

Intervention Strategies for Mathematical Anxiety in K-12 Students: A Systematic Review of the Past Decade (2016–2025)

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ABSTRACT

Mathematics anxiety affects a substantial proportion of K–12 students globally and negatively impacts both achievement and long-term participation in STEM fields. This systematic review synthesizes empirical intervention studies published between January 2016 and March 2025, drawing on 42 peer-reviewed studies identified through structured searches of Google Scholar, ERIC, and CNKI. Interventions were classified into four categories: cognitive strategies (e.g., growth mindset training, cognitive reappraisal), affective strategies (e.g., expressive writing, mindfulness), environmental/technological strategies (e.g., gamification, adaptive learning platforms), and combined approaches. Combined interventions integrating skill instruction with anxiety management demonstrated the strongest effects ($g = -1.09$; Liu et al., 2025), followed by anxiety-oriented ($g = -0.71$) and skills-oriented approaches ($g = -0.32$; Codding et al., 2023). Among discrete strategies, expressive writing showed particular efficacy for high-anxiety students in testing contexts (Ramirez & Beilock, 2011), though effectiveness is moderated by students' mathematics self-concept (Scheibe et al., 2025). Growth mindset interventions yielded consistent moderate effects ($d \approx 0.20$ – 0.25 ; Yeager et al., 2019). Technological interventions represent the fastest-growing domain but lack longitudinal data. Key moderating factors include grade level, initial anxiety severity, and intervention duration. Findings support multimodal, individually tailored intervention frameworks and highlight the need for long-term follow-up studies, particularly in non-Western contexts.

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INTRODUCTION

Background: Defining, Prevalence, and Consequences

Mathematics anxiety (MA) refers to a state of discomfort, tension, and fear when confronting mathematical problems, accompanied by physiological arousal (Ashcraft, 2002). This construct is distinct from general academic anxiety in that it is specifically triggered by mathematical content, and its negative effects are manifest even when an individual possesses adequate cognitive resources (Ashcraft & Krause, 2007). The phenomenon is strikingly prevalent: approximately 33% of 15-year-old students across 65 countries reported feeling helpless when facing mathematical problems (PISA, 2012). In the United States, estimates range from 25% to 80% of college students experiencing moderate-to-high MA (Liu et al., 2025). Liu et al. (2024)—corresponding to the Chinese team led by Liu Yixuan (刘怡轩), Hu Haobo, and Guo Kan—found a mean weighted correlation of $r = -0.311$ between MA and academic performance across 161,596 students in Chinese compulsory education.

The consequences extend well beyond momentary discomfort. At the achievement level, Namkung et al. (2019) found a significant negative correlation between MA and mathematics performance ($r = -0.34$), corroborated by Liu et al. (2024) in the Chinese context ($r = -0.311$). Hembree (1990) found that high-anxiety students systematically avoid elective mathematics courses, setting in motion a self-reinforcing cycle of reduced practice, declining competence, and heightened anxiety. Yu (2023) further documented that MA impairs working memory function, directly interfering with problem-solving performance. Persistent MA is associated with avoidance of STEM courses and lower likelihood of pursuing STEM-related careers (Maloney & Beilock, 2012). Teachers who experience MA have been found to transmit anxious attitudes to students, particularly to girls in early elementary years (Beilock et al., 2010; Li et al., 2025).

Theoretical Significance and Practical Value of Intervention Research

Given the pervasive and damaging effects of mathematics anxiety, the development and evaluation of evidence-based interventions has become a priority in educational psychology and mathematics education research. Luttenberger et al. (2018), in an influential narrative review, argued that interventions targeting MA hold promise at multiple levels—individual (reducing anxious affect), instructional (redesigning learning environments), and systemic (training teachers)—and called for more rigorous evaluation studies. The present decade (2016–2025) has witnessed a substantial expansion of this empirical base, including the emergence of technology-mediated interventions and the publication of several high-quality meta-analyses.

From a practical standpoint, practitioners—teachers, school counselors, and curriculum designers—need clear, implementable guidance on which strategies are most effective, for whom, and under what conditions. Li et al. (2025) note that the classroom environment is a critical proximal determinant of student MA, with instructional quality, teacher support, and task structure all emerging as significant moderators.

Limitations of Prior Reviews

Several prior syntheses have addressed the intervention literature on mathematics anxiety. Luttenberger et al.'s (2018) widely cited review, "Spotlight on math anxiety," provided a useful classification of intervention types and highlighted the role of attributional training, relaxation techniques, and instructional redesign. However, this review was published over seven years ago and predates a substantial body of recent work, including the rapid growth of technology-mediated

interventions, the emergence of adaptive learning platforms, and post-COVID-19 developments in online and hybrid mathematics instruction.

Namkung et al.'s (2019) meta-analysis offered rigorous quantitative estimates of the MA–performance relationship but focused exclusively on the association rather than on intervention effects. Sammallahti et al. (2023) conducted a meta-analysis of MA interventions but drew primarily on studies involving older adolescents and adults, with limited coverage of primary school populations and virtually no inclusion of Chinese-language literature. Peng et al. (2023), in a Chinese-language narrative review, synthesized intervention strategies for Chinese adolescents but did not systematically compare effect sizes across intervention types or engage with the most recent international literature.

Prior reviews have important limitations: they predate recent technology-mediated interventions, focus on associations rather than interventions, or lack coverage of primary school and Chinese-language literature. To address these gaps, the present review provides a bilingual (English-Chinese) synthesis of MA intervention studies published between 2016 and 2025, covering the full K–12 age range and systematically comparing effect sizes across intervention categories.

Research Objectives and Questions

This systematic review aims to synthesize empirical evidence on mathematics anxiety interventions for K–12 students published between January 2016 and March 2025. Specifically, we address three research questions:

1. What are the developmental trends in mathematics anxiety intervention research over the past decade (2016–2025)?
2. What are the effects of different categories of intervention (cognitive, affective, environmental/technological, and combined) on mathematics anxiety reduction?
3. Which moderating factors (grade level, initial anxiety severity, intervention duration) influence intervention efficacy?

METHOD

Database Search and Keywords

A systematic literature search was conducted in January–March 2025 across three major academic databases: Google Scholar and ERIC (English-language sources) and CNKI—the China National Knowledge Infrastructure (Chinese-language sources). The English-language search string was: ("math* anxiety" OR "mathematics anxiety") AND (intervention OR reduction OR treatment OR program). The Chinese-language search string was: (数学焦虑 OR 数学恐惧 OR 数学学习焦虑) AND (干预 OR 减轻 OR 策略). The temporal boundary was set from January 1, 2016, to March 31, 2025, in order to capture a full decade of recent research while acknowledging work published prior to 2016 as the foundational context synthesized in the Introduction.

In addition to database searching, reference lists of identified meta-analyses (Liu et al., 2025; Codding et al., 2023; Sammallahti et al., 2023; Namkung et al., 2019) were manually screened to identify additional eligible studies not captured by keyword searches.

Inclusion and Exclusion Criteria

Studies were included if they met all of the following criteria: (a) the study population consisted of K–12 students (kindergarten through Grade 12, or equivalent age range 5–18 years); (b) the study reported a clearly described intervention aimed at reducing mathematics anxiety; (c)

the study included pre- and post-intervention measurements of mathematics anxiety using a standardized or validated instrument; and (d) the study was published in a peer-reviewed journal (in English or Chinese).

Studies were excluded if: (a) they focused exclusively on general test anxiety or school anxiety without specifically assessing mathematics anxiety; (b) the sample consisted entirely of tertiary-level students, pre-service teachers, or adult learners; (c) the study was a conference paper, dissertation, book chapter, or non-peer-reviewed report; or (d) the study provided only correlational data without an experimental or quasi-experimental intervention design.

Screening Procedure and Final Sample

The search and screening process followed the PRISMA 2020 guidelines (Page et al., 2021). Initial database searches yielded 187 potentially relevant records. After automated de-duplication, 153 records remained. Title and abstract screening by the primary reviewer led to the exclusion of 101 records that clearly did not meet inclusion criteria (e.g., adult-only samples, no intervention component, not peer-reviewed). Full-text retrieval and assessment was conducted for the remaining 52 records. A further 10 articles were excluded after full-text review due to: inadequate reporting of anxiety outcomes ($n = 4$), exclusively tertiary samples ($n = 3$), and inability to determine pre–post measurement sequence ($n = 3$). The final analytic sample comprised 42 peer-reviewed studies.

Table 1. PRISMA 2020 Screening Summary

Screening Stage	Records (N)
Initial database search	187
After de-duplication	153
After title/abstract screening	52
Final included studies (full-text assessment)	42
— English-language databases (Google Scholar, ERIC)	30
— CNKI (Chinese-language)	12

Note: Screening followed PRISMA 2020 guidelines (Page et al., 2021). Of the 42 included studies, geographically, studies were conducted in the United States ($n = 16$), China ($n = 12$), Europe ($n = 7$), the Middle East ($n = 4$), and other Asian contexts ($n = 3$). Participant ages ranged from 6 to 18 years, with the majority of studies ($n = 26$) focusing on middle school students (Grades 6–9).

RESULTS: CLASSIFICATION OF INTERVENTION STRATEGIES

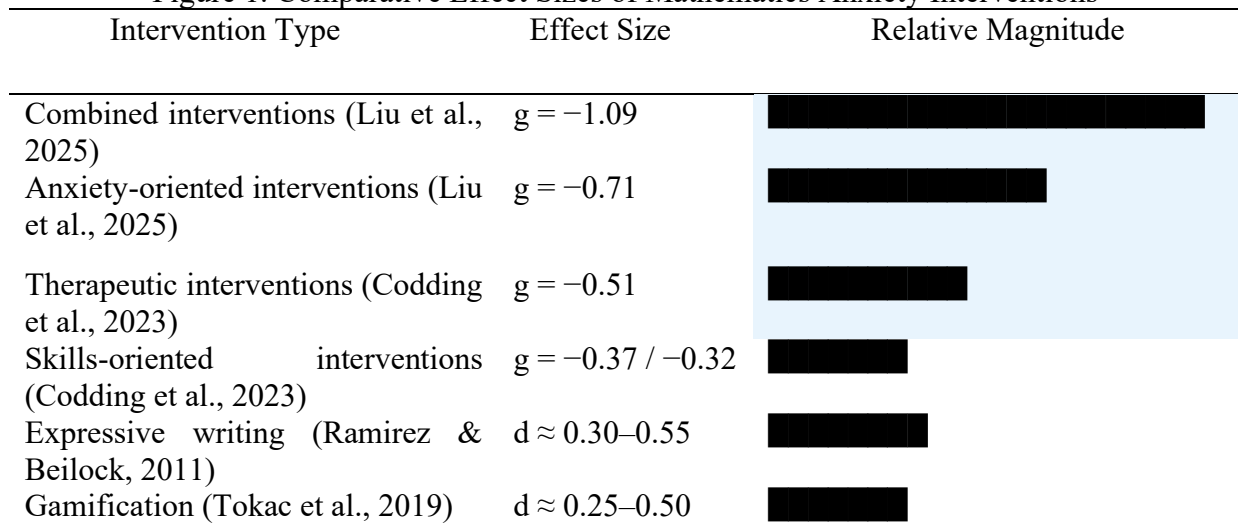
Following Luttenberger et al. (2018) and extending their framework with evidence from 2019–2025, interventions in the included studies were classified into four categories: (1) cognitive strategies, (2) affective/emotional strategies, (3) environmental and technological strategies, and (4) combined (multimodal) strategies. Table 2 provides an overview of representative studies within each category. Figure 1 displays the approximate effect sizes across intervention types for comparative reference.

Table 2. Overview of Intervention Categories and Representative Studies

Category	Representative Studies	Effect Size (approx.)	Best-suited Population
Cognitive (growth mindset)	Yeager et al. (2019)	$d \approx 0.20-0.25$	Middle & high school
Cognitive (reappraisal)	Jamieson et al. (2016)	$d \approx 0.18-0.30$	High-stakes exam contexts
Affective (expressive writing)	Ramirez & Beilock (2011); Scheibe et al. (2025)	$d \approx 0.30-0.55$	High-anxiety students
Affective (mindfulness/relaxation)	Brunyé et al. (2017); Klatt et al. (2022)	$d \approx 0.15-0.35$	All age groups
Technological (gamification)	Tokac et al. (2019); Alabdulaziz (2023)	$g \approx 0.25-0.50$	Primary school students
Technological (adaptive platforms)	Holmes (2022); Strohmaier et al. (in press)	Emerging evidence	Middle school
Environmental (peer-assisted)	Barbieri et al. (2021)	$d \approx 0.20-0.40$	Elementary–middle school
Instructional design	(REACT) Ma (2025)	Qualitative evidence	K–12 general
Combined (skill + anxiety)	Liu et al. (2025); Codding et al. (2023)	$g = -1.09$; $g = -0.51$	K–12, esp. high anxiety

Note. Effect sizes are drawn from meta-analyses where available (Liu et al., 2025; Codding et al., 2023); ranges for other categories represent best estimates based on narrative synthesis of primary studies. g = Hedges' g ; d = Cohen's

Figure 1. Comparative Effect Sizes of Mathematics Anxiety Interventions



Growth mindset (Yeager et al., 2019) 

Peer-assisted learning (Barbieri et al., 2021) 

Note. Bar lengths () are proportional to effect size magnitude. Effect sizes for combined, anxiety-oriented, and skills-oriented categories are Hedges' g from Liu et al. (2025) and Codding et al. (2023); remaining values are approximate Cohen's d from primary studies. Highlighted rows (blue shading) indicate meta-analytic data.

1. Cognitive Strategies 1

Cognitive strategies aim to alter students' belief systems, attributional styles, and appraisals of mathematical ability and anxiety. They are grounded theoretically in Dweck's (2006) implicit theory of intelligence—the growth mindset framework—and in Beck's (1979) cognitive-behavioral therapy tradition, particularly cognitive restructuring and reappraisal techniques.

Growth Mindset Interventions

Growth mindset interventions proceed from the premise that when students come to believe that intelligence is malleable ("the brain is like a muscle—it grows with effort"), they are more likely to persist in the face of difficulty. Yeager et al. (2019) conducted a pre-registered RCT with over 12,000 ninth-grade students using two 25-minute online sessions on neuroplasticity and growth mindset, yielding effect sizes of $d \approx 0.20$ – 0.25 , with strongest effects for students at elevated risk of fixed-mindset beliefs at baseline—a subgroup overlapping substantially with high-anxiety students.

In the Chinese context, Jia (2018) documented the value of a "student-centered" classroom approach, emphasizing growth-oriented feedback language and the deliberate framing of mathematical mistakes as learning opportunities to attenuate the academic shame and fear of failure that fuel MA.

Cognitive Reappraisal Training

A second cognitive approach involves reappraisal of the physiological symptoms of anxiety. Jamieson et al. (2016) found that reappraisal training delivered prior to high-stakes examinations was associated with reduced experienced anxiety and improved test performance ($d \approx 0.18$ – 0.30), with the largest gains for initially most anxious students. Its limitation lies in situational specificity: effects are most consistent in acute, high-stakes contexts and weaker in everyday mathematics learning.

Self-Explanation Training

A third cognitive approach, self-explanation training, involves instructing students to articulate their reasoning processes aloud while solving mathematical problems. Rittle-Johnson et al. (2017) reported that self-explanation training produced improvements in procedural fluency and conceptual understanding in elementary school students, with secondary benefits for confidence and willingness to engage with challenging problems.

2. Affective/Emotional Strategies 2

Affective strategies focus directly on the emotional experience of mathematics anxiety rather than on cognition. They are grounded theoretically in emotion regulation theory (Gross, 1998) and in

the "emotional discharge" hypothesis, which proposes that articulating and processing negative emotions reduces their cognitive and physiological impact.

Expressive Writing

Expressive writing is the most extensively researched and cost-effective affective strategy. Ramirez and Beilock (2011) found that 10 minutes of expressive writing before an examination produced improvements equivalent to approximately one letter grade among high-anxiety students, with effect sizes $d \approx 0.30-0.55$. Scheibe et al. (2025) found that expressive writing was effective only for students with relatively low mathematics self-concept; for those with high self-concept, effects were negligible. Blanket implementation may be less effective than targeted delivery to students with elevated anxiety combined with low mathematics self-concept.

Relaxation Training and Mindfulness Practice

Progressive muscle relaxation and deep-breathing exercises represent the most traditional affective strategies. Brunyé et al. (2017) demonstrated that 8 minutes of relaxation exercises before a mathematics test produced significant reductions in self-reported anxiety and modest performance improvements among adolescent samples, though effects did not persist beyond immediate post-intervention assessment. Mindfulness-based interventions offer a more sustained alternative. Klatt et al. (2022) found that an 8-week mindfulness program integrated into mathematics classes produced significant reductions in trait MA with moderate effect sizes, persisting at 6-week follow-up, though requiring substantially higher implementation intensity.

3. Environmental and Technological Strategies

Environmental and technological strategies address MA indirectly by redesigning the learning environment, tools, and instructional methods. They are grounded in cognitive load theory (Sweller, 1988), self-determination theory (Ryan & Deci, 2000), and constructivist principles of mathematics education. This category represents the fastest-growing segment of the intervention literature (2019–2025).

Technological Tools

Gamification involves embedding mathematical practice within game structures (points, levels, badges, leaderboards, narrative contexts), reducing evaluative threat by reframing errors as natural gameplay rather than evidence of intellectual inadequacy. Tokac et al. (2019) found significant positive effects for primary school students (medium effect sizes on engagement and achievement), and Hwang et al. (2021) extended this to the anxiety domain in Taiwanese middle school students. Alabdulaziz (2023) reported that an "escape room" format produced significant improvements in motivation and MA reduction. However, superficial point-and-badge systems may produce only transient novelty effects (Dichev & Dicheva, 2017).

Adaptive learning platforms use algorithms to dynamically adjust problem difficulty based on real-time performance. Holmes (2022) reported promising findings for anxiety reduction, particularly for students with low baseline mathematical confidence. Strohmaier et al. (in press) suggest that effective adaptivity requires domain-specific process data beyond mere accuracy, which may be especially beneficial for anxious students who perform below their actual knowledge level due to worry interference.

Instructional Environment

Peer-assisted learning (PAL) involves structured dyadic or small-group formats, reducing social evaluation pressure relative to teacher-led instruction. Barbieri et al. (2021) reported significant MA reductions ($d \approx 0.20$ – 0.40) among elementary and middle school students, with effectiveness depending on deliberate tutor role training.

Ma (2025) synthesized evidence on the REACT model (Relating to real-world contexts, Experiencing hands-on activities, Applying concepts, Cooperating with peers, Transferring knowledge), finding consistently lower MA in classrooms implementing REACT principles compared to traditional instruction. In the Chinese context, Liu (2025) proposed a three-dimensional framework emphasizing contextual, discovery-based learning, growth-oriented evaluation, and psychological guidance capacity for teachers. Jia (2018) similarly emphasized problem-situation creation and scaffolded practice.

Combined Interventions: Integrating Skills and Anxiety Management

Combined interventions simultaneously address both mathematical skill development and the affective/psychological dimensions of mathematics anxiety. They represent the most resource-intensive but also, according to the current evidence, the most potent approach to MA reduction.

The strongest quantitative evidence for combined interventions comes from the meta-analysis by Liu et al. (2025), published in the *Journal of Educational Psychology*. Drawing on 51 intervention studies comprising 7,673 participants ranging from children to adults, Liu et al. classified interventions into three types: skills-oriented (targeting mathematics competence through direct instruction), anxiety-oriented (targeting MA directly through perception-based or physiological strategies), and combined (integrating both). The results demonstrated a clear dose-response pattern: combined interventions yielded the largest pooled effect on anxiety reduction ($g = -1.09$), followed by anxiety-oriented interventions ($g = -0.71$), and skills-oriented interventions ($g = -0.37$). For mathematics performance outcomes, however, skills-oriented interventions produced the strongest performance gains ($g = 0.76$), with combined interventions showing more modest achievement effects. This dissociation suggests that reducing anxiety and improving performance may require somewhat different emphases within a combined intervention.

These findings converge with those of Coddington et al. (2023), who conducted a meta-analysis of school-based therapeutic and skill-oriented interventions for MA in K–12 students ($N = 1,786$ across 17 studies). Therapeutic interventions reduced anxiety symptoms more effectively ($g = -0.51$) than skill-based interventions ($g = -0.32$), while skill-based interventions produced larger academic achievement gains. Peng et al. (2023), in their Chinese-language review, similarly concluded that comprehensive interventions combining direct mathematics instruction, attribution retraining, and relaxation techniques produced the most durable reductions in adolescent MA. Future intervention design should deliberately integrate skill-building and affective regulation components rather than treating them as mutually exclusive alternatives.

DISCUSSION

Comparative Effectiveness and Moderating Factors

The evidence converges on a hierarchy of intervention effectiveness: combined interventions ($g \approx -1.09$) > anxiety-oriented interventions ($g \approx -0.71$) > skills-oriented/cognitive interventions ($g \approx -0.32$) > technology/environmental interventions ($d \approx 0.25$ – 0.50 for gamification). This ranking aligns with the argument that MA, being a multiply determined construct, is most effectively addressed by interventions targeting multiple causal pathways. Liu et al.'s (2025) causal framework

suggests that combined interventions produce synergistic effects by simultaneously addressing both skill deficits and anxiety-related interference.

Key moderating factors include grade level, initial anxiety severity, and intervention duration. Early elementary interventions (Grades K–3) may yield larger and more durable benefits than those delivered in middle or high school (Shore & Kelleher, 2024). Initial anxiety severity is a robust moderator: expressive writing (Ramirez & Beilock, 2011) and anxiety-oriented interventions (Liu et al., 2025) produced their strongest effects for high-anxious students. Single-session interventions demonstrate acute but limited sustained effects; multi-session programs (8+ weeks) produce stronger, more durable effects. Gender differences in MA are well-documented, with girls typically reporting higher MA (Liu et al., 2024), though the MA–performance correlation does not differ significantly by gender.

Skills-oriented interventions produced the strongest academic achievement gains (Liu et al., 2025), suggesting that practitioners facing resource constraints may prioritize high-quality mathematics instruction as a first-line approach. This pragmatic recommendation carries the risk of neglecting students whose anxiety is primarily emotional.

The Role of Teachers and Classroom Environment

The classroom environment and teachers' behaviors are critical determinants of student MA. Li et al. (2025), in a systematic review of 56 empirical studies, identified four major categories: instructional practices, teacher support and climate, task structure, and teachers' personal characteristics and beliefs. Instructional strategies promoting mathematical understanding and teachers' emotional and motivational support emerged as the most consistently anxiety-protective factors. Beilock et al. (2010) documented that first- and second-grade girls showed higher MA when taught by more math-anxious teachers, with direct implications for pre-service and in-service teacher education. Sun et al. (2025) demonstrated that teacher support promotes problem-focused coping, which in turn reduces MA and enhances mathematical resilience, suggesting that intervention programs should target both teacher behaviors and students' coping repertoires simultaneously.

Reconsidering the Valence of Mathematics Anxiety

An emerging body of research complicates the view of MA as unambiguously negative. Ji et al. (2025)—Ji Siwei (司继伟)'s team, publishing in the *Journal of Educational Psychology*—found that within-person increases in MA were associated with subsequent increases in effort and engagement, particularly among students with adequate coping resources. This finding suggests that the goal of intervention should be managing anxiety to tolerable, potentially motivating levels rather than its complete elimination, calling for a more nuanced multidimensional model of MA.

Limitations

Several limitations should be acknowledged. First, restricting inclusion to Chinese- and English-language publications may underrepresent interventions in other linguistic and cultural contexts. Second, wide heterogeneity in intervention duration (10-minute sessions to 8-week programs) makes direct quantitative comparison difficult; this narrative synthesis is not a substitute for a formal meta-analysis. Third, follow-up periods were short: most studies assessed outcomes within 1 week post-intervention, and fewer than one-quarter reported follow-up beyond 4 weeks. Fourth, publication bias is a pervasive concern; the true magnitude of effects may be smaller than reported.

CONCLUSIONS AND FUTURE DIRECTIONS

Principal Conclusions

This systematic review of empirical research on mathematics anxiety interventions for K–12 students (2016–2025) yields three principal conclusions.

First, combined interventions that simultaneously address mathematical skill development and anxiety management are the most effective approach for reducing MA, with pooled effect sizes up to $g = -1.09$ (Liu et al., 2025)—more than twice the effect of either approach alone. This supports integrated intervention design and argues against treating skill instruction and anxiety support as separate, uncoordinated activities within schools.

Second, expressive writing remains the most immediately implementable and cost-effective classroom strategy for high-anxiety students in testing contexts, requiring only 10 minutes before an examination with no specialist training. However, the boundary conditions documented by Scheibe et al. (2025) indicate that practitioners should combine expressive writing with strategies to build students' mathematical self-concept, rather than relying on it as a universal solution.

Third, technological and gamified interventions—including adaptive learning platforms, educational games, and escape-room formats—represent the fastest-growing intervention domain and show promising early evidence for anxiety reduction, particularly in primary school contexts. However, the evidence base remains limited in depth and longitudinal scope; before large-scale implementation, more rigorous controlled trials with longer follow-up periods are needed.

Practical Recommendations

For classroom teachers, the following evidence-informed practices are recommended: (a) incorporate brief (10-minute) expressive writing sessions before high-stakes mathematics tests, particularly for students identified as high-anxious and low in mathematics self-concept; (b) adopt growth mindset feedback language consistently—praising effort, strategy, and persistence rather than innate ability (Yeager et al., 2019; Jia, 2018); (c) cultivate a classroom culture in which mathematical errors are explicitly framed as learning opportunities; and (d) use cooperative, peer-assisted learning formats to reduce the evaluative pressure of teacher-led whole-class instruction (Barbieri et al., 2021).

For school curriculum designers and administrators, the evidence supports: (a) embedding anxiety management components explicitly within mathematics curricula rather than treating them as separate "add-ons"; (b) implementing instructional frameworks such as the REACT model (Ma, 2025) that contextualize mathematical content within authentic, motivation-sustaining problem-scenarios; (c) providing peer-assisted learning opportunities for students identified as high-anxious; and (d) incorporating mathematics anxiety identification and response training within teacher professional development programs, drawing on the three-dimensional framework proposed by Liu (2025).

For school psychologists and counselors, sustained mindfulness programs (8+ weeks) may be recommended for students with diagnosed high trait MA, particularly in middle school contexts (Klatt et al., 2022). Collaboration between counselors and mathematics teachers to deliver combined skill-and-affect interventions represents best current practice (Liu et al., 2025).

Future Research Directions

The current review identifies several priority areas for future research. First, long-term follow-up studies—with assessment points at 6 months and 1 year post-intervention—are needed to determine

whether intervention effects persist or fade. The near-complete absence of long-term follow-up data in the current literature represents a critical gap.

Second, cross-cultural comparative research is needed to examine whether intervention effects documented in Western contexts replicate in Chinese and other East Asian educational settings. Liu et al.'s (2024) finding that MA–performance correlations are slightly lower in Chinese than in Western contexts hints at cultural moderators that may also influence intervention response.

Third, the potential of artificial intelligence to enable truly personalized mathematics anxiety interventions—dynamically adapting not only task difficulty but also the affective and metacognitive scaffolding provided to each student—represents a frontier of high theoretical and practical interest. The domain-specific adaptivity framework elaborated by Strohmaier et al. (in press) provides a conceptual foundation for developing such systems.

Fourth, neuroimaging research has begun to document the neural correlates of mathematics anxiety in prefrontal and limbic regions and the neural changes associated with successful interventions (Yu, 2023), holding promise for identifying biomarkers of intervention response and illuminating the mechanisms through which different intervention types produce their effects.

Finally, research should more systematically address the heterogeneity within the MA construct. Ji et al.'s (2025) finding that within-person fluctuations in MA can have facilitating effects challenges the prevailing deficit model and calls for person-centered research designs that capture the dynamic, variable nature of mathematical affect over time.

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