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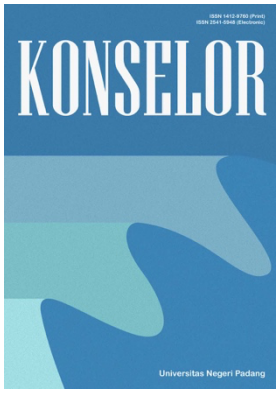

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Effect of mindfulness-based interventions on students with mathematics anxiety: a discursive-analytic review

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Original Article

Effect of mindfulness-based interventions on students with mathematics anxiety: a discursive-analytic review

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Abstract: Most students are affected by mathematics anxiety in terms of how they study, recall, and comprehend mathematical concepts. Mathematics anxiety significantly impedes students' efforts to attend or study mathematics courses. Researchers have developed mindfulness-based interventions (MBIs) to aid in the recovery of students suffering from academic anxiety, particularly mathematics anxiety. The primary objective of this article is to assess how effective these MBIs have aided in alleviating students from mathematics anxiety so as to achieve success in their academics. This study utilized a discursive-analytic literature review approach. The following MBIs were identified: mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), dialectical behavioral therapy (DBT), self-compassion therapy (SCT), yoga, and meditation. Few studies examined some MBIs and reported their significant treatment effects on mathematics anxiety. Specifically, existing studies examining MBSR and MBCT for the treatment of mathematics anxiety in students reported a significant positive effect. A study examined the efficacy of SCT in treating mathematics anxiety in students and reported a positive effect. Educators who use MBIs should prioritize the implementation of successful therapy strategies with their students, consider the necessary time frame to achieve desired results, and explore the fundamental processes that facilitate change. This will facilitate future educators in adapting their techniques in a manner that is advantageous to their respective students.

Key Words: Mindfulness-based stress reduction; Mindfulness-based cognitive therapy; Dialectical behavioral therapy; Self-compassion therapy

INTRODUCTION

Mathematics anxiety is a psychological phenomenon characterized by feelings of discomfort that impede people' ability to successfully engage in numerical manipulation and problem-solving in daily life and educational settings. The presence of elevated levels of mathematics anxiety in students has been seen to have an influence on their psychological and cognitive performances at school. Perina (2002) asserts that the existence of mathematics anxiety has a negative influence on students' working memory. Mathematics anxiety is a factor that can influence a student's academic performance and future opportunities. The possession of a complete grasp of the underlying reasons and effects connected with mathematics anxiety, as well as effective techniques to aid students in lessening its impact, is deemed vital for mathematics instructors (Smith, 2004). Mathematical anxiety is characterized by several symptoms, such as a disinclination to actively participate in mathematical

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matters, apprehension about enrolling in higher-level mathematics courses, and an uncommon degree of unease encountered inside a mathematics classroom.

Mathematics anxiety may be experienced by anyone irrespective of their intellectual capacity, age, or level of mathematical ability (Rossnan, 2006). The use of mathematical principles has significant importance in the progress of human society, specifically in the domain of engineering. In present-day society, there is a growing need for mathematics as a result of the expanding requirements in many areas. A considerable proportion of people face obstacles when it comes to obtaining professional and personal opportunities as a result of their anxiety or insufficient proficiency in mathematics. These unfavorable experiences arisng from anxiety persist and have long-term implications throughout adult life (Tobias, 1993). The existence of mathematics anxiety might potentially be alleviated with the use of mindfulness-based treatment techniques. Mindfulness-based interventions (MBIs) are a therapy modality used in the area of psychology to address symptoms related to mental health issues and emotional challenges. The primary aim of this study is to employ a literature review approach to assess the effectiveness of mindfulness-based interventions in mitigating mathematics anxiety among student participants spanning several age cohorts.

Mindfulness pertains to the deliberate and conscious practice of focusing one's attention on a certain item or event. The idea of mindfulness involves the intentional direction of one's attention, with an emphasis on the current moment, and the adoption of a non-evaluative perspective (Kabat-Zinn, 1996). It is the deliberate act of focusing one's attention and consciousness on the present moment, including all facets of one's subjective experience, such as physical sensations, emotional reactions, mental visualizations, internal thoughts, and perceptual engagements (Creswell, 2017). The practice of mindfulness is seeing a surge in popularity among individuals, and its significance is progressively becoming acknowledged as a pertinent factor in several areas of human endeavor. Consequently, there has been a widespread implementation of mindfulness-based strategies aimed at improving overall health and well-being, particularly among various demographics. The use of mindfulness methodologies has been expanded to include more fields, including psychology, healthcare, neurology, and business (Maynard et al., 2017).

Mindfulness-based interventions (MBIs) are therapeutic approaches that employ a mindfulness framework. They refer to practices that facilitate students' intentional focus on present-moment experiences, particularly within the academic context. MBIs facilitate the reduction of anxiety and stress and the improvement of mental health (Sharpe, 2022). According to Hofmann and Gómez (2017), MBIs are effective in reducing the severity of anxiety and depression symptoms in a diverse population of individuals seeking treatment. Dunning et al. (2019) noted that the use of MBIs to improve the behavioral, cognitive, and mental health outcomes of children and adolescents is on the rise. MBIs aim to cultivate heightened awareness and focus on the present and immediate state of experience (Creswell, 2017). MBIs consist of various interventions, including mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), dialectical behavior therapy (DBT), self-compassion therapy (SCT), yoga, and meditation.

This specific form of MBI prioritizes the mitigation of stress and anxiety to a larger extent. This technique (MBSR) encompasses several elements, including meditation, yoga, and relaxation training. The MBSR, originally named the stress reduction and relaxation program, was founded by Jon Kabat-Zinn in the year 1979. The MBSR integrates components of Buddhist mindfulness meditation with contemporary therapeutic and psychological methodologies (Kabat-Zinn, 1982; 1990; 2003). Its primary objective was to mitigate the anguish endured by those enduring chronic pain, facilitate their adaptation to medical circumstances, and provide systematic guidance in the practice of mindfulness meditation as a strategy for effectively managing stress and regulating emotions (Kabat-Zinn, 1982). The MBSR intervention has been applied to several nonclinical populations, such as student cohorts and those residing in economically challenged metropolitan regions (Grossman et al., 2004). According to Santorelli (2014), there are several basic ideas and aspects within MBSR that possess universal value. In order to effectively guide students in the use of the MBSR program for stress management, the teacher must possess a thorough understanding of the students' requirements and adhere to certain principles that promote the achievement of the program's goals.

The Mindfulness-Based Cognitive Therapy (MBCT) approach is based on the MBSR program, which originated from the Buddhist practice of mindfulness. The MBCT was developed as a targeted

intervention intended to address individuals with a preexisting history of depression. The primary objective of MBCT is to enhance individuals' understanding and management of their cognitive processes and emotional states. This approach aims to reduce stress, develop mindfulness of bodily sensations, thoughts, and emotions, and effectively address potential signs of relapse in a proactive manner (Surya & Wibowo, 2021). The possible benefits of the MBCT method include the facilitation of interpersonal alignment and brain integration for people. This technique enhances the counselor's capacity to assist individuals in their pursuit of personal growth, fostering a transition from a condition of poor health to a state of enhanced well-being. According to Sipe and Eisendrath (2012), MBCT integrates elements of cognitive therapy and psychoeducation that are specifically relevant to the treatment of depression. MBCT exerts favorable impacts on cognitive processes including learning, memory, critical thinking, and understanding. Individuals who have anxiety related to mathematics may face cognitive disturbances. The therapeutic technique MBCT places emphasis on guiding students to adopt a new way of being and interacting with their thoughts and emotions, while allocating little attention to altering or interrogating specific cognitive processes.

Dialectical Behavior Therapy (DBT) is an intervention specifically intended to target intricate and difficult mental illnesses that exhibit resistance to standard treatment methods. Originally, this method was developed for those with persistent suicidal problems. Dimeff and Linehan (2001) have noted that DBT aimed at assisting persons with comorbid illnesses, namely those who have received a diagnosis of borderline personality disorder. The authors conducted a research whereby they delineated five discrete roles of DBT which include several facets of the therapy's efficacy. To begin with, DBT facilitates the enhancement of behavioral capacities, it enhances the drive to initiate change by altering inhibitions and reinforcement contingencies, and it places emphasis on the generalization of newly gained capabilities to the natural world, enabling patients to effectively employ their acquired skills in real-life scenarios. Furthermore, it establishes an atmosphere that is crucial for facilitating the talents of both the client and therapist. Finally, DBT improves the capacities and motivation of therapists, leading to more effective treatment of clients and ultimately contributing to the overall effectiveness of the therapeutic process. DBT is designed to improve an individual's ability to skillfully regulate intense emotions in a way that fosters overall psychological and emotional health (Rynkiewicz, 2020).

Self-compassion refers to the continuous process of engaging with oneself in a compassionate and equitable manner, with the aim of alleviating stress and mitigating distress. Gilbert and Proctor (2006) suggest that self-compassion plays a crucial role in bolstering emotional resilience by inhibiting the danger system and stimulating the care providing system. Rockcliff et al. (2008) conducted a study that provided evidence in favor of the aforementioned claim. The researchers discovered that administering a concise self-compassion exercise to participants resulted in a reduction in their levels of the stress hormone cortisol. Furthermore, it has been shown that the intervention also led to an augmentation in heart rate variability, a phenomenon that has been linked to an enhanced capacity for self-regulation during periods of stress (Svendsen et al., 2016). The idea of self-compassion in the context of mental healing and stress has been described as including three fundamental components. Germer and Neff (2013) have identified these components as self-kindness, shared humanity, and mindfulness. Practicing self-kindness entails demonstrating compassion towards oneself in the face of personal limitations. Self-kindness is exhibiting warmth and empathy towards oneself in times of suffering, failure, or feelings of inadequacy, as opposed to subjecting oneself to self-criticism.

According to Neff (2003), when individuals are explicitly questioned, the majority tend to express that they exhibit more kindness towards others as compared to oneself. Expressing kind sentiments and demonstrating affection towards others has the potential to significantly contribute to the amelioration of sadness and anxiety. Students who see academic shortcomings inside themselves, particularly in comparison to their peers who excel in such areas, may experience self-loathing and subject themselves to a dehumanizing state of isolation due to the dread of potential embarrassment. The concept of common humanity encompasses the acknowledgement that the human experience is characterized by inherent flaws and that we are not alone in our experiences of distress (Germer & Neff, 2013). The practice of mindfulness also entails the need of not excessively associating ourselves

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with unpleasant ideas or emotions, so preventing ourselves from being overwhelmed and carried away by our adverse responses (Bishop et al., 2004). The act of excessively contemplating our unpleasant emotions has the effect of narrowing our attention and fostering an excessively pessimistic perception of oneself (Nolen-Hoeksema, 1991). Engaging in a mindful approach towards challenging emotions offers individuals an enhanced cognitive capacity, enabling them to attain heightened lucidity, broader outlooks, and a state of emotional balance (Baer, 2003).

METHOD

This study examines the efficacy of mindfulness-based therapies for mathematics anxiety using a discursive-analytic assessment of the literature. Because this research was based on an empirical literature review, ethics clearance was not required. The author conducted a thorough study of the literature to find research that have been written on the usefulness of mindfulness-based therapies on students who suffer from mathematics anxiety. By entering search phrases related to the various types of interventions, the author filtered through the literature already written on this subject. For this literature study, publications were selected based on a number of inclusion criteria. The research needed to be published in an English peer-reviewed journal. MBI's research article was disqualified if it had no English language, was a student thesis, a conference proceeding, an encyclopedia, a research protocol, or was not peer-reviewed.

Participants

A significant portion of the research data was compiled using the following databases: Google Scholar, PubMed, and Scopus. Mathematics anxiety OR Academic anxiety, mindfulness-based interventions AND mathematics anxiety, mindfulness-based stress reduction AND mathematics anxiety, mindfulness And mindfulness AND mindfulness-based interventions, mindfulness-based cognitive therapy AND mathematics anxiety, self compassion therapy AND mathematics anxiety, and dialectal behavioral therapy AND mathematics anxiety are some of the boolean operators that have been added to the titles, abstracts, and subheadings. Beginning in June and ending in September 2023, all searches and inclusion were completed.

Procedures

Two reviewers independently reviewed the full-text papers with the researcher to start the selection process and evaluated their eligibility. After differences were ironed out, a total of 3 articles satisfied the inclusion requirements based on the predetermined eligibility criteria. The researcher created a table during the data extraction stage that includes details from all the publications included in the study that were published between 2018 and 2022. Authors, study year, study design, population, sample size, treatment sessions, and outcomes examined, kind of MBIS utilized, method of administration, participant characteristics, and study conclusion were all information that the researcher retrieved.

Data Analysis

During the electronic search process, a total of 31 articles were identified. After removing duplicate articles, 30 articles remained for further screening. It was observed that the majority of the titles and abstracts screened did not pertain to the relationship between mindfulness-based interventions (MBIs) and mathematics anxiety in students, but rather focused on anxiety related to clinical issues. Subsequently, a thorough assessment was conducted to determine the eligibility of the articles for inclusion in the analysis. The selected articles were published within the timeframe of 2015 to 2022, as indicated in Table 1.

Table 1. Articles on MBIs and anxiety symptoms in students

Authors	Year	Study Design	Population	Sample Size	Treatment Session	Outcome Assessed	MBI Used	Method of administration	Participants Characteristics	Conclusions
LaGueet al.	2018	Quasi experimental design	Students in secondary school	Total of 5: Participants A-3 B-1 C-1	6weeks, 12 sessions and 45 minutes	Math anxiety	MBCT	Physical meeting	Sex: male and female. Age:-15-16yrs	MBCT was successful in alleviating math anxiety.
Pinthong	2018	QED	College students	Initially 26 students Eventually 17 students comprising 12 females and 6 males	3weeks 20 minutes	Math anxiety	MBSR	Physical meeting	Sex: male and female Age: 34 -35yrs	MBSR was effective in reducing math anxiety
Sujadi	2022	Online cross sectional survey method	University students	Total of 344 students	April to June	Academic anxiety	SCT	Online meetings	Age: 18 and above	SCT enabled students to manage their anxiety.

The objective of this study was to assess the efficacy of Mindfulness-Based Interventions (MBIs) in addressing mathematics anxiety among students, with a focus on empirical research. Mathematics plays a crucial role in the academic achievement of students, since it is an essential subject. However, the presence of anxiety about mathematics may have detrimental effects on students' academic performance, perhaps resulting in failure. Engaging in mindfulness-based therapies such as MBSR, MBCT, DBT, and SCT has the potential to facilitate academic achievement among students with mathematics anxiety. The use of MBIs is on the increase across many clinical and institutional contexts (Creswell, 2017; Kabat-Zinn, 2003, 2013). In recent times, there has been a notable change in attention towards the use of MBIs in the context of children and adolescents (Dunning, et al., 2019). This study has significance as it aims to familiarize students with various mindfulness treatments, perhaps offering them a sense of optimism towards achieving achievement, as opposed to harboring self-loathing tendencies and succumbing to sadness and failure.

In a study conducted by LaGue et al. (2018), it was demonstrated that MBCT effectively mitigated mathematics anxiety. The participants were divided into three groups and engaged in instructional sessions, wherein they were instructed to compose letters to themselves reflecting on their emotional experiences subsequent to the MBCT training. The findings revealed that all participants reported positive outcomes in their letters, particularly noting improvements in their academic performance in mathematics.The effectiveness of MBSR on students with math anxiety was examined in a study conducted by Pinthong (2018). The findings revealed that the implementation of MBSR as a mindfulness intervention yielded significant positive outcomes for students with math anxiety. Specifically, the study observed a reduction of 13.8% in math anxiety levels following in-class mindfulness training, which was then followed by one week of individual practice.

A marginal and statistically insignificant rise of 0.7% in math anxiety was seen from the commencement of the tutoring class to the immediate period before the implementation of the mindfulness intervention. The efficacy of tutoring as a standalone intervention in mitigating math anxiety was shown to be limited. However, when combined with mindfulness practice, tutoring demonstrated a significant decrease in levels of arithmetic anxiety. The participants in the study were instructed to compose a letter addressed to their future selves, drawing upon a range of inquiries derived from their engagement in mindfulness-oriented exercises. According to Maynard et al. (2017), MBCT has been shown to be helpful in enhancing cognitive abilities and reducing anxiety and stress among individuals of various age groups, including children and adults, within an academic context. According to the findings of Mojdeh and Bahram (2015), it was shown that the implementation of DBT had positive outcomes in terms of anxiety reduction among students.

Hence, it is recommended that students be provided with mindfulness-based therapies, since these interventions have the potential to not only decrease mathematics anxiety but also enhance academic achievement. The empirical investigation conducted by Sujadi (2022) demonstrated the efficacy of SCT in addressing academic anxiety among students, including instances of mathematics anxiety. The study conducted by the author demonstrated a significant relationship between self-compassion and anxiety. Specifically, the findings indicated that those with more capacities for attentional concentration, compassion, appreciation, and resistance to psychological stress tend to have

lower levels of perceived academic anxiety. It is important for individual students to recognize that those they see as capable of achieving what they themselves cannot may possess faults or limitations in other domains. There exists a collective imperfection that extends beyond our individual selves. On the contrary, it is our shortcomings that serve as defining characteristics of our membership within the human race.

Frequently, individuals experience a sense of isolation and detachment from others while reflecting over their own challenges and shortcomings, leading to an illogical perception that they are the only individuals facing such difficulties. There is a prevailing perception that we are deviating from the norm, indicating a potential deviation from expected standards. This kind of narrow focus exacerbates feelings of alone and seclusion, so intensifying our experience of distress. It is often overlooked that failure and imperfection are inherent aspects of the human experience. Practicing mindfulness in this context necessitates individuals experiencing stress and depression to adopt a cognitive approach that mitigates the exacerbation of their condition, so preventing the emergence of negative ruminations pertaining to personal inadequacies. Educators using MBIs have to give precedence to the effective execution of therapeutic procedures with their students, while also taking into account the requisite time frame for attaining targeted outcomes, and delving into the underlying mechanisms that foster transformative change. This will enable future instructors to modify their instructional strategies in a way that is beneficial to their individual pupils.

The present research has reviewed past interventions about the impact of Mindfulness-Based Interventions (MBIs) on the treatment of mathematics anxiety among student populations. This paper, which is grounded on a comprehensive analysis of the relevant research, has shown the efficacy of MBIs in addressing mathematics anxiety across student populations. Future research should investigate the potential beneficial impact of mindfulness-based therapies on students' academic performance. Teachers who use MBIs with their students should focus on implementing effective MBI procedures with them. They should also think about the time frame needed to get the results they want and look into the underlying mechanisms that lead to transformational change in mathematically anxious students. This will give future mathematics teachers the chance to change how they teach so that it works best for each of their students.

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