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From Anxiety to Well-Being: A Systematic Review on Mathematics Well-Being and Hidden Math Anxiety in Learning Contexts

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Abstract: Many students feel discomfort in mathematics caused by hidden mathematical anxiety. This emotional state is often subtle yet persistent, slowly undermining their self-confidence, perseverance, and willingness to actively participate in mathematical tasks. Although researchers' focus on the concept of mathematical well-being persists, the direct relationship between concealed mathematical anxiety and students' emotional experiences in learning remains insufficiently explored in depth. This study aims to investigate how hidden mathematical anxiety affects mathematical well-being and to identify educational and psychological practices that can enhance students' emotional experiences in mathematics lessons. A systematic review was conducted by collecting articles published between 2013 and 2025 from four databases: Springer, ERIC, Scopus, and SAGE. Of the 165 articles identified in the initial stage, 144 were re-screened against predefined inclusion criteria, and 48 were ultimately included in the final thematic synthesis. Five main themes were successfully identified and analyzed. The research findings indicate that mathematics wellbeing (MWB) has a strong reciprocal relationship with hidden math anxiety, whereby high MWB is associated with low levels of hidden anxiety and more positive engagement in learning. Intrapersonal factors such as self-efficacy, a growth mindset, and emotional regulation play a significant role in enhancing students' MWB whilst reducing anxiety. Furthermore, a supportive classroom environment and positive teacher-student relationships were found to strengthen mathematical wellbeing. Various psycho-educational interventions, including mindfulness, project-based learning, and gamification, were also effective in balancing academic challenges with emotional comfort, thereby supporting sustained improvement in MWB. Fostering mathematical well-being helps students manage hidden anxiety, strengthen emotional stability, and maintain engagement in the mathematics learning process. A mutually supportive and nurturing learning environment is the primary foundation for realizing this process.

Keywords: hidden math anxiety, learning, math anxiety, mathematics well-being, well-being.

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INTRODUCTION

Globally, studies on mathematical wellbeing and anxiety have developed extensively in Asia and Europe, with a focus on psychological analysis in Asia and pedagogical approaches in Europe (Hill et al., 2021; Zhang & Wang (2020); Sainio et al., 2023). The emotional aspects of mathematics learning are now receiving greater attention. Mathematics is no longer seen only as a discipline that requires logical abilities and problem-solving skills, but also as a human activity with elements of emotion, belief, and psychological wellbeing. Many students experience conditions such as tension, anxiety, and discomfort when interacting with mathematics, a condition known as mathematics anxiety. Some studies have even found a form of anxiety that is not immediately apparent, called hidden math anxiety.

Over the past twenty years, much of the international educational literature has focused considerable attention on the phenomenon of

maths anxiety. Various cross-cultural studies indicate that maths anxiety is not merely an individual emotional response, but a systemic phenomenon influenced by pedagogical, social, and structural factors (Dowker et al., 2016; Barroso et al., 2025; Zhang et al., 2019). Furthermore, long-term research conducted across various countries indicates that unaddressed maths anxiety from an early stage has the potential to narrow students' career choices, reduce participation in STEM fields, and undermine overall academic self-confidence (Hembree, 1990; Ma, 1999; Maloney & Beilock, 2012; Foley et al., 2017). These findings highlight the importance of a comprehensive approach that focuses not only on reducing anxiety but also on strengthening students' psychological well-being in mathematics learning

Hidden math anxiety is a condition where students appear to be performing well academically but are experiencing emotional distress (Barroso et al., 2025). This hidden anxiety often goes undetected by teachers and conventional academic evaluation systems, but it can also have a long-term impact on students' psychological well-being and achievement. Therefore, understanding and reducing hidden mathematics anxiety is important so that mathematics learning is not only cognitively effective but also emotionally healthy.

There are many strategies for reducing hidden math anxiety, including cognitive behavioral therapy, relaxation training and breathing, gamification, and mathematics wellbeing. The concept of mathematics wellbeing (MWB) to reduce hidden math anxiety enables students to maintain emotional balance, demonstrate resilience, and engage positively in mathematics learning. This concept is rooted in positive psychology theory (Seligman, 2011), which focuses on the dimensions of positive emotions, engagement, social relationships, meaning, and achievement (PERMA framework). In the context of mathematics education, mathematical wellbeing encompasses an individual's ability to feel satisfaction and find meaning during the learning process. This aspect focuses not only on academic achievement but also on creating a pleasant emotional experience with mathematics itself.

Several studies over the past five years have analyzed the implementation and adaptation of the PERMA framework in mathematics education. Research findings from this psychological approach indicate improvements in students' emotional experiences and academic engagement in mathematics. For example, Kern et al. (2015) applied the PERMA framework to measure students' academic well-being and demonstrated that engagement and achievement are among the strongest indicators of academic success. Similarly, Cavioni et al. (2020) developed a PERMA-based intervention program in elementary schools and found increased students' learning motivation and a general reduction in math anxiety. Based on the PERMA framework developed by Seligman (2011), experts are increasingly emphasizing the importance of integrating well-being principles into educational settings to foster positive emotions, engagement, meaningful relationships, and academic success (Kern et al., 2015). This line of thinking underscores the importance of fostering students' holistic development alongside academic achievement. Autonomy and self-determination play a crucial role in supporting students' adjustment and academic achievement. Although these findings are promising, existing research has primarily focused on general math anxiety, academic engagement, learning motivation, or overall student well-being. Relatively little attention has been paid to hidden math anxiety; this anxiety persists psychologically even though it is often not reflected in students' observable behavior or academic performance. Consequently, although PERMA-based approaches have demonstrated potential to improve students' emotional experiences, the specific mechanisms by which mathematical well-being alleviates hidden math anxiety remain poorly

understood. This unresolved issue highlights a significant research gap and provides a strong rationale for conducting this systematic review.

Mathematical well-being and mathematical anxiety are mutually influential. Students with high emotional wellbeing tend to demonstrate better emotional control, motivation, and self-efficacy, making them better able to cope with learning demands (Zhang & Wang (2020); Özcan & Kültür, 2021). Conversely, students with low mathematical well-being are more prone to hidden anxiety, which can reduce learning performance. In this case, personal factors such as mindset, self-efficacy, and resilience play a crucial role in strengthening mathematical well-being and reducing hidden mathematical anxiety. However, strengthening these personal factors cannot be separated from external support, such as teachers and a positive learning environment.

The role of teachers and a supportive learning environment is important in shaping students' mathematical well-being. Teachers who can create positive interpersonal relationships, provide emotional support, and build a psychologically safe classroom climate can increase student motivation and engagement while reducing anxiety levels towards mathematics (Sainio et al., 2023; Johnson & Ndirangu, 2024). In line with this, various learning approaches, such as project-based learning, gamification, and mindfulness-based learning, have also been proven effective in strengthening emotional well-being and encouraging meaningful learning experiences (Piñero Charlo et al., 2022; D'Souza & Smyth, 2025).

An analysis of the existing literature reveals several significant research gaps. Firstly, the majority of studies on mathematical well-being focus on measuring well-being in general, without distinguishing it from hidden anxiety, so the interventions designed often miss the mark (Barroso et al., 2025; Foley et al., 2017). Second, although the literature on mathematical well-being is growing, the current evidence remains scattered across various psychological and educational frameworks. Many studies examine variables such as engagement, motivation, emotional regulation, or self-efficacy in isolation, making it difficult to gain a comprehensive understanding of how these factors collectively influence students' emotional experiences in mathematics learning. (Hill et al., 2021; Kern et al., 2015)

Thirdly, systematic reviews integrating empirical evidence from various disciplines including educational psychology, cognitive neuroscience, and mathematics pedagogy are almost non-existent, despite the importance of such an interdisciplinary approach for building a holistic understanding (Maloney & Beilock, 2012). These gaps are the primary focus of this study, which uses a Systematic Literature Review (SLR) approach to address them in a structured and comprehensive manner.

Research Questions

1. How are mathematical well-being and hidden maths anxiety interrelated in a learning context?
2. Which personal factors contribute most to improving MWB and reducing hidden mathematical anxiety?
3. How does the classroom environment influence students' mathematical well-being and hidden mathematical anxiety?
4. Which interventions are effective in reducing anxiety whilst improving mathematical learning well-being?

METHOD

Research Design

This study employed a Systematic Literature Review (SLR) to examine the relationship between hidden mathematics anxiety and mathematics well-being in mathematics education. This approach was chosen as it provides a comprehensive explanation of previous research findings, whilst identifying patterns, trends, and research gaps that have not yet been extensively examined. The entire review process adheres to the PRISMA 2020 guidelines

(Preferred Reporting Items for Systematic Reviews and Meta-Analyses) developed by Page et al. (2021), which comprises four main stages: identification, screening, eligibility assessment, and article inclusion. This research was conducted between October 2025 and March 2026. The entire process of searching for, selecting, and analyzing articles was carried out online by the researcher, without being tied to any specific physical location. Access to the journal database was via the researcher's institutional network.

Search Strategy

The literature search was conducted using four international databases: Scopus, SpringerLink, ERIC, and SAGE Journals. This search covered publications released between 2013 and 2025. The search process used various combinations of keywords related to math anxiety, mathematical well-being, PERMA, optimal development, resilience, emotional regulation, engagement, and motivation to ensure a broader, more comprehensive scope. Boolean operators (AND/OR) and wildcard techniques were used to refine the search across the selected databases. The records obtained from the various searches were then combined, and duplicate articles were removed before screening. Examples of the main Boolean search strings used in this review are presented below:

1. ("math anxiety" OR "mathematics anxiety" OR "mathematical anxiety") AND (wellbeing OR "well-being" OR PERMA OR flourishing)
2. SpringerLink: ("math anxiety" OR "hidden mathematics anxiety") AND ("mathematics wellbeing" OR "mathematical well-being") AND ("emotional regulation" OR "student resilience")
3. ERIC: ("math anxiety" OR "hidden math anxiety") AND ("mathematics wellbeing") AND ("students" OR "mathematics learning")
4. SAGE Journals: ("math anxiety" OR "hidden anxiety") AND ("mathematics wellbeing" OR "well-being in mathematics education").

Inclusion and Exclusion Criteria

The population for this study comprises all scientific articles published in reputable international and national journals between 2013 and 2025 that address maths anxiety and maths well-being across all student groups, including primary school pupils, lower secondary school pupils, upper secondary school pupils, and university students. The focus of this review encompasses a broad range of students, as the phenomenon of hidden anxiety about mathematics and its relationship with mathematical well-being is relevant across all levels of education. The selection process was carried out in stages in accordance with the PRISMA 2020 guidelines.

The first stage involved screening the titles and abstracts of the 165 articles identified in the initial search, resulting in 144 relevant articles. The second stage consisted of a full-text review based on the predefined inclusion and exclusion criteria. The inclusion criteria were: (1) empirical articles or systematic reviews, (2) discussing mathematical well-being or mathematical anxiety, (3) written in English or Indonesian, and (4) published in peer-reviewed journals. The exclusion criteria were applied as follows, each forming a distinct category that is not separate from the others: (1) Non-empirical articles such as editorials, reviews, opinion pieces, or theoretical essays that have no meaningful connection to math anxiety or math well-being. However, systematic reviews and conceptual studies that make a significant theoretical contribution to the objectives of the review are still included; (2) opinion pieces or perspective articles; (3) articles with irrelevant mathematical context (i.e., not addressing mathematical anxiety or mathematical well-being); and (4) articles that are not fully accessible in full-text form.

The instrument used in this study was a data extraction form containing columns for recording the article title, author name, year of publication, country, research objective, participants, methodological approach (quantitative, qualitative, or mixed), main variables, and key

findings. Article quality assessment was conducted using an adapted version of the Critical Appraisal Skills Programme (CASP) checklist, primarily based on the qualitative checklist. Specifically, the original CASP checklist was adapted as follows: (1) simplifying certain indicators specific to qualitative research, such as those related to the researcher-participant relationship, so that it could also be applied to mixed-methods studies; (2) adding items to assess the clarity of intervention descriptions related to emotion regulation or well-being strategies; and (3) removing items irrelevant to the context of non-clinical educational research, such as those focused on the validation of clinical outcomes. These modifications were made to ensure suitability for the diverse research designs included in this review.

Research Procedure

This research procedure consisted of four stages in accordance with the PRISMA 2020 guidelines. First, the identification stage, which involved searching for articles in four databases using predetermined keywords. Second, the screening stage, which involved selecting articles based on the relevance of their titles and abstracts to the research topic, resulting in 144 articles. Third, the eligibility assessment stage, which involved reading the full text and strictly applying the inclusion and exclusion criteria. Fourth, the inclusion stage, which involved selecting the final 48 articles for analysis. Each stage was systematically documented in a PRISMA flow diagram to ensure the transparency and reproducibility of the research process.

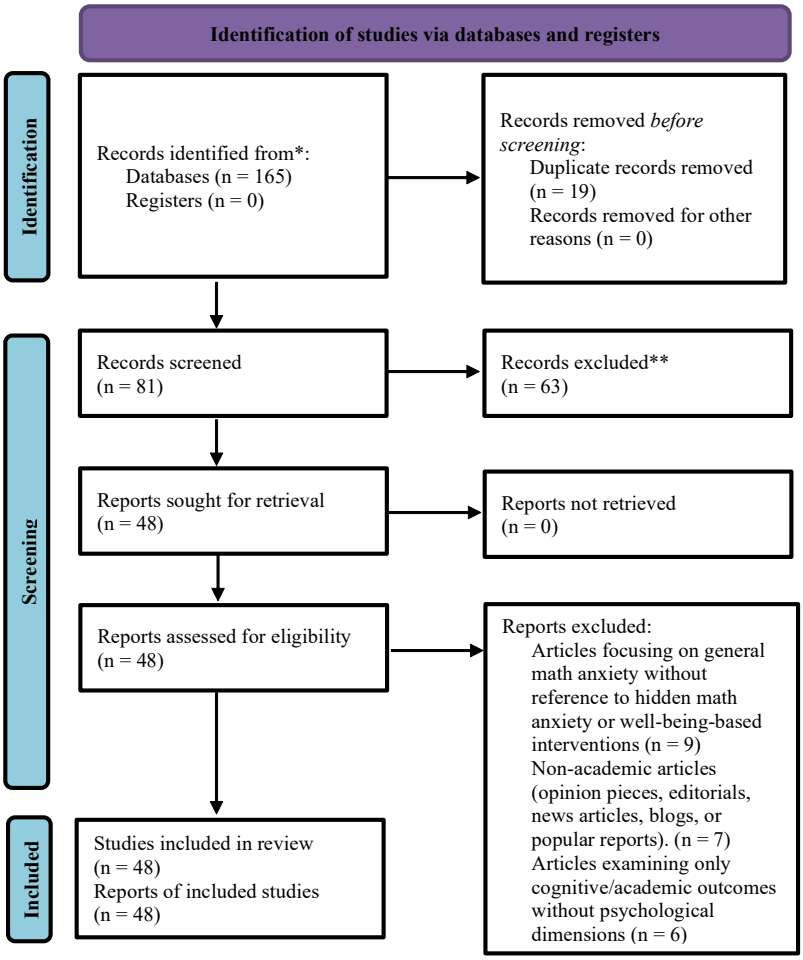

Figure 1. PRISMA flow diagram of the article selection process for a systematic literature review

Data Analysis Techniques

Data from 48 selected articles were analyzed using thematic synthesis. Each article was coded to identify recurring patterns and key themes, such as personal factors (mindset, self-efficacy, emotional regulation, resilience), social factors (teacher support, classroom climate, interpersonal relationships), and types of intervention (REBT, mindfulness, gamification, project-based learning). The coding process was carried out in three stages: free-line coding, the development of descriptive themes, and the formulation of analytical themes that addressed the research questions.

In addition, a descriptive analysis was conducted to examine publication trends by year, country, and methodological approach (quantitative, qualitative, and mixed-methods). All data were then synthesized to address the four research questions (RQ1–RQ4) and to describe the dynamics of the relationship between hidden mathematical anxiety and mathematical well-being across various contexts of mathematics learning.

RESULT AND DISCUSSION

Based on a systematic literature review of 48 articles, the relationship between mathematics well-being (MWB) and hidden mathematics anxiety is complex, dynamic, and mutually influential within the learning process. The analyzed articles demonstrate a diversity of global contexts, spanning countries across Europe, the Americas, Asia, Africa, and Australia, indicating that this issue is universal in education. Methodologically, the research is dominated by quantitative approaches, although there are also qualitative, mixed-methods, and several experimental and review studies. This indicates that this topic is examined both through the measurement of relationships between variables and through an in-depth understanding of students' learning experiences. The topics discussed in the research are quite diverse, covering the relationship between maths anxiety and cognitive and emotional factors, such as self-efficacy and emotion regulation; the role of social factors, such as teacher support and school climate; and the influence of individual characteristics, such as gender and motivation. Furthermore, several studies focus on developing interventions to reduce maths anxiety and improve student well-being. Overall, these findings indicate that research on MWB and hidden maths anxiety is expanding broadly with a strong tendency towards quantitative approaches, and involves various interacting factors within the context of learning.

Distribution of Research Methodologies

An analysis of the methodological approaches used in the 48 articles shows that quantitative research predominates, followed by qualitative research, mixed-methods research and conceptual studies. The full distribution is presented in Table 1.

Table 1. Distribution of research methodologies across the 48 selected articles

No.	Type of Method	Number of Articles	Percentage (%)	Example Studies
1	Quantitative	30	62.5	Zhang & Wang (2020); Barroso et al. (2025);
2	Qualitative	8	16.7	Skagerlund et al. (2024) Hill et al. (2021); Joshi & Mehta (2025)
3	Mixed-Methode	7	14.6	Morse (2024); Lutz et al. (2025); Touhami et al. (2025)

4	Review / Conceptual Study	3	6.2	Beaudoin et al. (2024); Ball et al. (2024); DePascale et al. (2024
Total	-	48	100	-

Table 1 indicates that the majority of studies (62.5%) are quantitative, reflecting the scientific community's efforts to objectively assess the relationship between anxiety and mathematical well-being. However, the rise in qualitative and mixed-method studies since 2021 signals a shift in mindset towards a deeper exploration of students' emotions, perceptions, and subjective experiences.

Publication trends by year

The distribution of articles by publication year shows a significant increase during the 2023–2024 period, as shown in Table 2. Although the search covered publications from 2013 to 2025, no studies published between 2013 and 2017 met the inclusion criteria required for this article.

According to Table 2, the most significant increase in publications occurred between 2023 and 2024 (56.3%), indicating growing academic interest in issues of math anxiety and well-being in the post-pandemic era. The 2021–2022 period also showed a notable increase, with the emergence of studies on MWB and self-efficacy in the context of online learning. The year 2025 brought research on new topics in the form of pedagogical innovations and more integrated social-emotional interventions.

Table 2. Publication trends of articles by year range (2018–2025, N = 48)

No.	Time Period	Number of Articles	Percentage (%)	Research Focus
1	2018 - 2020	4	8.3	Teacher and student anxiety; numeracy and risk
2	2021 - 2022	10	20.8	MWB, self-efficacy; impact of the COVID-19 pandemic
3	2023 - 2024	27	56.3	Mindfulness interventions, gamification, REBT; classroom climate
4	2025	7	14.6	PBL innovation, visualization, social-emotional interventions
Total	-	48	100	-

Geographical Distribution of Research

Geographically, research on MWB and mathematical anxiety is spread across various regions of the world. Table 3 presents the distribution of articles based on the region/country of origin of the research.

Table 3 shows that research from Europe (33.3%) and Asia (31.3%) dominates, together accounting for around 65% of the total articles.

Table 3. Geographical distribution of articles by region/country (N = 48)

No.	Region/Country	Number of Articles	Percentage (%)	General Focus
1	Europe (Finland, Spain, Italy, Greece, United Kingdom)	16	33.3	Anxiety, cognitive function, & the role of teachers
2	Asia (China, Japan, Iran, Turkey, India, Vietnam, Malaysia)	11	22.9	Mindset, self-efficacy, & emotional regulation

3	Americas (US, Canada)	14	29.1	MWB, PBL, growth mindset, online interventions
4	Africa (Nigeria, Kenya, South Africa, Algeria) 2025	4	8.33	REBT interventions, mindfulness, & teacher wellbeing
5	Australia/Oceania	3	6.25	FQA approach & conceptual MWB

Asian research tends to focus on psychological analyses such as self-efficacy, mindset, and emotional regulation, whilst European research places greater emphasis on cognitive aspects and the pedagogical role of teachers. Africa and the Americas stand out in studies of social-emotional interventions, whilst Australia remains limited in scale but offers important ideas and insights through the MWB framework.

Figure 2 provides an overview of the geographical distribution of the reviewed articles by region. The regions with the highest research

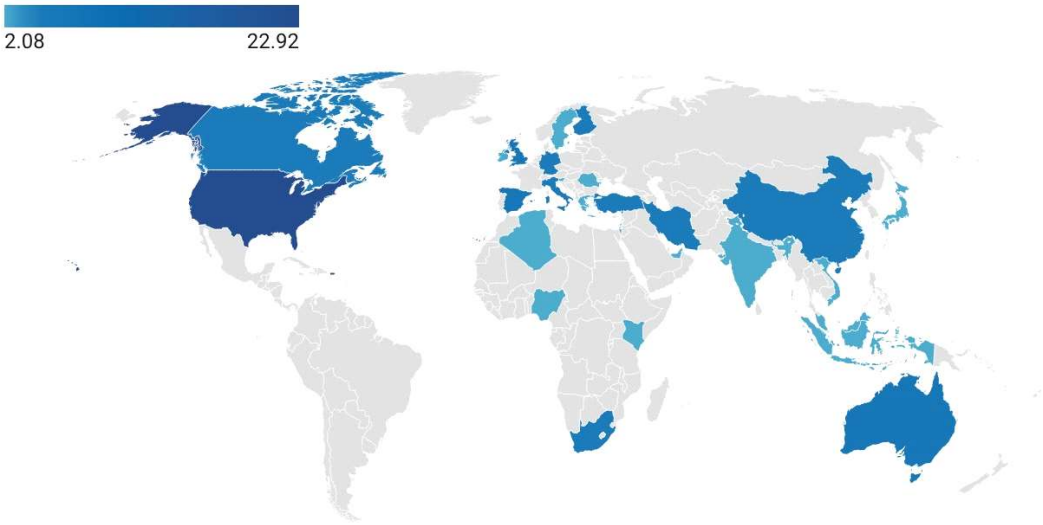

Figure 2. Global distribution map by region

contributions are highlighted in darker shades. Europe and Asia appear to dominate the literature on mathematics anxiety and mathematical well-being, while Africa, the Americas, and Australia show more limited contributions. This visualization supports the findings in Table 3 and helps clarify the comparison of research distribution across regions.

Results of The Thematic Synthesis

The thematic synthesis of 48 articles yielded five main themes aligned with the four research questions (RQ1–RQ4). A summary of the themes, subthemes, number of articles, and representative studies is presented in Table 4. The process of grouping articles into themes in this review uses a non-exclusive (overlapping) approach; articles that address several of the same dimensions may be grouped into more than one theme. Consequently, the total number of articles across all themes exceeds 48, and the percentages of these articles do not sum to 100%. The figures in the table represent the relative thematic frequency relative to the total corpus (N = 48) and should not be interpreted as mutually exclusive proportions.

Table 4. Summary of themes from the thematic synthesis (non-exclusive coding N= 48)

No.	Main Theme	Subtheme / code	No. of Articles (%)	Representative Studies
1	Mathematical Anxiety & Emotional Regulation	Hidden anxiety, emotional regulation, working memory, negative interpretation	14 (29.16%)	Barroso et al. (2025); Ramirez et al. (2018); Skagerlund et al. (2024)
2	Mathematical Well-being (MWB)	Dimensions of MWB, positive emotions, engagement, meaning, relationships, achievement	10 (20.8%)	Hill et al. (2021); Marquez et al. (2024); Zhang & Wang (2020)
3	Americas (US, Canada)	Self-efficacy, growth mindset, resilience, motivation	11 (22.9%)	Ozcan & Kultur (2021); McCaughey et al. (2022); Lv et al. (2021)
4	Personal Factors (Mindset, Self-Efficacy, Resilience)	Teacher proximity, classroom climate, teacher EQ, social belonging	8 (16.7%)	Sainio et al. (2023); Johnson & Ndirangu (2024); Ramirez et al. (2018)
5	Educational Environment & Social Support	REBT, mindfulness, gamification, PBL, visualization, FQA	5 (10.4%)	Egara & Mosimege (2025); D'Souza and Smyth (2025); Piñero Charlo et al. (2022)

This thematic synthesis indicates that the reviewed studies address the interrelated psychological, emotional, and educational dimensions of mathematics learning. To clarify the analysis, the themes are presented separately; however, the findings reveal significant overlap among the identified categories. Specifically, math anxiety often co-occurs with personal factors such as self-efficacy, resilience, motivation, and a growth mindset. At the same time, students' emotional regulation and mathematical well-being are frequently linked to educational support and psycho-educational interventions. The overlap was particularly evident between the themes of Personal Factors and Educational Environment & Social Support, with several studies discussing how supportive classroom contexts foster students' self-efficacy, resilience, growth mindset, and motivation. This finding highlights the interconnected nature of individual and contextual factors in shaping students' experiences of learning mathematics.

To further illustrate these reciprocal relationships, a conceptual thematic framework was developed based on recurring patterns identified across the reviewed studies. This framework provides a visual understanding of how personal factors, the educational environment, psychoeducational interventions, and emotional regulation interact to shape mathematical anxiety and mathematical well-being.

As illustrated in Figure 3, the identified themes are conceptually interconnected rather than operating in isolation. Personal factors emerge as key components linking educational

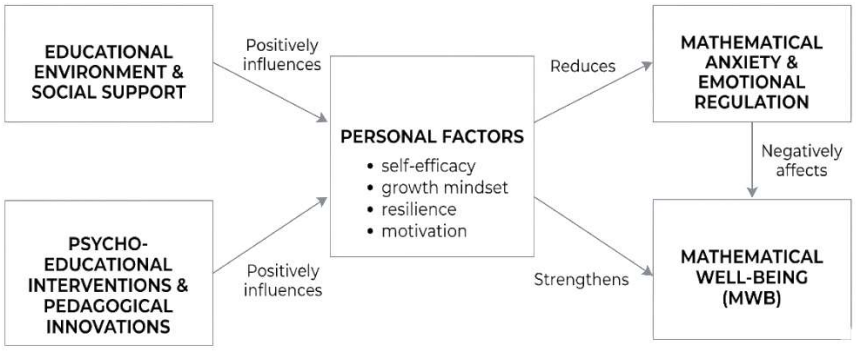

Figure 3. Thematic framework of mathematics learning variables

experiences to students' emotional outcomes in mathematics learning. A supportive educational environment and psychoeducational interventions are consistently associated with lower levels of math anxiety and improved mathematical well-being.

To provide a deeper understanding of these findings, the following sections discuss the results in relation to the research questions guiding this systematic review.

RQ1: The relationship between mathematical well-being and hidden mathematical anxiety

Based on Table 4, the themes of mathematical anxiety and emotional regulation were the most dominant (29.2%), reflecting their prominence in the literature. The findings revealed a strong reciprocal pattern between MWB and hidden mathematical anxiety: students with high MWB generally exhibited lower levels of hidden anxiety and were able to maintain positive engagement in the mathematics learning process. Research by Hill et al. (2021) and Barroso et al. (2025) confirms that stable emotional well-being helps students develop a positive view of mathematics, reduces fear of failure, and fosters a sense of academic competence. Conversely, students experiencing psychological pressure without adequate emotional support tend to internalize anxiety, which subsequently hinders cognitive flexibility and exacerbates the learning experience. Thus, improved MWB serves as a bridge facilitating the transition from emotional distress to a more adaptive and meaningful learning environment. The nature of the relationship between MWB and implicit math anxiety varies across the reviewed studies. A statistically significant inverse correlation was reported in most quantitative studies, indicating that higher MWB scores are consistently associated with lower levels of implicit anxiety. Some longitudinal and quasi-experimental studies (e.g., Ramirez et al., 2018) demonstrate a directional effect: improvements in MWB precede and predict reductions in anxiety over time, suggesting a potential causal relationship. Furthermore, several mediation analyses (e.g., Zhang & Wang, 2020) indicate that this relationship is partially mediated by variables such as self-efficacy and emotion regulation strategies, suggesting a mediated causal structure rather than a direct one. Overall, the relationship between MWB and hidden math anxiety is best described as a bidirectional correlation with a mediated causal pathway.

RQ2: Personal factors contributing to improved MWB and reduced anxiety

The theme of personal factors accounted for 22.9% of the total articles (Table 4), making it the second largest theme after anxiety and emotional regulation. Personal factors were found to contribute significantly to the balance between

MWB and hidden maths anxiety. Three personal clusters were most consistently identified in this review: (a) beliefs and motivation, encompassing self-efficacy and a growth mindset; (b) emotional regulation, namely strategies for managing arousal and cognitive reinterpretation; and (c) individual characteristics, including anxiety sensitivity, neurodivergent profiles, and gender. Studies by Ozcan & Kultur (2021), McCaughey et al. (2022), and Zhang & Wang (2020) indicate that self-efficacy, growth mindset, emotional regulation, and resilience are the primary determinants of students' emotional well-being. Students with high self-efficacy are better able to manage fear and academic pressure because they believe that their mathematical abilities can be developed through effort. Conversely, students with a fixed mindset tend to view mistakes as failures rather than learning opportunities, thereby triggering hidden anxiety that is difficult to detect

RQ3: The role of the classroom and institutional environment on MWB and anxiety

With a contribution of 16.7% (Table 4), the theme of the educational environment and social support reinforces the idea that the classroom psychological climate is a key determinant of MWB whilst also mitigating hidden anxiety. Teachers play a dual role: as a source of emotion (teacher anxiety that can be transmitted to students) and as architects of the learning climate (through closeness, empathy, and clear assessment structures). Research by Sainio et al. (2023) and Johnson & Ndirangu (2024) indicates that teachers capable of creating a safe, supportive learning environment that values students' thought processes have been shown to reduce emotional tension and enhance active participation. Research by Marquez et al. (2024) confirms that a positive classroom climate fosters emotional engagement, whilst warm interpersonal relationships between teachers and students strengthen students' sense of competence in mathematics. In this context, mathematical well-being is not merely the result of individual circumstances, but also the fruit of healthy social interactions within the learning environment. To complement this narrative synthesis, a keyword co-occurrence analysis was conducted in VOSviewer using the titles and abstracts of the 48 studies included in this review. The resulting network visualization provides an overview of the conceptual relationships among the dominant constructs discussed in the literature.

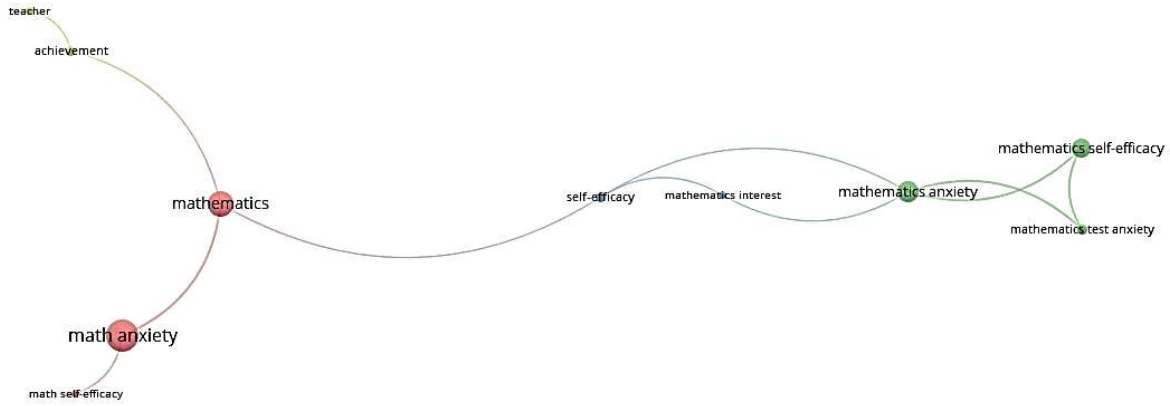

Figure 4. Keyword co-occurrence network of major constructs related to mathematical well-being

As illustrated in Figure 4, teacher-related factors are conceptually connected with mathematics achievement, which is further associated with psychological constructs such as self-efficacy and mathematics anxiety. The network also highlights the close relationship

between mathematics anxiety and students' perceptions of mathematical competence, suggesting that classroom experiences influence not only academic outcomes but also students' emotional and motivational development. This visualization further supports the role of the classroom environment in shaping mathematical well-being.

RQ4: The effectiveness of interventions in reducing anxiety and improving MWB

Although the themes of psycho-educational interventions and pedagogical innovations represented the smallest proportion of articles (10.4%), the quality and diversity of the approaches identified were highly significant. A variety of psychological and pedagogical interventions proved effective in reducing hidden maths anxiety and improving MWB. A comparative analysis of the identified interventions revealed varying patterns of effectiveness across student profiles and educational contexts. Mindfulness-based interventions (D'Souza & Smyth, 2025) demonstrated the strongest short-term effects in reducing excessive anxiety responses, particularly among high school students in high-stakes exam contexts; however, the sustained impact of these interventions on long-term mental well-being (MWB) is less consistently demonstrated, indicating that they function primarily as tools for regulating excessive emotions. Project-Based Learning (PBL) approaches (Lutz et al., 2025) demonstrate strong effects in fostering intrinsic motivation and a positive mathematical identity, with the greatest benefits observed in elementary and middle school populations where collaborative task designs can be effectively implemented. That said, implementing PBL in mathematics classrooms may require thorough pedagogical preparation by teachers, particularly when designing collaborative and authentic mathematics tasks. As reflected in the reviewed literature, practical considerations such as curriculum requirements, limited class time, and the assessment of open-ended activities must be taken into account when implementing this approach. Gamification strategies (Pinero Charlo et al., 2022) yield the highest levels of engagement among young learners and students with low initial motivation. However, their effectiveness diminishes progressively among older students or in college settings, highlighting developmental limitations of this approach. Rational Emotive Behavior Therapy (REBT) (Egara & Mosimege, 2025) has shown significant effects in the African educational context, where cognitive-behavioral reinterpretation of attributions for mathematical failure aligns with students' cultural meaning-making. In this context, REBT encourages students to reinterpret mathematical failure as a temporary and manageable learning experience rather than as evidence of fixed personal inability. This cognitive reframing may help reduce self-blame and foster more adaptive emotional responses toward mathematics learning. An imagery-based approach (Vargas et al., 2025) proved most effective for students with strong spatial reasoning abilities as well as those studying a curriculum heavy in statistics. Overall, no single intervention proved universally superior across all contexts. Instead, the effectiveness of interventions is influenced by students' age, cultural background, prior anxiety levels, and the specific dimensions of MWB targeted. These findings highlight the importance of context-sensitive intervention design and call for future comparative trials to establish a clearer hierarchy of evidence.

Implications

Overall, the findings of this study confirm that the journey from anxiety to well-being in the context of mathematics learning occurs when personal factors, social support and pedagogical strategies interact harmoniously. MWB not only

mitigates latent anxiety, but also fosters students' emotional engagement, intrinsic motivation and academic resilience. The rapidly increasing research trend since 2021 (Table 3) reflects a paradigm shift from a deficit approach (addressing anxiety) towards a promotive approach (building mathematical wellbeing). Therefore, mathematics education oriented towards wellbeing needs to prioritize a balance between the cognitive and affective domains, so that mathematics is no longer perceived as a source of anxiety, but rather as a space for the growth of curiosity, self-confidence, and students' psychological wellbeing. In practice, teachers are encouraged to integrate emotionally supportive teaching strategies, such as probing questions, collaborative problem-solving, and formative feedback that emphasizes effort rather than performance comparisons. School psychologists can design emotion regulation training and screening programs to identify hidden math anxiety at an early stage. Curriculum developers should integrate well-being-oriented math activities, including contextual tasks, collaborative learning, and the reinforcement of a growth mindset, to ensure that cognitive achievement and emotional well-being are developed simultaneously in classroom learning practices.

■ CONCLUSION

This systematic review indicates that the transition from math anxiety to math well-being is not an instantaneous process but rather the result of continuous, sustained interactions among personal, social, and pedagogical factors. Students who possess the ability to regulate their emotions, self-assurance, resilience, and stronger motivation tend to demonstrate higher levels of mathematical well-being, enabling them to face mathematical challenges with greater self-confidence and a positive orientation toward learning. Mathematical well-being helps protect students psychologically against hidden math anxiety, which is often not readily apparent in their academic behavior. Personal foundations, such as a growth mindset, empower students to view mistakes as a natural part of the learning process rather than as a threat to their knowledge and achievements. However, this inner strength reaches its full potential only when reinforced by an emotionally nurturing classroom environment and teachers prepared to facilitate students' psychological growth. Positive teacher-student relationships and social support from peers significantly create the psychological space in which mathematical well-being can truly flourish. Therefore, these findings underscore the importance of integrating mathematical well-being into mathematics education through humanistic and sustainable approaches, including reflective learning, project-based learning, and gamification, all of which can balance the cognitive, emotional, and social dimensions of the learning process. Contemporary mathematics education must evolve from a learning space filled with anxiety to one that actively fosters self-confidence, positive emotions, and a deep understanding of the meaning of the mathematics learning experience.

The findings of this review have interrelated implications for both educational policy and pedagogical practice. Educators and curriculum designers are strongly encouraged to integrate social-emotional learning components into mathematics instruction, to ensure that emotional well-being is developed alongside cognitive achievement, rather than being treated as a secondary concern. Teacher professional development programs must go beyond subject-matter expertise to include emotional competencies, thereby enabling teachers to serve as role models and nurturers, and to uphold mathematical well-being in their classrooms. At the institutional level, school policies must prioritize creating psychologically safe learning environments where students feel fully supported

in taking academic risks without fear of failure or judgment from peers or teachers. Despite these contributions, this review is not without limitations. The selection of databases was limited to specific academic repositories, and the restriction to English-language publications may have excluded studies from other regions and linguistic traditions, thereby introducing linguistic and geographical biases. Furthermore, the specific keywords and inclusion criteria used in the search process may not have captured the full relevant literature, potentially limiting the comprehensiveness and diversity of the findings. Differences in how mathematical well-being is operationally defined across the included studies also pose challenges for direct comparisons and the broader dissemination of results. In addition, the studies included in this analysis employed various approaches to assess latent mathematical anxiety, with most relying primarily on self-report instruments and students' subjective emotional experiences. Although these instruments provide valuable insights and information regarding students' inner states, they may not fully capture the less visible dimensions of anxiety, which persist even when academic performance is adequate. Therefore, findings related to hidden anxiety toward mathematics must be interpreted within the methodological limitations of the existing evidence, and future research is encouraged to incorporate complementary behavioral or observational indicators. Given these limitations, future research is advised to expand the search for databases by including a broader range of international and multilingual sources, develop more standardized and culturally inclusive instruments for measuring mathematical well-being, particularly by considering sociocultural dimensions, such as collective orientations toward learning and collaborative mathematical engagement, which may shape students' experiences of mathematical well-being, and conduct longitudinal empirical studies examining the ongoing relationship between math anxiety, teacher well-being, and students' mathematical well-being across various educational contexts and cultural backgrounds.

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