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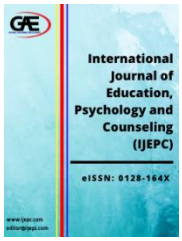

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MAPPING THE RESEARCH LANDSCAPE OF MINDFULNESS INTERVENTION AND MATHEMATICS ANXIETY: A BIBLIOMETRIC ANALYSIS

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Abstract:

The growing recognition of affective factors in mathematics learning has positioned mindfulness interventions as a promising approach to mitigating mathematics anxiety and enhancing academic performance. Despite increasing scholarly attention, the research landscape remains fragmented, with limited synthesis of publication trends, influential works, thematic developments, as well as global collaboration patterns. Accordingly, this investigation seeks to delineate the intellectual configuration and developmental trajectory of scholarship concerning mindfulness-based interventions and mathematics anxiety through a rigorous bibliometric examination. The dataset was extracted from the Scopus database via advanced search protocols anchored on the principal terms “mindfulness intervention” and “mathematics anxiety,” producing a final corpus of 230 scholarly works covering the period from 1980 through May 2026. The analytical procedure incorporated Scopus Analyzer for initial metric assessment, OpenRefine for systematic data refinement and normalization, and VOSviewer for bibliometric network mapping, encompassing co-authorship structures, co-citation linkages, and keyword co-occurrence patterns. The results demonstrate a pronounced escalation in publication productivity, especially post-2017, reaching its highest levels in recent years, indicating growing academic interest driven by the integration of psychological well-being in education. Highly cited articles are predominantly grounded in cognitive and educational psychology,

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emphasizing constructs such as working memory, attention, and emotion regulation. Keyword co-occurrence analysis identifies "anxiety," "mathematics learning," and "mathematics education" as dominant themes, alongside emerging areas such as mindfulness, self-regulated learning, and executive function. Country-level collaboration networks highlight the dominance of the United Kingdom, the United States, as well as Canada, while other regions exhibit comparatively limited international integration. Overall, the study delivers a structured and comprehensive survey of the field, demonstrating its transition from a niche research area to an expanding interdisciplinary domain. The findings contribute meaningful perspectives for educators, researchers, alongside policymakers by highlighting research gaps, key trends, as well as opportunities for future investigation in mindfulness-based approaches to reducing mathematics anxiety.

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Keyword:

Mathematic Anxiety, Mindfulness Intervention

Introduction

Mathematics anxiety is a pervasive phenomenon affecting learners across age groups and educational contexts. It manifests not only as emotional distress but also as avoidance behaviors that undermine mathematical learning and limit participation in STEM fields (Annisa et al., 2024; Brewster & Miller, 2023; Victor-Aigbodion, 2023). The negative impact of math anxiety extends beyond academic performance; it can shape self-concept, career aspirations, and lifelong attitudes toward quantitative reasoning (Ramirez et al., 2018). In light of these difficulties, educators alongside researchers have sought interventions that address both cognitive barriers and emotional regulation. Among these strategies, mindfulness-based interventions (MBIs) have gained prominence due to their capacity to enhance attention control, reduce stress responses, and foster resilience in academic settings (Bautista, 2023; Bellinger et al., 2015; Duraku et al., 2023).

Mindfulness practices, ranging from structured programs like MBSR/MBCT to brief classroom exercises, have been adapted for use with students experiencing mathematics anxiety. Empirical studies report reductions in math-specific anxiety symptoms following MBIs across primary school children (Peter & Henderson, 2019), adolescents (Nzeadibe et al., 2023), college students (Samuel et al., 2022), and even within digital learning environments (Hladký et al., 2025). These interventions often yield secondary benefits such as improved self-efficacy and test performance under pressure (Bellinger et al., 2015; Zuo & Wang, 2023). However, the literature also reveals complexities: not all studies find significant effects on performance outcomes; intervention fidelity varies; and questions remain about optimal dosage and delivery formats (Bautista, 2023; Chancey et al., 2023).

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Recent meta-analyses confirm moderate effect sizes for MBIs in reducing both general test anxiety and math-specific distress but call for more robust experimental designs to disentangle active ingredients from placebo effects or general classroom support (Fulambarkar et al., 2022; Sammallahti et al., 2023). Interdisciplinary research has also explored neurobiological mechanisms underlying mindfulness's impact on emotion regulation relevant to math learning contexts Calderone et al., 2024). As digital tools proliferate in education, new modalities for delivering MBIs, such as interactive tutors or game-based platforms, are being tested for scalability and accessibility (Bereczki et al., 2024; Hladký et al., 2025).

Despite advances in understanding the promise of mindfulness for mitigating mathematics anxiety, critical gaps persist regarding long-term efficacy across diverse populations. This review synthesizes foundational theories of math anxiety, maps the diversity of mindfulness-based approaches, evaluates empirical evidence, discusses methodological limitations, and identifies emerging trends shaping future research.

Research Question

1. What are the longitudinal trends in the volume of scholarly publications on mindfulness interventions and mathematics anxiety from 1980 to May 2026?
2. Which publications on mindfulness interventions and mathematics anxiety are the most influential, as indicated by citation impact?
3. What are the dominant and emerging research themes in mindfulness interventions and mathematics anxiety, as identified through keyword co-occurrence analysis??
4. How are international research collaborations structured in the field of mindfulness-based interventions and mathematics anxiety, as revealed by country-level co-authorship networks?

Methodology

Bibliometric analysis refers to a structured procedure for the retrieval, organization, and assessment of bibliographic information extracted from academic literature (Alves et al., 2021; Assyakur & Rosa, 2022; Verbeek et al., 2002). In addition to standard descriptive metrics such as publication venues, chronological distribution, and prominent contributors (Wu & Wu, 2017), bibliometric methodologies extend to more sophisticated analytical procedures, including document co-citation analysis, which is employed to reveal the underlying intellectual architecture of a specific research field. A thorough literature review demands a cyclical and well-organized workflow that involves the careful development of targeted keywords, exhaustive exploration of relevant databases, and detailed evaluative examination of the retrieved studies. This systematic methodology supports the establishment of a solid bibliographic base while simultaneously reinforcing the dependability and validity of research findings. In doing so, it strengthens the formation of a comprehensive bibliography and enhances the overall reliability of the resulting conclusions (Fahimnia et al., 2015).

In this investigation, priority was assigned to publications of high impact due to their essential influence in constructing the theoretical foundation of the discipline. To guarantee precision and uniformity in the dataset, the Scopus database served as the principal mechanism for data extraction (Al-Khoury et al., 2022; di Stefano et al., 2010; Khiste & Paithankar, 2017). Furthermore, to uphold academic rigor, inclusion was restricted solely to peer-reviewed journal articles, whereas non-indexed materials such as books and lecture notes were deliberately

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excluded (Gu et al., 2019). Leveraging the comprehensive scope provided by Elsevier's Scopus repository, pertinent scholarly works published between 1980 and May 2026 were systematically gathered for further examination.

Data Search Strategy

The bibliometric data employed in this study were obtained in a systematic manner from Scopus using a structured and replicable search strategy. The query was executed within the TITLE-ABS-KEY field to ensure that the selected publications explicitly addressed the core constructs of mathematics, anxiety-related factors (e.g., stress, worry, nervousness), educational contexts, and mindfulness-related concepts (e.g., meditation, awareness, attention). Boolean operators (AND, OR) and truncation techniques (e.g., "math*") were strategically applied to enhance both the breadth and precision of the search. To ensure disciplinary relevance and interdisciplinary coverage, the results were restricted to the subject categories of Psychology (PSYC), Social Sciences (SOCI), as well as Mathematics (MATH), which collectively reflect the theoretical and applied dimensions of the research domain. Furthermore, inclusion criteria were limited to peer-reviewed journal articles (document type: "ar") written in English to maintain academic quality, consistency, and comparability across studies. This comprehensive search process yielded a total of 230 publications.

Following data retrieval, a rigorous screening procedure was carried out in accordance with the inclusion and exclusion criteria specified in Table 2. The inclusion criteria specified that all selected studies must be published in English, fall within the domains of Computer Science, Psychology, and Mathematics, and be published within the extended timeline of 1980 to 2026. The inclusion of this broad temporal range allows the dataset to capture both seminal foundational studies and contemporary developments, thereby providing a longitudinal perspective on the evolution of research in mathematics anxiety and mindfulness. Studies published prior to 1980 were excluded to avoid limited or less relevant early contributions, while publications not written in English were also excluded to preserve uniformity in interpretation as well as analytical processing. In addition, works falling beyond the specified subject domains were excluded to maintain thematic focus and analytical coherence. This multi-stage screening process enhances the robustness, validity, and reliability of the final dataset, ensuring that the selected 230 articles provide a comprehensive foundation for subsequent bibliometric analysis.

Table 1: The Search String

Scopus	TITLE-ABS-KEY (("mathematics" OR "math*") AND ("anxiety" OR "stress" OR "worry" OR "nervousness") AND ("education" OR "learning" OR "teaching" OR "instruction") AND ("mindfulness" OR "meditation" OR "awareness" OR "attention")) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))

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Table 2: The Selection Criterion is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Subject	Computer Science, Psychology and Mathematics	Others
Timeline	1980 – 2026	<1980

Data Analysis

VOSviewer is a broadly acknowledged and highly user-friendly bibliometric analysis program created by Nees Jan van Eck and Ludo Waltman at Leiden University. It is purpose-built to enable the visual representation and structured examination of scientific literature using sophisticated mapping methodologies. The application delivers comprehensive features for generating network-based visualizations, conducting clustering of interconnected elements, and producing density-based mapping representations. Its methodological versatility supports the investigation of a wide range of bibliometric linkages, such as co-authorship structures, co-citation relationships, and keyword co-occurrence patterns, thereby allowing a deeper interpretation of scholarly frameworks and intellectual domains. Equipped with an intuitive and interactive user environment, together with ongoing methodological refinements, VOSviewer facilitates the smooth processing and responsive exploration of extensive bibliometric datasets. In addition, its functionality for deriving bibliometric metrics, tailoring visualization configurations, and combining data from multiple sources strengthens its role as a sophisticated instrument for academic research analysis.

A key advantage of VOSviewer is its capacity to convert intricate bibliometric datasets into maps that are both visually accessible and analytically informative. The software is especially proficient in conducting network-oriented analyses, such as detecting patterns of keyword co-occurrence, grouping interconnected research topics into clusters, and producing density-based visual representations. Its intuitive interface supports users at varying levels of expertise, allowing seamless exploration and interpretation of shifting research trajectories. Ongoing development of the tool further sustains its position at the leading edge of bibliometric visualization, providing flexible analytical functions applicable to diverse forms of data, including citation networks, authorship structures, and collaboration linkages.

In the present investigation, bibliographic records encompassing publication year, article titles, author details, source journals, citation metrics, and keyword sets were extracted in PlainText format from Scopus, spanning the timeframe from 1980 through May 2026. The compiled dataset was then processed and examined using VOSviewer (version 1.6.20). By implementing VOS mapping alongside clustering methodologies, the software facilitated the generation and in-depth exploration of bibliometric network structures. In contrast to conventional Multidimensional Scaling (MDS), VOSviewer adopts a distinct mapping framework that arranges items within a reduced-dimensional space in such a way that the inter-item distances correspond to their level of relatedness. While this approach shares a conceptual foundation with MDS, the VOS methodology integrates specialized normalization mechanisms tailored for co-occurrence datasets. This is primarily achieved through the application of association strength ($AS_{(ij)}$), which improves the precision as well as the interpretative clarity of relational patterns within bibliometric network analyses.

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$$AS_{ij} = \frac{C_{ij}}{W_i W_j}$$

which expresses a quantity defined as the "proportional relationship between, on one side, the empirically observed frequency of joint occurrences between items i and j, and on the other side, the frequency of such co-occurrences that would be anticipated if i and j were assumed to occur independently in a statistical sense" (Van Eck & Waltman, 2007).

Result and Discussion

There are 4 research questions being discussed in this section.

RQ1: What Are the Longitudinal Trends in The Volume of Scholarly Publications on Mindfulness Interventions and Mathematics Anxiety From 1980 To May 2026?

The longitudinal distribution of publications from 1980 to 2026 reveals a markedly uneven yet progressively intensifying research trajectory. The early phase (1980–2009) is characterized by irregular and relatively limited academic production, with annual output typically ranging from one to three publications and percentages consistently below 2.6%. This pattern suggests that the research domain was in a nascent or exploratory stage, likely constrained by limited theoretical grounding, low academic visibility, and the absence of established interdisciplinary linkages. The modest increase observed between 2010 and 2016 (rising to 9 publications in 2016) indicates the beginning of conceptual consolidation, possibly driven by emerging theoretical frameworks and increased recognition of the topic's relevance within educational and psychological research. However, fluctuations during this period imply that the field had not yet reached maturity or sustained scholarly momentum.

A significant and sustained growth phase is evident from 2017 onwards, culminating in a pronounced surge between 2020 and 2025. The peak in 2025 (31 publications; 13.5%) represents the highest recorded output, followed by consistently high contributions in 2024 (22; 9.6%) and 2023 (16; 7.0%), indicating a robust expansion of scholarly interest. This acceleration can be linked to a set of interconnected influences, including a growing international focus on student well-being and mental health, the incorporation of mindfulness practices into educational contexts, and heightened attention to affective variables such as mathematics anxiety in improving academic performance. Additionally, the post-2020 rise may reflect the broader ramifications of the COVID-19 pandemic, which intensified research on psychological resilience and alternative pedagogical strategies. The slight decline in 2026 (12; 5.2%) is likely due to incomplete indexing instead of an actual downturn in research output. Taken together, these patterns demonstrate a clear transition from an underexplored domain to a rapidly expanding and contemporary research frontier with strong interdisciplinary relevance.

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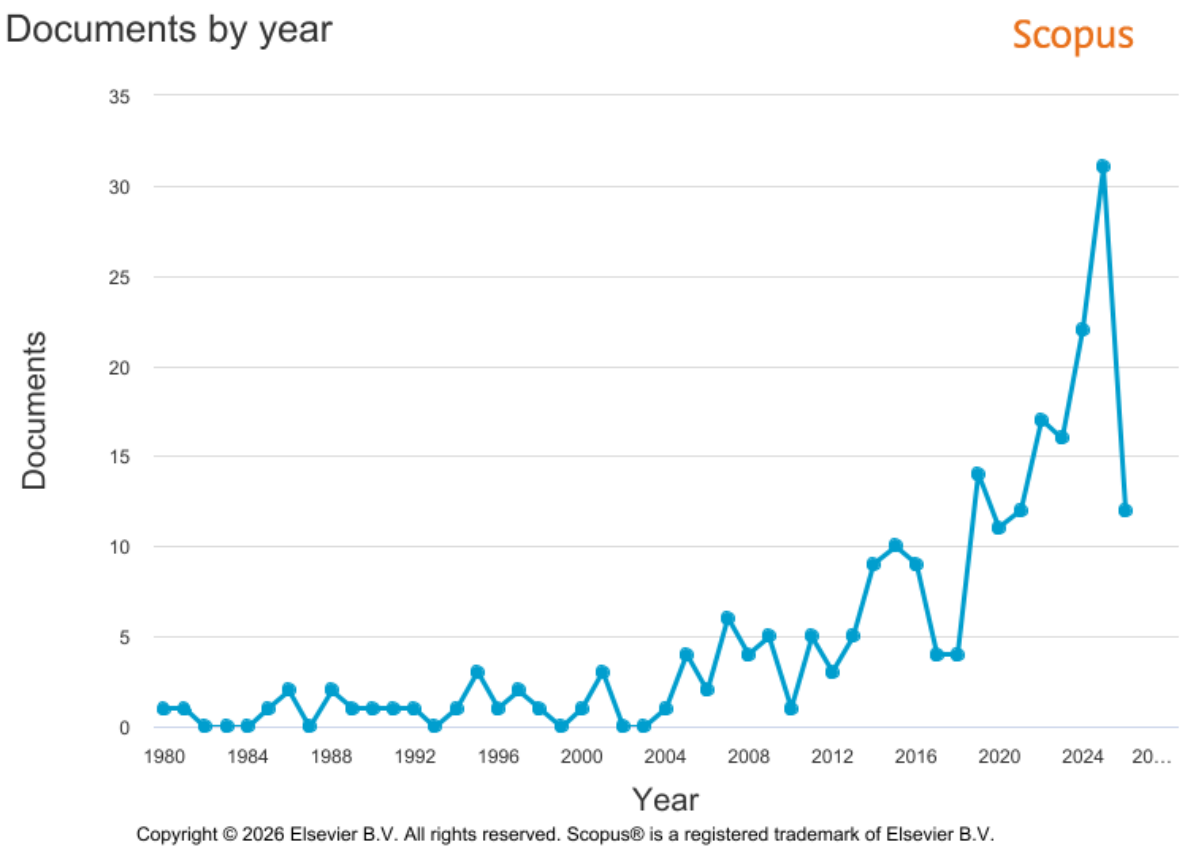

Figure 1: Trend Of Research in Augmented Reality by Years

Table 3: Number of Publications

Year	Number of Publications	Percentage
2026	12	5.2
2025	31	13.5
2024	22	9.6
2023	16	7.0
2022	17	7.4
2021	12	5.2
2020	11	4.8
2019	14	6.1
2018	4	1.7
2017	4	1.7
2016	9	3.9
2015	10	4.3
2014	9	3.9
2013	5	2.2
2012	3	1.3
2011	5	2.2
2010	1	0.4
2009	5	2.2

2008	4	1.7
2007	6	2.6
2006	2	0.9
2005	4	1.7
2004	1	0.4
2001	3	1.3
2000	1	0.4
1998	1	0.4
1997	2	0.9
1996	1	0.4
1995	3	1.3
1994	1	0.4
1992	1	0.4
1991	1	0.4
1990	1	0.4
1989	1	0.4
1988	2	0.9
1986	2	0.9
1985	1	0.4
1981	1	0.4

RQ2: Which Publications on Mindfulness Interventions and Mathematics Anxiety Are the Most Influential, As Indicated by Citation Impact?

Table 4 displays the ten publications with the highest citation counts, revealing a strong dominance of foundational and theory-driven studies that have significantly shaped the intellectual structure of the field. The most highly cited work by Colin MacLeod and Andrew Mathews (1988), with 623 citations, underscores the centrality of cognitive theories of anxiety, particularly attentional bias toward threat, as a theoretical backbone for subsequent research. Similarly, highly cited contributions such as Sian Beilock and Thomas Carr (2005) and Gerardo Ramirez et al. (2018) highlight the critical role of working memory and cognitive interference in explaining mathematics anxiety. The emphasis placed on these studies indicates that the discipline is firmly grounded in cognitive and psychological frameworks, where anxiety is conceptualized not simply as an affective condition but as a process that actively disrupts cognitive functioning and undermines performance outcomes. This explains their high citation impact, as they provide transferable theoretical models applicable across multiple domains, including education, psychology, and neuroscience.

In addition, Table 4 reflects a growing emphasis on intervention-based and educational research, particularly studies integrating mindfulness and socio-emotional learning. The highly cited randomized controlled trial by Kimberly Schonert-Reichl et al. (2015), which has accumulated 606 citations, illustrates the substantial impact of empirically validated school-based mindfulness interventions, reinforcing the increasing relevance of applied research in authentic educational contexts. In addition, the presence of studies on executive functions, ADHD, and academic achievement indicates the interdisciplinary expansion of the field, linking mathematics anxiety to broader constructs such as self-regulation and cognitive development. Earlier works on mathematical discourse and classroom interaction (e.g., Paul Cobb, 1997) further highlight the pedagogical dimension, suggesting that social and

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instructional contexts also contribute to learning outcomes. Collectively, the citation patterns in Table 4 suggest that highly influential studies are those that either (i) establish robust theoretical frameworks or (ii) offer empirically validated interventions with wide applicability, thereby justifying their sustained scholarly impact across disciplines.

Table 4: Most Cited Author

No	Authors	Title	Year	Source title	Cited by
1	MacLeod & Mathews (1988)	Anxiety and the Allocation of Attention to Threat	1988	The Quarterly Journal of Experimental Psychology Section A	623
2	Schonert-Reichl et al. (2015)	Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: A randomized controlled trial	2015	Developmental Psychology	606
3	Beilock & Carr (2005)	When high-powered people fail: Working memory and "Choking under pressure" in math	2005	Psychological Science	497
4	Ramirez et al. (2018)	Math Anxiety: Past Research, Promising Interventions, and a New Interpretation Framework	2018	Educational Psychologist	356
5	Toplak et al., (2009)	Executive functions: Performance-based measures and the behavior rating inventory of executive function (BRIEF) in adolescents with attention deficit/hyperactivity disorder (ADHD)	2009	Child Neuropsychology	316
6	Buja et al., (2008)	Data visualization with multidimensional scaling	2008	Journal of Computational and Graphical Statistics	261
7	Massetti et al. (2008)	Academic achievement over 8 years among children who met modified criteria for attention-deficit/hyperactivity disorder at 4-6 years of age	2008	Journal of Abnormal Child Psychology	238
8	Cobb et al. (1997)	Reflective discourse and collective reflection	1997	Journal for Research in	207

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				Mathematics Education	
9	Forman et al. (1998)	"You're going to want to find out which and prove it": Collective argumentation in a mathematics classroom	1998	Learning and Instruction	185
10	Wang et al. (2015)	Is Math Anxiety Always Bad for Math Learning? The Role of Math Motivation	2015	Psychological Science	181

RQ3: What Are the Dominant and Emerging Research Themes in Mindfulness Interventions and Mathematics Anxiety, As Identified Through Keyword Co-Occurrence Analysis?

Figure 2 presents the keyword co-occurrence network, revealing a highly interconnected research structure centered on core constructs such as anxiety (24 occurrences; total link strength = 38), mathematics learning (23; 24), mathematics (20; 29), and mathematics education (18; 31). The prominence and high link strength of anxiety indicate that it functions as the primary conceptual hub, strongly connected to multiple subdomains within mathematics-related research. Closely related terms such as math anxiety and mathematics anxiety further reinforce the centrality of affective factors in shaping learning outcomes. The co-occurrence of these keywords with academic achievement, learning, and mathematics achievement suggests that the literature consistently positions anxiety as a critical determinant of performance. This pattern reflects a well-established theoretical orientation in which emotional variables are directly linked to cognitive processes and academic success, thereby explaining the dense connectivity observed in the network.

Moreover, Figure 2 highlights the emergence of secondary clusters that extend beyond core mathematics constructs into cognitive, psychological, and educational dimensions. Keywords such as working memory, executive function, metacognition, and self-efficacy indicate a strong cognitive-psychological underpinning, suggesting that researchers increasingly examine the mechanisms through which anxiety affects learning. Simultaneously, the presence of terms such as mindfulness, self-regulated learning, and cognitive awareness reflects a growing interest in intervention-based and regulatory approaches aimed at mitigating mathematics anxiety. The inclusion of ADHD, learning difficulties, and depression further demonstrates the interdisciplinary expansion of the field into clinical and developmental contexts. Notably, lower link strength values for terms like achievement emotions and cognitive awareness imply that these areas remain relatively underexplored, representing potential avenues for future research. Overall, the network structure in Figure 2 indicates a mature yet evolving research domain characterized by strong theoretical foundations and increasing diversification toward applied and intervention-oriented studies.

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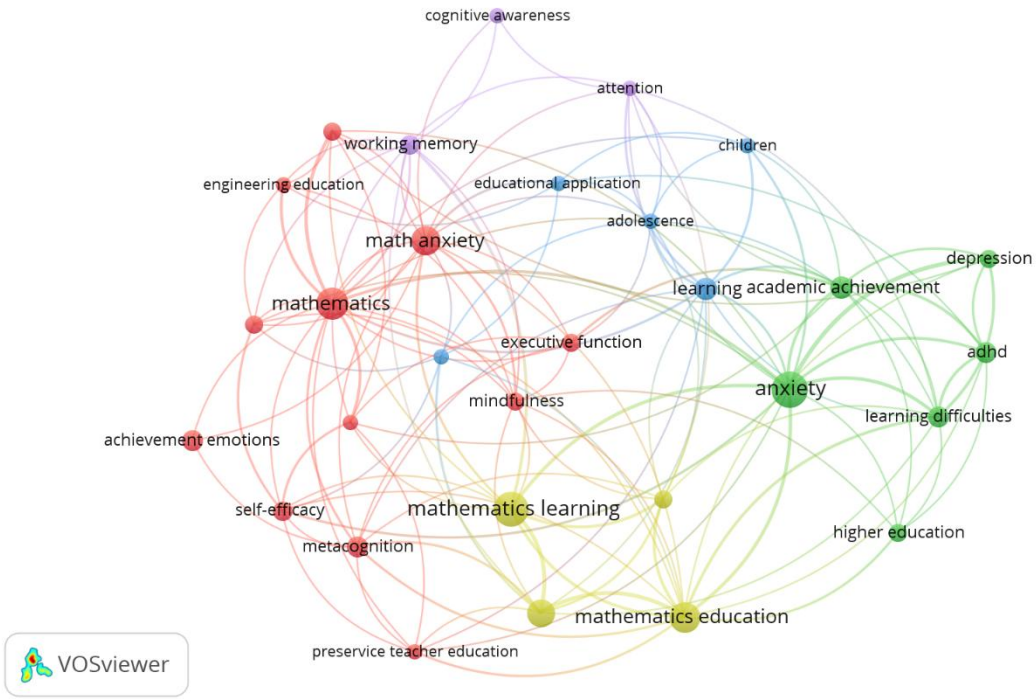

Figure 2: Network Visualization Map of Keywords' Co-Occurrence

RQ4: How Are International Research Collaborations Structured in The Field of Mindfulness-Based Interventions and Mathematics Anxiety, As Revealed by Country-Level Co-Authorship Networks?

Figure 3 illustrates the country-level co-authorship network, revealing a clear concentration of research productivity and collaboration within a small group of leading countries. The United States dominates the network, leading in document production with 82 publications, alongside the highest citation count at 4,795 and a total link strength of 20. This pattern reflects not only a considerable volume of scholarly output but also robust international collaborative connections. This leadership position is further reinforced by the United Kingdom and Canada, which exhibit high citation counts (1,552 and 1,804, respectively) and significant link strengths, reflecting their influential role in structuring as well as shaping the intellectual landscape of the field. The strong performance of these countries can be attributed to well-established research ecosystems, extensive funding opportunities, and a long-standing emphasis on interdisciplinary studies integrating psychology, education, and cognitive science. Additionally, countries such as Australia and Germany demonstrate notable collaboration strength, suggesting their active participation in global research networks despite relatively moderate publication outputs.

In contrast, Figure 3 also highlights a disparity between research productivity and collaborative integration among emerging or developing research contributors. Nations including Turkey, China, as well as Indonesia exhibit comparatively reduced total link strength despite moderate publication counts, indicating limited international collaboration and weaker integration into the global research network. Similarly, Taiwan presents an interesting case, with a relatively high citation count (486) but zero link strength, suggesting that its research output is impactful yet largely independent or domestically concentrated. This pattern may be influenced by

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language barriers, regional research focus, or limited cross-border collaboration opportunities. Overall, the structure depicted in Figure 3 reflects a core–periphery dynamic, where a few highly connected countries drive the field's development, while others remain peripheral, underscoring the necessity for strengthened international collaboration in order to improve knowledge exchange as well as research impact globally.

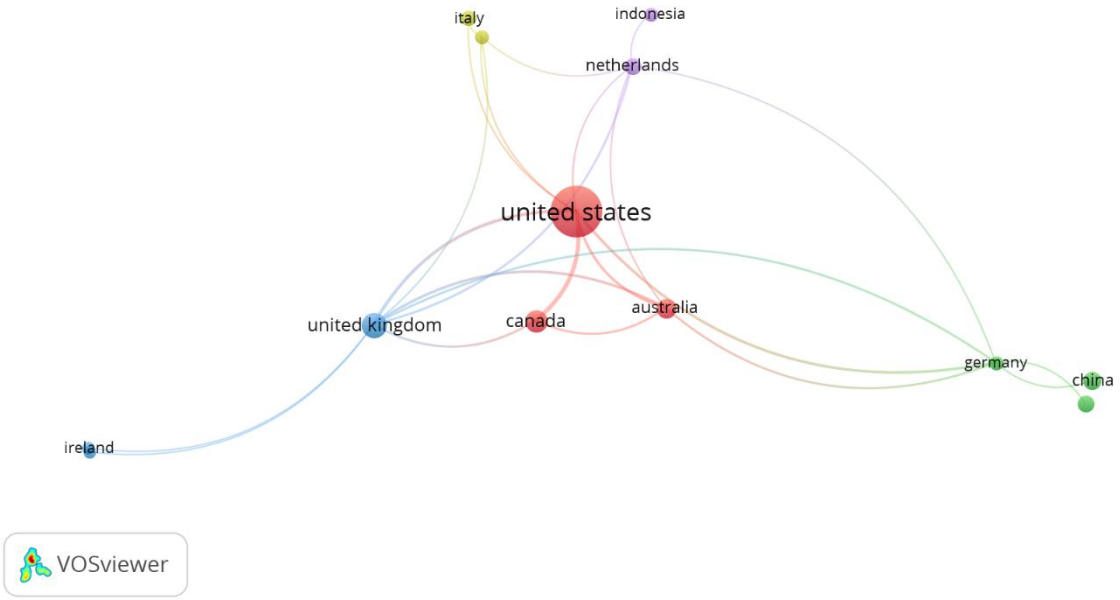

Figure 3: Network Visualization Map of Keywords' Co-Authorship

Conclusion

The present study was conducted to systematically map the research landscape of mindfulness interventions and mathematics anxiety through a comprehensive bibliometric approach. The analysis addressed key questions related to publication trends over time, identification of highly influential studies, prevailing and nascent thematic directions, as well as the configuration of international research collaboration networks. Drawing on a dataset comprising 230 publications published between 1980 and May 2026, the study sought to deliver a systematic synthesis of the field's evolution, its foundational intellectual underpinnings, and its contemporary trajectory, as detailed in the study document.

The findings indicate that the field has experienced a gradual transition from limited and fragmented research activity in earlier decades to a more consistent and accelerated growth phase in recent years, particularly after 2017. Influential works are largely grounded in cognitive and educational perspectives, emphasizing the role of anxiety, working memory, as well as attention in influencing mathematical performance. The keyword co-occurrence analysis indicates that established focal areas like mathematics learning, anxiety, and mathematics education remain central, while newer themes, including mindfulness, self-regulated learning, and executive function, reflect a shift toward intervention-focused and applied research. In addition, the collaboration analysis demonstrates a concentration of research output and network strength within a small number of leading countries, indicating an uneven global distribution of scholarly contributions and limited integration among developing regions.

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This study advances the field by delivering an integrated and systematically organized synthesis of the current literature, allowing clearer identification of research patterns, thematic development, and collaboration structures. It extends current understanding by combining multiple bibliometric techniques to uncover both the intellectual as well as social dimensions of the field. The results also offer practical implications, particularly in supporting the development of mindfulness-based strategies aimed at reducing mathematics anxiety in educational settings. The identification of emerging themes highlights the importance of integrating cognitive and emotional regulation approaches in intervention design.

A number of constraints ought to be taken into account. The examination was restricted to one database only, which may not fully represent all relevant studies. The use of selected keywords may have restricted the inclusion of related research employing alternative terminology. In addition, bibliometric methods rely on quantitative indicators, which may not fully capture the depth or contextual significance of individual research outputs. Subsequent studies could broaden the scope by incorporating multiple databases, refining search strategies, and combining bibliometric analysis with systematic or qualitative reviews to achieve a more comprehensive understanding.

In conclusion, the research illustrates that investigations into mindfulness-based interventions and mathematics anxiety have developed into an expanding and increasingly interdisciplinary domain. The findings highlight the importance of mapping research trends to better understand the development of the field and to identify areas requiring further investigation. Bibliometric analysis serves as a useful approach for revealing underlying patterns and guiding future research directions. Continued efforts are needed to enhance international collaboration, diversify research contexts, and strengthen the application of mindfulness-based approaches in addressing mathematics anxiety.

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Author Contribution Statement: All authors contributed significantly to the development of this manuscript. Author A: Vikneswray D/O Mani Raj was responsible for the conceptualization, methodology, and overall supervision of the study. Author B: Mohd Muslim Bin Md Zalli handled data collection, analysis, and interpretation of results. Author C: Johthi D/O Subramaniam contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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