tend to demonstrate better mathematics learning achievement than those with lower emotional intelligence. Specifically, this study seeks to answer the following research question: Is there a significant positive relationship between emotional intelligence and mathematics learning achievement among senior high school students? The findings are expected to enrich the literature on mathematics education while providing empirical evidence that may assist teachers and educational practitioners in designing learning environments that simultaneously strengthen students' cognitive competence and emotional development.

RESEARCH METHOD

This study employed a quantitative correlational research design to examine the relationship between emotional intelligence and mathematics learning achievement among senior high school students. A correlational approach was selected because the primary objective of the study was to determine the magnitude and direction of the relationship between the independent variable, namely emotional intelligence, and the dependent variable, namely mathematics learning achievement, without manipulating either variable. This design enables researchers to investigate naturally occurring relationships among variables and is widely used in educational research to identify factors associated with students' academic outcomes (Creswell & Creswell, 2017). The study

utilized primary data, which were collected directly from participants through questionnaires and mathematics achievement tests during the 2025/2026 academic year.

The population of this study consisted of all tenth-grade students enrolled at SMA Swasta Dwiwarna Medan, totaling 149 students distributed across four classes. The sample comprised 38 students, representing approximately 25% of the population. The sample was selected using simple random sampling, ensuring that every student had an equal probability of being included in the study. Random sampling was chosen to minimize sampling bias and improve the representativeness of the sample, thereby enhancing the generalizability of the research findings. Before data collection, permission was obtained from the school administration, and informed consent was secured from all participants to ensure that ethical research principles were maintained throughout the study.

Two research instruments were employed to collect the data. Emotional intelligence was measured using a structured questionnaire adapted from contemporary emotional intelligence frameworks encompassing five dimensions: self-awareness, self-regulation, self-motivation, empathy, and social skills. The questionnaire consisted of 30 Likert-scale items with five response categories ranging from strongly disagree (1) to strongly agree (5). Mathematics learning achievement was measured using a teacher-developed achievement test covering the topic of Systems of Linear Equations in Three Variables (SLETV). Prior to data collection, both instruments underwent content validity evaluation by three experts in mathematics education and educational psychology. Construct validity was subsequently examined using the Pearson Product-Moment correlation, whereas internal consistency reliability was assessed using Cronbach's Alpha. Following commonly accepted criteria, questionnaire items with corrected item-total correlation coefficients greater than 0.30 were considered valid, while a Cronbach's Alpha coefficient of 0.70 or higher indicated satisfactory reliability (Taber, 2020; Hair et al., 2022).

The collected data were analyzed using both descriptive and inferential statistics. Descriptive statistical analysis was conducted to summarize respondents' emotional intelligence scores and mathematics learning achievement through frequencies, percentages, means, standard deviations, minimum scores, and maximum scores. Prior to hypothesis testing, several prerequisite analyses were performed, including the Kolmogorov–Smirnov normality test and the linearity test, to ensure that the assumptions underlying parametric statistical analysis were satisfied. The relationship between emotional intelligence and mathematics learning achievement was subsequently examined using the Pearson Product-Moment correlation coefficient, followed by the calculation of the coefficient of determination (R^2) to estimate the proportion of variance in mathematics achievement explained by emotional intelligence. The strength of the correlation was interpreted according to established correlation coefficient guidelines (Field, 2024).

Hypothesis testing was performed using a two-tailed significance test with a significance level of $\alpha = 0.05$. The null hypothesis (H_o) stated that there was no significant relationship between emotional intelligence and mathematics learning achievement, whereas the alternative hypothesis (H_1) proposed a significant positive relationship between the two variables. Statistical significance was determined based on the p-value obtained from the Pearson correlation analysis, where $p < 0.05$ indicated rejection of the null hypothesis. All statistical analyses were conducted using IBM SPSS Statistics Version 27, which is widely recognized as reliable software for educational and behavioral science research. The use of standardized analytical procedures ensures that the methodology can

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be replicated by future researchers investigating similar relationships in different educational contexts.

RESULTS AND DISCUSSION

Results

Descriptive statistical analysis was conducted to provide an overview of students' emotional intelligence and mathematics learning achievement before hypothesis testing. Emotional intelligence scores were obtained from responses to a 30-item Likert-scale questionnaire measuring five dimensions: self-awareness, self-regulation, self-motivation, empathy, and social skills. Mathematics learning achievement was assessed using a post-test on the topic of Systems of Linear Equations in Three Variables (SLETV). The descriptive statistics included the number of participants (N), minimum score, maximum score, mean, and standard deviation for each research variable.

Table 1 presents the descriptive statistics of the research variables.

Variable	N	Minimum	Maximum	Mean	SD
Emotional Intelligence	38	58	116	89.16	9.47
Mathematics Learning Achievement	38	70	100	83.29	7.91

The descriptive results indicate that the students' emotional intelligence was generally at a good level, with a mean score of 89.16 (SD = 9.47). The observed scores ranged from 58 to 116, suggesting moderate variability in students' emotional competencies. The relatively small standard deviation indicates that the distribution of emotional intelligence scores was fairly homogeneous among participants.

Similarly, mathematics learning achievement showed a mean score of 83.29 (SD = 7.91), with scores ranging from 70 to 100. Based on the school's assessment criteria, the average achievement falls within the good category, indicating that most students demonstrated satisfactory mastery of the learning material. The relatively low standard deviation further suggests that students' mathematics achievement was reasonably consistent across the sample.

To provide a clearer description of students' emotional intelligence levels, the questionnaire scores were classified into four categories based on predetermined score intervals. The distribution of students across these categories is presented in Table 2.

Table 2. Distribution of Students' Emotional Intelligence Levels

Category	Frequency	Percentage (%)
Very Good	1	3
Good	17	44
Fair	19	50
Poor	1	3

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Total	**38**	**100**

Table 2 shows that 50% of the students demonstrated a fair level of emotional intelligence, while 44% were categorized as having good emotional intelligence. Only one student (3%) achieved the very good category, and one student (3%) was classified as having poor emotional intelligence. These findings indicate that although the overall emotional intelligence of the participants was relatively positive, most students had not yet reached the highest level of emotional competence. This result suggests that emotional intelligence remains an important psychological aspect that deserves greater attention in mathematics instruction, particularly in developing students' self-regulation, motivation, and resilience when solving mathematical problems.

Before testing the research hypothesis, assumption tests were performed to ensure that the data satisfied the requirements for parametric statistical analysis. In this study, the assumption testing consisted of a normality test for the distribution of residual scores. Since the research employed Pearson Product-Moment correlation analysis, normally distributed data are required to produce valid statistical inference.

The normality of the data was examined using the One-Sample Kolmogorov–Smirnov test. A significance value (Sig.) greater than 0.05 indicates that the data are normally distributed.

Table 3. Results of the Normality Test

Variable	N	Kolmogorov–Smirnov	Sig.	Interpretation
Residual Scores	38	0.840	0.481	Normal Distribution

The results presented in Table 3 indicate that the significance value obtained from the Kolmogorov–Smirnov test was 0.481, which is greater than the significance level of 0.05. Therefore, the residual scores are normally distributed, indicating that the assumption of normality was satisfied. Consequently, Pearson Product-Moment correlation analysis was considered appropriate for examining the relationship between emotional intelligence and mathematics learning achievement.

Since the normality assumption was fulfilled, hypothesis testing was subsequently conducted using parametric statistical procedures.

After confirming that the assumption of normality was satisfied, the relationship between emotional intelligence and mathematics learning achievement was examined using the Pearson Product-Moment correlation analysis. This analysis aimed to determine both the strength and direction of the relationship between the two variables.

Table 4. Pearson Correlation Analysis

Variables	r	Sig.	Interpretation
Emotional Intelligence – Mathematics Learning Achievement	0.518	0.001	Moderate Positive Correlation

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The correlation analysis revealed a moderate positive relationship between emotional intelligence and mathematics learning achievement ($r = 0.518$). Furthermore, the obtained significance value ($p = 0.001$) was lower than the predetermined significance level of 0.05, indicating that the relationship was statistically significant.

Accordingly, the null hypothesis (H_o), which stated that there is no significant relationship between emotional intelligence and mathematics learning achievement, was rejected, whereas the alternative hypothesis (H_1) was accepted. These findings indicate that students with higher emotional intelligence tend to demonstrate better mathematics learning achievement.

To estimate the contribution of emotional intelligence to mathematics achievement, the coefficient of determination (R^2) was calculated.

Table 5. Coefficient of Determination

Statistic	Value
Pearson Correlation (r)	0.518
Coefficient of Determination (R^2)	0.268
Percentage Explained	26.8%

The coefficient of determination indicates that emotional intelligence accounts for approximately 26.8% of the variance in students' mathematics learning achievement. The remaining 73.2% of the variance is likely explained by other factors that were not included in this study, such as prior mathematical ability, learning motivation, mathematics anxiety, self-efficacy, instructional quality, family support, and classroom learning environment.

Discussion

The findings of this study revealed a statistically significant positive relationship between emotional intelligence and mathematics learning achievement among senior high school students ($r = 0.518$; $p = 0.001$). This result indicates that students possessing higher levels of emotional intelligence tend to achieve better mathematics learning outcomes than those with lower emotional intelligence. The correlation coefficient falls within the moderate category, suggesting that emotional intelligence is an important predictor of mathematics achievement although it is not the sole determinant. The coefficient of determination further showed that emotional intelligence explained 26.8% of the variance in mathematics learning achievement, whereas the remaining 73.2% was explained by other psychological, instructional, and environmental factors.

These findings support the theoretical perspective that successful mathematics learning depends not only on students' cognitive abilities but also on their emotional competencies. Emotional intelligence enables students to regulate anxiety, maintain concentration, control frustration, sustain learning motivation, and persist in solving mathematical problems. Mathematics is widely recognized as a subject that frequently requires students to deal with abstract concepts and challenging problem-solving activities. Consequently, students who are capable of managing their emotions effectively are more likely to remain engaged in learning activities and achieve better

academic performance than students who experience difficulties in emotional regulation. Emotional intelligence therefore functions as a psychological resource that facilitates more effective learning processes.

The present findings are consistent with the meta-analysis conducted by MacCann et al. (2020), who analyzed 158 independent studies involving more than 42,000 students and concluded that emotional intelligence is a significant predictor of academic achievement across different educational settings. Similarly, Sánchez-Álvarez et al. (2020) reported that emotional intelligence consistently demonstrates a positive relationship with academic performance regardless of the measurement model employed. More recently, Quílez-Robres et al. (2023) emphasized that emotional intelligence contributes moderately to students' educational success and should be considered one of the most important non-cognitive factors influencing academic achievement. The consistency between the present findings and these international studies indicates that the contribution of emotional intelligence to students' learning achievement is evident not only across different countries but also within the Indonesian mathematics education context.

The results of this study also support previous studies conducted by the authors in the field of mathematics education. Magdalena and Irvan (2025) demonstrated that mathematics achievement cannot be explained solely by demographic variables such as gender or learning duration, suggesting that psychological factors play an equally important role in determining academic success. Likewise, Apriani and Irvan (2025) found that students' learning concentration significantly influenced mathematics achievement, indicating that emotional and cognitive processes operate simultaneously during learning. Furthermore, Siregar and Irvan (2025) reported that the implementation of constructivist learning significantly improved students' critical thinking skills, emphasizing that meaningful learning experiences are strengthened when students are cognitively and emotionally engaged. Collectively, these findings suggest that emotional intelligence complements instructional quality in promoting successful mathematics learning.

Although emotional intelligence contributed significantly to mathematics learning achievement, the relatively moderate coefficient of determination indicates that other influential variables remain unexplored. Previous educational research has identified several factors associated with mathematics achievement, including mathematics self-efficacy, mathematics anxiety, self-regulated learning, intrinsic motivation, classroom climate, teacher instructional competence, parental support, and students' socioeconomic background. These variables may interact with emotional intelligence in complex ways to influence students' learning outcomes. Consequently, emotional intelligence should not be interpreted as the sole determinant of mathematics achievement but rather as one important component within a multidimensional framework of academic success.

The practical implications of the present study are particularly relevant for mathematics teachers and school administrators. Mathematics instruction should extend beyond the transmission of mathematical knowledge by incorporating learning experiences that strengthen students' emotional competencies. Teachers may adopt collaborative learning, problem-based learning, inquiry-based instruction, reflective activities, and classroom discussions that encourage students to express their ideas, regulate their emotions, and develop resilience when solving mathematical problems. In addition, learning innovations reported by Hasanah and Irvan (2025) demonstrated that

problem-based mathematics comic media effectively enhanced students' learning motivation and achievement, whereas Ammy et al. (2025) showed that Problem-Based Learning assisted by Quizizz significantly improved students' conceptual understanding. These findings reinforce the notion that emotionally supportive learning environments and innovative instructional strategies jointly contribute to improving mathematics achievement.

The present study contributes to the literature by providing empirical evidence regarding the relationship between emotional intelligence and mathematics learning achievement among Indonesian senior high school students, an educational context that has received relatively limited attention in previous studies. Unlike earlier investigations that primarily focused on general academic achievement, this study specifically examined mathematics learning achievement, thereby providing more contextual evidence for mathematics education. The integration of recent international findings with empirical evidence from Indonesian mathematics classrooms strengthens the generalizability of the theoretical proposition that emotional intelligence constitutes an important factor supporting mathematics learning.

Nevertheless, several limitations should be acknowledged. First, the study involved students from only one senior high school, limiting the generalizability of the findings to broader educational contexts. Second, the correlational research design does not permit causal conclusions regarding the influence of emotional intelligence on mathematics learning achievement. Third, only one independent variable was examined, whereas mathematics achievement is influenced by numerous cognitive, affective, instructional, and environmental variables. Future research is therefore recommended to involve larger and more heterogeneous samples from different regions and educational levels. Researchers are also encouraged to investigate the simultaneous effects of emotional intelligence, mathematics anxiety, self-efficacy, learning motivation, and self-regulated learning using more advanced analytical approaches such as Structural Equation Modeling (SEM) or Partial Least Squares Structural Equation Modeling (PLS-SEM) to obtain a more comprehensive understanding of the determinants of mathematics learning achievement.

CONCLUSION

This study investigated the relationship between emotional intelligence and mathematics learning achievement among senior high school students. The findings demonstrated a moderate positive and statistically significant relationship between emotional intelligence and mathematics learning achievement ($r = 0.518$, $p = 0.001$). Therefore, the research hypothesis stating that students with higher emotional intelligence tend to achieve better mathematics learning outcomes was supported. The coefficient of determination ($R^2 = 0.268$) further indicated that emotional intelligence explained 26.8% of the variance in mathematics learning achievement, while the remaining 73.2% was attributable to other cognitive, motivational, instructional, and environmental factors not examined in this study.

These findings confirm that emotional intelligence constitutes an important non-cognitive factor influencing students' mathematics achievement. Students who are capable of regulating their emotions, maintaining learning motivation, demonstrating empathy, and adapting to academic challenges are more likely to achieve better learning outcomes in mathematics. Accordingly, mathematics instruction should not focus exclusively on developing cognitive competencies but

should also facilitate students' emotional development through learning environments that encourage self-regulation, collaboration, resilience, and positive classroom interaction.

From a practical perspective, the findings provide important implications for teachers, school administrators, and curriculum developers. Mathematics teachers are encouraged to integrate instructional strategies that promote both cognitive and emotional competencies, such as collaborative learning, problem-based learning, reflective learning activities, and emotionally supportive classroom practices. Strengthening students' emotional intelligence may contribute not only to improved mathematics achievement but also to greater learning engagement, persistence, and confidence when solving mathematical problems.

Despite these contributions, several limitations should be acknowledged. First, the study involved students from only one senior high school, limiting the generalizability of the findings to other educational contexts. Second, the correlational research design does not permit causal conclusions regarding the influence of emotional intelligence on mathematics learning achievement. Third, the study examined only one independent variable, whereas mathematics achievement is influenced by numerous psychological, instructional, and environmental factors.

Future research is recommended to include larger and more diverse samples from different schools and regions to improve the external validity of the findings. In addition, future studies should investigate other variables, such as mathematics self-efficacy, mathematics anxiety, learning motivation, self-regulated learning, classroom climate, and instructional quality, using more advanced analytical approaches such as multiple regression, Structural Equation Modeling (SEM), or multilevel analysis. Such investigations are expected to provide a more comprehensive understanding of the factors influencing mathematics learning achievement and to support the development of evidence-based instructional practices in mathematics education.

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