

Integrating Self Compassion into Mindfulness Meditation Lowers Math Anxiety in Indonesian Junior High School Students

Angelia¹, Widodo Winarso^{2*}, Arif Abdul Haqq³

^{1,2,3}UIN Siber Syekh Nurjati Cirebon, Indonesia

^{1,2,3}Jl. Perjuangan Bypass Sunyaragi, Kesambi District, Cirebon City, West Java, Indonesia

Correspondence Email: widodo@syekh Nurjati.ac.id

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Abstract:

Mathematics learning anxiety is a prevalent affective barrier adversely affecting academic performance, motivation, and psychological well-being among junior high school students. Yet, evidence-based interventions integrating mindfulness and self-compassion remain underexplored in this population. This study aims to examine the effectiveness of a mindfulness meditation program and a mindfulness meditation program integrated with self-compassion values in reducing mathematics learning anxiety, as well as to compare the anxiety levels across three groups. A quantitative approach with a quasi-experimental, nonequivalent control group design was employed. Participants were 112 seventh-grade students from SMP Negeri 1 Plered, Indonesia, assigned into three groups: Experiment Group 1 (mindfulness only, $n = 38$), Experiment Group 2 (mindfulness integrated with self-compassion, $n = 37$), and a control group (conventional learning, $n = 37$). The intervention consisted of four 5–10-minute sessions conducted before mathematics lessons over two weeks. Results revealed that Experiment Group 1 showed a significant reduction in anxiety scores from 95.55 to 81.68 ($t = 6.005$, $p < 0.001$), whereas Experiment Group 2 demonstrated a substantially larger reduction from 92.00 to 66.68, with all 37 students (100%) exhibiting decreased anxiety ($t = 12.990$, $p < 0.001$). A Kruskal-Wallis test confirmed significant differences in post-intervention anxiety levels across the three groups ($\chi^2 = 51.412$, $*p < 0.001$). These findings provide empirical evidence for the superiority of self-compassion-enhanced mindfulness interventions over mindfulness alone in alleviating mathematics anxiety among early adolescents. The results offer practical implications for integrating brief, scalable affective strategies into the Indonesian Merdeka Curriculum to support students' social-emotional learning and reduce subject-specific anxiety.

Abstrak:

Kecemasan belajar matematika merupakan hambatan afektif yang umum terjadi dan berdampak negatif terhadap prestasi akademik, motivasi, serta kesejahteraan psikologis siswa sekolah menengah pertama. Namun, intervensi berbasis bukti yang mengintegrasikan meditasi kesadaran (mindfulness) dan welas asih diri (self-compassion) masih jarang diteliti pada populasi ini. Penelitian ini bertujuan untuk menguji efektivitas program meditasi mindfulness dan program meditasi mindfulness yang terintegrasi dengan nilai-nilai self-compassion dalam menurunkan kecemasan

belajar matematika, serta membandingkan tingkat kecemasan di antara ketiga kelompok. Pendekatan kuantitatif dengan desain kuasi-eksperimen nonequivalent control group digunakan. Partisipan penelitian adalah 112 siswa kelas VII SMP Negeri 1 Plered, Indonesia, yang dibagi ke dalam tiga kelompok: Kelompok Eksperimen 1 (hanya mindfulness, $n = 38$), Kelompok Eksperimen 2 (mindfulness terintegrasi self-compassion, $n = 37$), dan Kelompok Kontrol (pembelajaran konvensional, $n = 37$). Intervensi dilaksanakan dalam empat sesi selama dua pekan, masing-masing sesi berlangsung 5–10 menit sebelum pelajaran matematika dimulai. Hasil penelitian menunjukkan bahwa Kelompok Eksperimen 1 mengalami penurunan signifikan skor kecemasan dari 95,55 menjadi 81,68 ($t = 6,005$; $p < 0,001$), sedangkan Kelompok Eksperimen 2 menunjukkan penurunan yang jauh lebih besar dari 92,00 menjadi 66,68, dengan seluruh 37 siswa (100%) mengalami penurunan kecemasan ($t = 12,990$; $p < 0,001$). Uji Kruskal-Wallis mengonfirmasi adanya perbedaan signifikan tingkat kecemasan pascaintervensi di antara ketiga kelompok ($\chi^2 = 51,412$; $p < 0,001$). Temuan ini memberikan bukti empiris bahwa intervensi mindfulness yang diperkuat dengan self-compassion lebih unggul dibandingkan mindfulness saja dalam meredakan kecemasan matematika pada remaja awal. Hasil penelitian ini juga menawarkan implikasi praktis bagi pengintegrasian strategi afektif yang singkat dan mudah diskalakan ke dalam Kurikulum Merdeka Indonesia guna mendukung pembelajaran sosial-emosional siswa serta mengurangi kecemasan spesifik terhadap mata pelajaran.

Keywords:

Mathematics Learning Anxiety, Mindfulness Meditation, Self Compassion,
Quasi Experimental Design, Junior High School Students

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INTRODUCTION

Mathematics is universally recognized as a foundational subject in secondary education, primarily because it cultivates logical, critical, and systematic thinking dispositions essential for academic and lifelong success. However, mathematics also frequently triggers anxiety among junior high school students an affective condition characterized by feelings of discomfort, fear, and apprehension when engaging with mathematical tasks. This mathematics learning anxiety negatively impacts students' academic motivation, self-confidence, and overall achievement (Hakim & Adirakasiwi, 2021).

Mathematics learning anxiety represents a significant global educational challenge. According to the Programme for International Student Assessment (PISA) 2022, each one point increase in the mathematics anxiety index corresponds to an 18 point decline in mathematics performance, with cross-national differences in anxiety levels explaining approximately 25% of the global variation in mathematics achievement (OECD, 2024). In the Indonesian context, empirical evidence confirms that mathematics anxiety exerts a detrimental effect on student learning outcomes. Research conducted in Indonesian junior high schools has revealed that a substantial proportion of students experience moderate to high levels of mathematics anxiety (Sari & Abadi, 2024; Pratiwi, 2021). These patterns indicate that mathematics learning anxiety is not merely an individual psychological issue but a systemic barrier requiring urgent affective interventions.

The nature of mathematics learning itself contains specific characteristics that predispose students to anxiety. Unlike many other subjects, mathematics is often perceived as a hierarchical discipline where mastery of foundational concepts is strictly required for subsequent understanding (Ashcraft, 2002). This cumulative structure means that students who fall behind may experience persistent difficulty, creating a cycle of failure and anxiety that becomes increasingly difficult to break. Furthermore, mathematics problems typically have unambiguous right or wrong answers, which intensifies students' fear of making mistakes and being publicly evaluated (Stuart, 2000). The emphasis on speed and accuracy in mathematics instruction, particularly in timed tests and examinations, exacerbates this pressure by activating time-related stress responses that interfere with working memory capacity a phenomenon known as the "choking under pressure" effect (Beilock & Carr, 2005). Additionally, mathematics instruction often involves public problem-solving, where students are required to demonstrate their reasoning processes in front of peers, creating social evaluation anxiety that is less prevalent in other subjects (Furner & Duffy, 2002). These subject-specific characteristics collectively create a uniquely anxiety provoking learning environment that distinguishes mathematics from other academic domains.

One promising approach to mitigating mathematics anxiety is mindfulness meditation, defined as the intentional, non-judgmental awareness of present-moment experiences (Zinn, 2003). A growing body of evidence demonstrates that mindfulness practice reduces anxiety and enhances students' academic outcomes. For instance, Zuo and Wang (2023) found that mindfulness-

based interventions significantly reduced mathematics test anxiety and improved mathematics achievement among middle school students aged 12–13. Their research demonstrated that mindfulness can relieve mathematics anxiety symptoms, including physiological manifestations, test-unrelated thinking and worries, and problem-solving obstacles caused by mathematics anxiety (Zuo & Wang, 2023).

Furthermore, mindfulness becomes more educationally meaningful when integrated with self-compassion an attitude of treating oneself with kindness and understanding in the face of difficulties or perceived inadequacies (Neff, 2003). Research has established that self-compassion is negatively correlated with academic stress and positively associated with emotional resilience among adolescents. Huang, Lin, Fan, Qiao, and Wang (2021) developed a self compassion based stress management intervention and found through a randomized controlled trial that participants showed significantly improved self-compassion levels and reduced depression and stress symptoms. Their study also revealed that self-compassion interventions enhance future-oriented coping, helping individuals build resources to deal with future stressors (Huang, Lin, Fan, Qiao, & Wang, 2021).

Despite the well documented individual effects of mindfulness and self-compassion on affective outcomes, a critical research gap remains: few, if any, studies have examined the effectiveness of an integrated mindfulness-and-self-compassion program specifically designed to reduce mathematics learning anxiety among junior high school students. Existing research, such as the study by Leppma and Darrah (2024), has linked both mindfulness and self-compassion to mathematics anxiety but focused exclusively on undergraduate university student populations, finding that self-efficacy and self-compassion predicted math anxiety while mindfulness showed only a significant correlation without a predictive relationship. Similarly, research by Ahmed, Tabassum, Aiman, Mustansar, and Hassan (2024) examined emotional and cognitive predictors of math anxiety among undergraduate mathematics students, confirming the roles of self-efficacy, mindfulness, and self compassion but again focusing on higher education contexts rather than early adolescence. Consequently, the applicability of integrated mindfulness self compassion interventions to early adolescents in basic education contexts particularly within the Indonesian educational system remains largely unexplored.

Addressing this gap is both theoretically and practically significant. The integration of mindfulness and self-compassion aligns closely with the philosophical foundations of the Indonesian Merdeka Curriculum, which prioritizes student well-being as a core component of the learning process. Furthermore, this integration is consistent with the Social and Emotional Learning (SEL) framework, which emphasizes the development of self-awareness, emotional regulation, and interpersonal skills as essential educational outcomes (CASEL, 2020). Recent research by Molyneux and Diamond (2025) demonstrated that integrating SEL principles into mathematics instruction can create emotionally supportive classrooms, with teachers reporting greater confidence and reduced math anxiety, and students showing higher engagement, cooperation, and resilience in problem-solving. By embedding mindfulness and self-compassion practices into the daily mathematics classroom routine, it may be possible to reduce subject-specific anxiety while simultaneously supporting broader social-emotional competencies (Molyneux & Diamond, 2025).

Therefore, this study aims to (1) analyze the level of mathematics learning anxiety among junior high school students after participating in a mindfulness meditation program; (2) analyze the level of mathematics learning anxiety after participating in a mindfulness meditation program integrated with self-compassion values; and (3) examine the differences in anxiety levels across the three groups (mindfulness only, mindfulness integrated with self-compassion, and conventional learning control group).

METHODS

This study employed a quantitative approach with a quasi-experimental nonequivalent control group design to investigate the effectiveness of mindfulness-based interventions in reducing students' mathematics anxiety. This design was selected because the intervention was implemented within naturally existing classroom groups where random assignment was not feasible, making the quasi-experimental approach particularly suitable for maintaining the authenticity of the educational setting while examining causal relationships (Creswell & Creswell, 2018; Shadish, Cook, & Campbell 2002). The study involved three groups: Experiment Group 1 received a mindfulness meditation intervention, Experiment Group 2 received a mindfulness meditation intervention integrated with self-compassion practices, and a Control Group participated in conventional mathematics instruction without any psychological

intervention. All three groups completed pretest and posttest assessments, enabling both within-group and between-group comparisons to determine whether mindfulness alone could reduce mathematics anxiety and whether incorporating self-compassion would produce additional benefits—an important comparative investigation given that emotional regulation, self-awareness, and self directed kindness have been identified as significant psychological resources supporting students' academic resilience and learning experiences (Neff, 2003; Neff & Germer, 2013).

Table 1. Nonequivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experimental Group 1 (Class 7D)	O ₁	X ₁ (Mindfulness Meditation)	O ₂
Experimental Group 2 (Class 7B)	O ₃	X ₂ (Mindfulness Meditation Integrated with Self-Compassion)	O ₄
Control Group (Class 7E)	O ₅	C (Conventional Mathematics Instruction)	O ₆

The research was conducted at SMP Negeri 1 Plered, Cirebon Regency, Indonesia, during the first semester of the 2025/2026 academic year. The target population consisted of all seventh-grade students enrolled at the school, totaling 266 students distributed across seven classrooms. A cluster random sampling technique was employed because the intervention was implemented at the classroom level rather than at the individual level, preserving the natural classroom structure and minimizing disruption to regular instructional activities. Three classes were randomly selected through a lottery procedure and assigned to different conditions: Class 7D as Experiment Group 1, Class 7B as Experiment Group 2, and Class 7E as the Control Group. Following the application of exclusion criteria—students absent from more than one session or failing to complete the posttest—the final sample comprised 112 students aged 12–13 years (38 in Experiment Group 1, 37 in Experiment Group 2, and 37 in the Control Group). Before data collection, detailed information regarding the study objectives, procedures, and participant rights was provided to both students and their parents or guardians to ensure informed participation, with inclusion requiring active enrollment, pretest attendance, and parental consent.

The intervention program was implemented over two weeks and consisted of four structured sessions conducted twice per week, each lasting approximately five to ten minutes and administered immediately before mathematics instruction. The brief duration was intentionally designed to maximize feasibility within the school schedule while minimizing disruption to academic activities. The first session introduced students to the fundamental concept of mindfulness as paying attention to present-moment experiences with openness and nonjudgmental awareness (Kabat-Zinn, 2003), followed by conscious breathing exercises; the second session involved body scan meditation; the third session emphasized emotional awareness; and the final session incorporated loving-kindness meditation. Although both experimental groups participated in the same mindfulness activities, Experiment Group 2 received additional self-compassion training integrated throughout the intervention, based on Neff's (2003) theoretical framework comprising self-kindness, common humanity, and mindfulness. Students were guided to replace self-critical thoughts with supportive internal dialogue, recognize that academic mistakes are common human experiences, and engage in reflective exercises to strengthen emotional awareness. To ensure procedural consistency, all sessions were facilitated by the first author using standardized scripts and prerecorded audio materials adapted from established protocols for adolescents (Neff & Germer, 2013; Zoogman, Goldberg, S. B., Hoyt, W. T., & Miller, L. (2015). *Mindfulness interventions with youth: A meta-analysis.*, 2015).

Data were collected using three complementary instruments: a 32-item Mathematics Anxiety Questionnaire adapted from Cooke, Hart, and Boggess, (2011) measuring four dimensions (somatic anxiety, cognitive anxiety, attitudes toward mathematics, and mathematical knowledge anxiety) with excellent internal consistency ($\alpha = 0.925$); a 19-item adapted Self-Compassion Scale (Neff, 2003) assessing self-kindness, common humanity, and mindfulness with acceptable reliability ($\alpha = 0.751$); and a researcher-developed 15-item Program Response Questionnaire evaluating students' perceptions of the intervention's usefulness, practicality, and acceptability. Content validity was established through expert judgment involving two educational psychology experts and one mathematics education expert using Aiken's V coefficient (Aiken, 1985), while empirical validity was assessed using Pearson Product Moment item-total correlation analysis. Data analysis was conducted using IBM SPSS Statistics version 26 (IBM Corp., 2019). Descriptive statistics were calculated to summarize pretest and posttest performance, and normality was examined

using the Shapiro–Wilk test (Shapiro & Wilk, 1965). For normally distributed data, paired-sample t-tests were performed with effect sizes calculated using Cohen's d (Cohen, 1988). To compare intervention effectiveness across groups, the Kruskal–Wallis H test was employed because gain scores violated the normality assumption (Field, 2018), followed by Mann–Whitney U post hoc comparisons with Bonferroni-adjusted significance levels. Ethical approval was obtained before data collection, and all procedures adhered to the Declaration of Helsinki (World Medical Association, 2013), with confidentiality, anonymity, voluntary participation, and participants' rights to withdraw strictly maintained throughout the research process.

RESULTS AND DISCUSSION

1. Descriptive Statistics of Mathematics Anxiety

Table 2 presents the descriptive statistics of mathematics anxiety scores across the three research groups before and after the intervention.

Table 2. Descriptive Statistics of Mathematics Anxiety Scores Across Groups

Group	n	Pretest Mean	SD	Posttest Mean	SD	Gain Score
E1 (Mindfulness Only)	38	95.55	8.42	81.68	7.96	13.87
E2 (Mindfulness + Self-Compassion)	37	92.00	7.85	66.68	6.74	25.32
Control	37	97.65	8.91	97.24	9.03	0.41

The descriptive findings indicate that all groups started the study with relatively similar levels of mathematics anxiety. Pretest means ranged from 92.00 to 97.65, suggesting comparable baseline conditions. Following the intervention, substantial differences emerged. The largest reduction was observed in Experiment Group 2, where anxiety scores decreased by 25.32 points. Experiment Group 1 also demonstrated a notable reduction of 13.87 points, whereas the Control Group exhibited virtually no change. These findings provide preliminary evidence that mindfulness-based interventions contributed to reducing mathematics anxiety, particularly when combined with self-compassion practices.

2. Normality Testing

Before conducting inferential analyses, the normality assumption was examined using the Shapiro–Wilk test.

Table 3. Shapiro–Wilk Normality Test Results

Group	Variable	Statistic	df	p
E1	Pretest	0.962	38	0.292
E1	Posttest	0.954	38	0.129
E2	Pretest	0.958	37	0.144
E2	Posttest	0.961	37	0.258
Control	Pretest	0.962	37	0.292
Control	Posttest	0.954	37	0.129

All significance values exceeded 0.05, indicating that mathematics anxiety scores were normally distributed. Therefore, paired-sample *t*-tests were employed to examine within-group differences between pretest and posttest scores.

3. Within-Group Changes in Mathematics Anxiety

To assess the effectiveness of the mindfulness meditation intervention in reducing mathematics anxiety, a paired-sample *t*-test was performed for students in Experiment Group 1. The analysis compared anxiety scores measured before and after the intervention to determine whether the observed changes were statistically significant. Given that mindfulness practices are intended to enhance present-moment awareness and emotional regulation, it was hypothesized that students would demonstrate lower levels of mathematics anxiety following participation in the program. The results of the analysis are summarized in table 4, which presents the descriptive statistics and inferential test outcomes for the pretest and posttest measurements.

The results indicate a statistically significant reduction in mathematics anxiety following the mindfulness meditation intervention ($t = 6.005, p < 0.001$). The average decrease of 13.87 points demonstrates that mindfulness meditation effectively reduced anxiety levels. At the individual level, 31 students (81.6%) experienced decreased anxiety, one student showed no change, and six students reported slightly higher anxiety scores after the intervention.

Building upon the findings from Experiment Group 1, a paired-sample *t*-test was subsequently performed to evaluate the effectiveness of the mindfulness meditation program integrated with self-compassion in Experiment Group 2. This analysis was designed to determine whether incorporating self-compassion practices into mindfulness training would lead to a greater reduction in mathematics anxiety. The intervention encouraged students not only to develop present-moment awareness but also to respond to

learning challenges with self-kindness, acceptance, and recognition of common humanity. Such psychological resources are theoretically associated with lower levels of academic stress and anxiety. Accordingly, the analysis examined whether significant differences existed between pretest and posttest anxiety scores after the implementation of the integrated intervention. The results are presented in table 5.

Table 4. Paired-Sample t-Test Results for Experiment Group 2

Variable	Mean	SD	t	df	p
Pretest	92.00	7.85	12.990	36	< 0.001
Posttest	66.68	6.74			

The integrated intervention produced a highly significant reduction in mathematics anxiety ($t = 12.990$, $p < 0.001$). Anxiety scores decreased by 25.32 points, nearly twice the reduction observed in Experiment Group 1. Remarkably, all participants (100%) demonstrated lower anxiety scores after the intervention, indicating a highly consistent effect across students.

Table 5. Paired-Sample t-Test Results for Control Group

Variable	Mean	SD	t	df	p
Pretest	97.65	8.91	0.312	36	0.756
Posttest	97.24	9.03			

The Control Group exhibited no statistically significant change in mathematics anxiety. The negligible reduction of only 0.41 points suggests that conventional mathematics instruction alone did not influence students' anxiety levels during the study period.

4. Comparative Effectiveness of the Interventions

To determine whether the reductions in anxiety differed significantly among groups, gain scores were compared using the Kruskal-Wallis H test.

Table 6. Comparison of Mathematics Anxiety Reduction Across Groups

Group	Pretest Mean	Posttest Mean	Gain Score	Students with Reduced Anxiety
E2 (Mindfulness + Self-Compassion)	92.00	66.68	25.32	37 (100%)
E1 (Mindfulness Only)	95.55	81.68	13.87	31 (81.6%)
Control	97.65	97.24	0.41	17 (45.9%)

To determine whether the reductions in anxiety differed significantly among groups, gain scores were compared using the Kruskal Wallis H test. To establish the comparative effectiveness of the intervention models, the magnitude of mathematics anxiety reduction was examined across all three groups using gain scores. While the within-group analyses confirmed that both intervention conditions were associated with significant improvements, a direct comparison was necessary to identify which intervention produced the greatest reduction in anxiety. Preliminary assumption testing indicated that the gain score distributions were not normally distributed ($p < 0.05$), thereby violating the assumptions required for parametric analysis of variance. Consequently, the Kruskal Wallis H test was employed as a robust non-parametric alternative for comparing three independent groups. This analysis evaluated whether the observed differences in anxiety reduction were attributable to the type of intervention received. The results of the Kruskal–Wallis test are summarized in table 8.

Table 7. Kruskal–Wallis Test Results

Test	χ^2	df	p
Kruskal–Wallis H	51.412	2	< 0.001

The Kruskal–Wallis analysis revealed significant differences among the three groups, indicating that the type of intervention substantially influenced anxiety reduction. The ranking of gain scores clearly demonstrates the superiority of the mindfulness plus self-compassion intervention. To identify the source of these differences, post hoc analyses were conducted.

Table 8. Post Hoc Pairwise Comparisons (Mann–Whitney U with Bonferroni Adjustment)

Comparison	Z	Adjusted p	Interpretation
Control vs E1	3.941	< 0.001	Significant
Control vs E2	7.160	< 0.001	Significant
E1 vs E2	-3.266	0.003	Significant

The post hoc analysis confirmed that both intervention groups significantly outperformed the Control Group. More importantly, Experiment Group 2 also differed significantly from Experiment Group 1, providing strong evidence that incorporating self-compassion significantly enhanced the effectiveness of mindfulness meditation.

5. Changes in Self-Compassion

To explore potential mechanisms underlying anxiety reduction, self-compassion was analyzed as a secondary outcome.

Table 9. Self-Compassion Scores Across Groups

Group	Pretest Mean	Posttest Mean	Gain Score	Students with Increased Self-Compassion
E1	58.39	61.87	3.48	26 (68.4%)
E2	56.59	70.76	14.17	37 (100%)
Control	57.82	62.96	5.14	24 (64.9%)

The findings indicate that self-compassion increased most substantially in Experiment Group 2. The gain score of 14.17 points was more than four times larger than that observed in Experiment Group 1. Additionally, all students initially categorized as having low self-compassion transitioned into moderate or high categories following the intervention. These results suggest that self-compassion may represent an important psychological mechanism through which mindfulness-based interventions reduce mathematics anxiety.

6. Student Responses to the Intervention Program

Students' perceptions of the intervention were assessed using a program evaluation questionnaire.

Table 10. Student Responses to the Intervention Program

Response Category	E1 (%)	E2 (%)
Positive	54.0	76.4
Neutral	39.0	18.6
Negative	7.0	5.0

Students in Experiment group 2 reported substantially more positive perceptions than those in Experiment Group 1. The higher level of acceptance suggests that self-compassion practices provided a more meaningful and relatable framework for managing academic difficulties. The combination of stronger statistical outcomes and more favorable student perceptions indicates that mindfulness integrated with self-compassion represents the most effective intervention model among those examined in this study.

The convergence of descriptive statistics, within-group analyses, between-group comparisons, self-compassion outcomes, and participant evaluations consistently demonstrates that mindfulness meditation

significantly reduced mathematics anxiety, while the integration of self-compassion produced the greatest and most consistent improvements across all measured outcomes.

The findings of this study demonstrate that both mindfulness meditation and mindfulness meditation integrated with self-compassion significantly reduced mathematics anxiety among junior high school students; however, the integrated intervention produced substantially greater reductions than mindfulness practice alone. The effectiveness of mindfulness meditation is consistent with previous research showing that mindfulness-based interventions can alleviate mathematics-related anxiety and improve students' engagement with mathematical tasks (Zuo & Wang, 2023). From a theoretical perspective, mindfulness enables individuals to attend to present-moment experiences in a non judgmental manner, thereby reducing anticipatory worry, catastrophic thinking, and negative self-evaluative processes that often characterize mathematics anxiety (Kabat-Zinn, 2003). By cultivating greater awareness of anxious thoughts without immediately reacting to them, students may become more capable of focusing on mathematical reasoning rather than on fear of failure. This interpretation is also supported by neuropsychological evidence suggesting that mindfulness training enhances emotional regulation through alterations in stress-related neural processes, including reduced amygdala reactivity and improved regulation of emotional responses Greco, Lindsay, Fairgrieve, Brown, and Creswell (2015). Nevertheless, the finding that a small proportion of students in the mindfulness-only group experienced limited improvement or increased anxiety suggests that awareness alone may not always be sufficient to produce adaptive outcomes. As noted by Britton (2019), increased awareness of distressing emotional experiences can occasionally intensify discomfort when individuals lack adequate coping resources to process those experiences constructively.

The superior effectiveness of the integrated mindfulness and self-compassion intervention represents the most important contribution of the present study. Students who received the combined intervention demonstrated significantly greater reductions in mathematics anxiety than those who participated in mindfulness practice alone, indicating that self-compassion may strengthen the emotional regulatory effects of mindfulness. This finding is consistent with the mindful self-compassion framework proposed by Germer and Neff (2019), which conceptualizes mindfulness as the capacity to recognize emotional experiences and self-compassion as the capacity to respond to those

experiences with kindness, acceptance, and understanding. Mathematics anxiety is frequently associated with self-criticism, fear of failure, and negative self-perceptions; therefore, self-compassion may directly counteract these maladaptive psychological processes by encouraging self-kindness and reducing harsh self-judgment (Neff, 2023). The findings also support the work of Leppma and Darrah (2024), who reported that self-compassion is a stronger predictor of mathematics anxiety than mindfulness alone. In this regard, mindfulness may help students identify their anxiety, whereas self-compassion may determine how effectively they respond to it. The substantial increase in self-compassion observed among students in the integrated intervention group further reinforces this interpretation. Moreover, recent neuroscientific evidence suggests that self-compassion is associated with neural systems involved in emotional regulation, self-referential processing, and fear extinction, thereby facilitating more adaptive responses to stressful academic experiences (Chen, Mei, Zhou, Dou, & Lei, 2024).

The absence of meaningful improvement in the control group further highlights the importance of incorporating explicit affective interventions into mathematics education. Students who participated only in conventional mathematics instruction exhibited virtually no reduction in mathematics anxiety, while a considerable proportion reported increased anxiety over time. This finding corroborates previous evidence indicating that mathematics anxiety tends to remain stable or intensify when no targeted intervention is provided (Hembree, 1990; Luttenberger, Wimmer, and Paechter 2018). The results therefore suggest that conventional instructional approaches, which primarily emphasize cognitive achievement, may be insufficient to address the emotional barriers that hinder mathematical learning. Beyond demonstrating intervention effectiveness, the study also contributes to the broader literature on Social and Emotional Learning (SEL) and its intersection with mathematics education. Existing SEL frameworks emphasize the development of self-awareness, self-management, and emotional competencies as essential components of student development (CASEL, 2020). However, within mathematics education, these competencies are particularly critical because mathematical learning inherently involves affective dimensions that shape cognitive processing. As Goldin (2014) posits in his theory of engagement structures in mathematics, students' emotional experiences during mathematical problem-solving including feelings of curiosity, frustration, and anxiety directly influence their cognitive strategies, persistence, and ultimately

their mathematical achievement. The present findings extend this perspective by demonstrating that mindfulness and self-compassion can be successfully integrated into mathematics education to address a specific academic-emotional challenge, thereby operationalizing what Schoenfeld (2011) describes as the "affective domain" in mathematical learning – the complex interplay of beliefs, emotions, and attitudes that significantly influences students' mathematical behavior and performance.

Furthermore, the integration of mindfulness and self-compassion addresses what Hannula (2015) identifies as the need for interventions targeting students' emotional regulation during mathematical activities, particularly given that mathematics anxiety often arises from the unique epistemological characteristics of the discipline, such as its cumulative structure and the perceived absoluteness of right and wrong answers (Ashcraft, 2002; Stuart, 2000). By helping students develop both awareness of their anxious responses and compassionate self-regulation, the intervention targets the affective roots of mathematical disengagement that traditional cognitive instruction alone cannot reach. This conclusion aligns with the work of Molyneux and Diamond (2025), who found that integrating SEL principles into mathematics instruction contributes to emotionally supportive classroom environments, reduces anxiety, and improves student engagement. Moreover, the findings resonate with the framework proposed by De Bellis and Goldin (2006), which conceptualizes mathematical affect as comprising emotional states, attitudes, beliefs, and values each of which can be positively influenced through structured affective interventions. The significant improvement in self-compassion observed in Experiment Group 2 suggests that such interventions may transform students' mathematical self-concept, moving them from a fixed mindset characterized by fear of failure toward what Dweck (2006) describes as a growth mindset, where challenges are viewed as opportunities for learning and development.

Several implications emerge from these findings. First, the study provides evidence that brief interventions consisting of only four sessions over two weeks can produce meaningful reductions in mathematics anxiety, highlighting their practicality and scalability within authentic school settings. Second, the findings suggest that self-compassion should not be viewed merely as a complementary component of mindfulness programs but rather as a critical mechanism that transforms emotional awareness into adaptive emotional regulation (Germer & Neff, 2019; Neff, 2023). Consequently, educators, school

counselors, and curriculum developers should consider integrating both mindfulness and self-compassion practices into classroom routines and student well-being initiatives. Nevertheless, several limitations should be acknowledged. The use of a quasi-experimental design limits causal inference compared with randomized controlled trials; the intervention duration was relatively short, and the study relied primarily on self-report measures that may be susceptible to response bias. Furthermore, the study was conducted within a single Indonesian junior high school, limiting the generalizability of the findings. Future research should therefore employ longitudinal and multi-site designs, incorporate behavioral and physiological indicators of anxiety, and examine whether reductions in mathematics anxiety translate into improvements in mathematics achievement, academic engagement, and long-term learning outcomes. Despite these limitations, the present study provides robust evidence that integrating mindfulness and self-compassion offers a theoretically grounded, empirically supported, and educationally feasible approach for reducing mathematics anxiety and promoting emotional well-being among adolescent learners.

CONCLUSION

This study provides empirical evidence that both mindfulness meditation and mindfulness meditation integrated with self-compassion are effective in reducing mathematics learning anxiety among junior high school students. However, the integrated intervention demonstrated substantially greater effectiveness than mindfulness practice alone. Students who participated in the mindfulness-self-compassion program experienced the largest reduction in anxiety, and the intervention consistently produced positive outcomes across all participants. Furthermore, significant differences were identified among the three groups, confirming a clear hierarchy of effectiveness in which mindfulness integrated with self-compassion outperformed mindfulness-only practice, while both interventions were superior to conventional instruction. These findings support the proposition that combining mindful awareness with compassionate self-regulation represents a particularly powerful approach for addressing mathematics-related anxiety during early adolescence.

The study contributes theoretically to the growing literature on Social and Emotional Learning (SEL) by demonstrating that mindfulness and self-compassion can be successfully adapted to address subject-specific anxiety

within mathematics education. Empirically, it extends previous research by providing quasi-experimental evidence from an Indonesian junior high school context and highlighting the added value of self-compassion as a mechanism for enhancing the effectiveness of mindfulness-based interventions. Practically, the findings suggest that brief, low-cost, and classroom-integrated interventions can be implemented without disrupting instructional time while yielding meaningful improvements in students' emotional well-being. Despite limitations related to the quasi-experimental design, short intervention duration, reliance on self-report measures, and single-school setting, the results indicate promising directions for future research involving longitudinal follow-up, diverse educational contexts, objective measures of anxiety, and investigations into the relationship between anxiety reduction, self-compassion development, and mathematics achievement.

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DECLARATIONS

- Author Contribution : A: Conceiving the study, Collected the data, Conducted the data analysis, and Prepared the original manuscript draft.
WW: The study design, interpreted the findings, critically reviewed and edited the manuscript, and acted as the corresponding author.
A. A. H. to the study design, interpretation of the findings, and manuscript revision.
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