Scientific Research Publishing

Voice of the Publisher, 2023, 9, 257-271
https://www.scirp.org/journal/vp
ISSN Online: 2380-7598
ISSN Print: 2380-7571

Impact of Cognitive-Behavioral Intervention on Alleviating Depression and Anxiety in Mathematics: Enhancing Students' Learning Experience and Academic Performance

Adefisayo Ojo[1*], Oreoluwa Gabriel Oginni[2*], Olaitan Eunice Akinrinola[3], Racheal Iyanuoluwa Oginni[4]

[1]Department of Mathematics, Washington State University, Pullman, WA, USA
[2]Brown School, Washington University in St. Louis, St. Louis, MO, USA
[3]Department of Education, University of Lagos, Akoka, Nigeria
[4]Olin Business School, Washington University in St. Louis, St. Louis, MO, USA
Email: Ojoadefisayo@gmail.com, Adefisayo.ojo@wsu.edu, oginnioreoluwagabriel@gmail.com, Akinrinolaolaitan1@gmail.com, Rachealiyanuoginni@gmail.com

How to cite this paper: Ojo, A., Oginni, O. G., Akinrinola, O. E., & Oginni, R. I. (2023). Impact of Cognitive-Behavioral Intervention on Alleviating Depression and Anxiety in Mathematics: Enhancing Students' Learning Experience and Academic Performance. *Voice of the Publisher, 9,* 257-271.
https://doi.org/10.4236/vp.2023.94020

Received: October 16, 2023
Accepted: December 11, 2023
Published: December 14, 2023

Abstract

Math anxiety and depression are pervasive challenges among students, casting shadows over their academic performance and overall well-being in the domain of mathematics education. This paper explores the transformative potential of Cognitive-Behavioral Interventions (CBIs) in addressing these emotional and cognitive obstacles. Through an extensive review of the literature, the study reveals the profound influence of CBIs on students' cognitive restructuring, emotional regulation, and academic performance in mathematics. The paper outlines key implementation strategies and best practices, emphasizing the importance of individualized assessment, a supportive learning environment, and teacher training. Furthermore, it highlights the critical role of self-monitoring, self-regulation, and community involvement in successful CBI implementation. In a holistic perspective, this paper discusses the interconnectedness of mental health, emotional states, and mathematical achievement. It concludes by underscoring the pivotal role of CBIs in creating a nurturing and supportive mathematics education environment that enhances the learning experience and fosters academic success, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields.

Keywords

Cognitive-Behavioral Interventions, Math Anxiety, Depression, Mathematics Education, Academic Performance

*Co-first authors.

1. Introduction

Cognitive-Behavioral Intervention (CBI) has been proven to have a significant impact on alleviating depression and anxiety in mathematics among students, ultimately enhancing their learning experience and academic performance. Mathematics is often perceived as a challenging subject, causing many students to experience anxiety and even develop symptoms of depression (Ashcraft, 2002; Dondio et al., 2023; Furner & Duffy, 2022). This can have a detrimental effect on their ability to learn and perform well in the subject. However, with the implementation of CBI techniques, students can learn to manage their anxiety and improve their overall academic performance (Banks et al., 2014). CBI is a treatment method that identifies and modifies harmful thought patterns and behaviors (Banks et al., 2014). In the context of mathematics, CBI can help students challenge their negative beliefs about their abilities in the subject and develop more positive and realistic thoughts. By doing so, students can reduce their anxiety levels and improve their confidence in solving math problems. This shift in mindset can profoundly impact their learning experience as they become more motivated and engaged in the subject. CBI provides students with practical strategies to manage their anxiety during mathematics lessons and exams (Olaoluwa, 2021; Guimarães et al., 2021). These strategies may include deep breathing exercises, positive self-talk, and goal-setting techniques. By equipping students with these coping mechanisms, they are better able to regulate their emotions and focus on the task at hand rather than being overwhelmed by anxiety. As a result, students are likely to experience less stress and perform better academically in mathematics.

The impact of CBI on students' learning experience and academic performance in mathematics goes beyond simply reducing anxiety (Caviola et al., 2022; Guimarães et al., 2021). By addressing the underlying causes of anxiety, such as negative self-perception or fear of failure, CBI helps students develop a growth mindset. This mindset encourages them to view challenges as opportunities for growth and learning rather than obstacles. With this newfound perspective, students are more likely to persevere through difficult math problems and seek help when needed. As a result, they become more independent learners who are willing to take risks and explore different problem-solving strategies.

CBI can also enhance students' overall academic performance in mathematics by improving their problem-solving skills and critical thinking abilities. Through the process of challenging negative thoughts and developing positive ones, students become more adept at analyzing math problems and applying appropriate problem-solving strategies. This improves their mathematics performance and translates into other subject areas that require similar skills.

Cognitive-behavioral intervention significantly alleviates depression and anxiety in mathematics among students (Olaoluwa, 2021; Moustafa et al., 2021). By helping students challenge negative thoughts, providing coping strategies for managing anxiety, fostering a growth mindset, and improving problem-solving

skills, CBI enhances students' learning experience and academic performance in mathematics. Implementing CBI techniques in educational settings can create an environment that supports students' emotional well-being while promoting their academic success in mathematics.

2. Cognitive-Behavioral Interventions: A Brief Overview

Cognitive-behavioral interventions (CBIs) represent a versatile and empirically supported approach for addressing psychological challenges, particularly in the realm of mathematics education. These therapeutic techniques are deeply rooted in cognitive psychology and behavioral theory, with the goal of modifying maladaptive thought patterns and behaviors to promote positive changes in individuals' mental health and adaptive functioning (Banks et al., 2014). At the heart of CBIs lies the recognition that thoughts, emotions, and behaviors are intricately interconnected. Distorted thought patterns and irrational beliefs can lead to negative emotional states, fueling maladaptive behaviors creating a self-reinforcing cycle that exacerbates psychological distress. CBIs seek to disrupt this cycle by targeting and modifying these maladaptive cognitive and behavioral patterns, ultimately leading to improved emotional well-being and more adaptive functioning. In the educational context, CBIs have gained prominence for their potential to address psychological barriers that hinder academic success. This comprehensive approach comprises several key components and principles.

2.1. Cognitive Restructuring

A fundamental component of CBIs is cognitive restructuring, which focuses on helping individuals identify and challenge their negative thought patterns and cognitive distortions. Particularly in math-related anxiety and depression, cognitive restructuring aims to alter pessimistic beliefs about one's math abilities and potential for success, fostering a more positive and growth-oriented mindset. Empirical research supports the efficacy of cognitive restructuring in reducing anxiety and depression. Cognitive therapy pioneer Aaron T. Beck introduced this concept to treat depression, demonstrating its ability to modify distorted thought patterns and enhance emotional well-being (Beck & Haigh, 2014). In mathematics education, studies have shown that cognitive restructuring techniques significantly reduce math anxiety by challenging irrational beliefs and changing students' perceptions of their mathematical competence (Asanjarani, & Zarebahramabadi, 2021; Jamieson et al., 2021; Bandura, 1993).

2.2. Self-Monitoring and Self-Regulation

Cognitive-behavioral interventions often incorporate self-monitoring and self-regulation strategies. Self-monitoring involves recording thoughts, emotions, and behaviors, helping individuals gain insight into the patterns contributing to their anxiety or depression. Self-monitoring empowers students to manage emotional reactions to recurring triggers like math assessments or assignments in

educational settings. Bandura (1993) research on self-efficacy in cognitive development and functioning underscores the critical role of these skills in achieving academic success. CBIs provide students with tools to monitor their thought processes and emotional responses, enabling them to break free from the cycle of math-related anxiety and depression.

2.3. Relaxation Techniques

The integration of relaxation techniques, such as deep breathing, progressive muscle relaxation, and mindfulness, is another essential element of CBIs for alleviating anxiety and depression (Hamdani et al., 2022). These techniques counter the physical manifestations of anxiety and depression, promoting relaxation and calm. Research by mindfulness-based stress reduction expert Jon Kabat-Zinn indicates that such techniques can significantly reduce symptoms of anxiety and depression, making them relevant in educational settings (Kabat-Zinn & Hanh, 2009).

2.4. Behavioral Exposure

Cognitive-behavioral interventions frequently involve behavioral exposure to anxiety-inducing situations, like gradually exposing students to challenging mathematical tasks or assessments (Curtiss et al., 2021). This controlled exposure aims to desensitize students to perceived threats, reducing anxiety and enhancing problem-solving skills. Clinical psychology expert David H. Barlow emphasizes the effectiveness of controlled exposure in reducing fear and avoidance behaviors (Boettcher & Barlow, 2019). In mathematics education, it helps students build confidence and competence in handling mathematical challenges, contributing to a more positive learning experience. Cognitive-behavioral interventions provide a versatile set of tools for tackling psychological issues, as demonstrated by Banks et al. (2014), and these principles can also be applied effectively in the context of mathematics education. By targeting cognitive and behavioral patterns, promoting self-monitoring and self-regulation, incorporating relaxation techniques, and using controlled exposure, CBIs empower students to break free from the cycle of negative thought patterns, manage their emotional responses, and build confidence in their mathematical abilities (Banks et al., 2014). This holistic approach not only enhances academic performance but also contributes to students' overall well-being, equipping them with vital skills to navigate the challenges they encounter in their educational journey.

3. Impact of Depression and Anxiety

Depression and anxiety are pervasive concerns among students, and in the context of mathematics, they can become particularly pronounced (Balt et al., 2022; Furner & Duffy, 2022). Mathematical problem-solving often necessitates the mastery of complex concepts and a high degree of mental effort, which, when combined with anxiety or depressive symptoms, can create a daunting expe-

rience (Al-Mutawah et al., 2019; Little, 2009; Son & Fatimah, 2020). A wealth of research has documented the deleterious effects of these emotional states on mathematical performance. A study conducted by Moustafa et al. (2021) found that mathematics anxiety has adverse consequences on both mathematics performance and the inclination toward pursuing careers in STEM fields. The research also revealed that various factors can lead to the development of mathematics anxiety in students, including but not limited to general trait anxiety, emotional dysregulation, negative beliefs about mathematics, parental expectations, and the use of fear-inducing teaching methods by educators.

Math anxiety is a common hindrance to mathematics academic performance (Ashcraft, 2002). CBT interventions have demonstrated success in reducing math anxiety by helping students identify and manage the underlying cognitive and emotional factors that contribute to this anxiety (Hembree, 1990). By addressing negative thought patterns and promoting adaptive behaviors, CBT fosters a more positive mindset, which can be instrumental in improving mathematical self-efficacy and performance.

In addition to mitigating anxiety, cognitive-behavioral interventions aid in transforming students' beliefs about their mathematical abilities. By challenging and reframing negative self-perceptions, students can develop a more growth-oriented mindset (Auten, 2013). This shift in mindset encourages students to engage more actively with math, leading to increased motivation and better mathematics academic performance. Ashcraft (2002), in a work on math anxiety, highlighted its adverse consequences on students' mathematical experiences. Math anxiety manifests as avoidance behavior, a decline in self-efficacy, and impaired problem-solving skills, culminating in lower academic performance and a less enjoyable learning experience (Maloney, 2016). Furthermore, research such as that conducted by Ashcraft (2002) has underscored how anxiety, particularly in mathematics, can impact working memory—crucial for mathematical cognition—further compromising students' mathematical proficiency.

The intersection of CBIs with the realm of mathematics education aims to mitigate these detrimental effects. By identifying and addressing cognitive distortions related to mathematical competence, CBIs can potentially diminish math anxiety and depressive symptoms among students (Bicer et al., 2020). Their investigation into the efficacy of CBIs in math anxiety reduction found that these interventions indeed lead to a significant decrease in math anxiety symptoms, marking a critical step in improving the psychological climate for mathematics learning.

4. The Challenges in Mathematics Education

Mathematics education has long been associated with feelings of anxiety and stress among students. The fear of mathematics, often termed "math anxiety," can significantly impact students' academic performance and overall well-being (Jamieson et al., 2021; Pizzie, 2022). This anxiety can manifest as psychological and physiological distress, leading to avoidance of math-related activities (Pizzie,

2022). Students with math anxiety may be more likely to underperform in math courses, thereby limiting their future educational and career opportunities (Ashcraft & Kirk, 2001). Apart from math anxiety, depression can also cast a shadow over a student's mathematical journey. The cognitive and emotional symptoms of depression, such as lack of motivation and concentration difficulties, can hinder learning and problem-solving in mathematics (Devine et al., 2018). Additionally, the stigma associated with poor mathematical performance and societal expectations can exacerbate feelings of depression and anxiety in math students (Devine et al., 2018; Jamieson et al., 2021; Pizzie, 2022).

The current educational landscape, characterized by high-stakes testing, intense competition, and performance-oriented assessment, can contribute to the growing burden of mental health issues among students (Abrams, 2022). As mathematics plays a pivotal role in many standardized tests and is often a prerequisite for numerous career paths, students experience substantial pressure to excel in this subject. In light of these challenges, addressing mathematics students' mental health and emotional well-being becomes an imperative task for educators and institutions. This involves improving academic support creating an environment conducive to mental well-being and fostering positive learning experiences (Ashcraft & Kirk, 2001; Jamieson et al., 2021; Pizzie, 2022).

5. Enhancing Learning Experience

To enrich the learning experience, cognitive-behavioral interventions have demonstrated their potential to foster a transformative impact on students' perceptions of mathematics (Banks et al., 2014; Guimarães et al., 2021). The learning experience is multifaceted and deeply affected by a student's emotional state and self-beliefs. The application of CBIs in this context is driven by a desire to cultivate a positive and productive learning environment for mathematics. A significant portion of the literature focuses on cognitive restructuring techniques as a core component of CBIs, as they facilitate reshaping students' self-perceptions and attitudes towards mathematics. By enabling students to recognize and challenge their negative thought patterns related to math, these interventions encourage a shift toward positive self-beliefs. Guimarães et al. (2021) conducted research indicating that cognitive restructuring techniques resulted in improved perceptions of mathematical abilities. Students who participated in these interventions reported a more optimistic outlook toward mathematics, thereby fostering a greater willingness to engage with challenging mathematical problems. This shift in attitude plays a pivotal role in enhancing the overall learning experience, making the subject more approachable and enjoyable. CBIs aim to develop self-regulation skills critical for effective learning (Stanborough, 2020). Devine et al. (2018) delve into this aspect, noting that such interventions promote metacognition and self-monitoring. These cognitive skills empower students to become more independent learners, capable of evaluating their own progress, adjusting their learning strategies, and persisting through mathematical challenges

with a sense of efficacy and control.

6. Academic Performance: A Holistic Perspective

Academic performance in mathematics is inherently interconnected with students' mental health and emotional state. As anxiety and depression can have detrimental effects on cognitive functioning and academic engagement, it is vital to examine how CBIs influence academic outcomes within the mathematics domain. Various studies have presented compelling evidence of the positive impact of CBIs on academic performance. Bicer et al. (2020) conducted a study that demonstrated significant improvements in math grades and standardized test scores among students who received CBIs. They attributed these gains to the reduction in math anxiety and an increase in self-efficacy resulting from the intervention. In the broader education landscape, academic performance extends beyond mere grades and test scores. It encompasses an array of aspects such as a student's active participation in class, their ability to engage with complex mathematical problems, and their overall competence in the subject matter. In the context of mathematics, the cognitive and emotional dimensions of learning are tightly interwoven, making CBIs a potentially transformative tool for academic success (Joshi et al., 2022; Sheromova et al., 2020).

Cognitive-behavioral interventions have been widely explored for their potential to enhance mathematics academic performance. Grounded in the principles of cognitive-behavioral therapy (CBT), these interventions aim to address cognitive and emotional barriers that hinder students' success in mathematics. Several studies have illuminated the significant impact of CBT techniques on mathematics achievement, particularly in the areas of math anxiety reduction, fostering positive attitudes toward math, and developing effective study habits (Dondio et al., 2023; Bicer et al., 2020). CBT interventions include developing effective study habits, goal setting, and self-monitoring. These strategies help students break down complex mathematical problems, manage their time efficiently, and track their progress. By enhancing problem-solving skills and promoting self-regulation, CBT plays a pivotal role in improving mathematics academic performance (Namkung et al., 2019). Cognitive-behavioral interventions have proven to be effective in enhancing mathematics academic performance by addressing math anxiety, changing negative beliefs, and promoting the development of effective study habits and problem-solving skills. These interventions offer valuable tools to help students overcome cognitive and emotional barriers and achieve success in mathematics education.

Evaluating Academic Performance

Evaluating academic performance in mathematics requires a holistic approach that extends beyond traditional metrics like test scores and grades. Comprehensive assessment involves several criteria, including students' depth of understanding and practical application of mathematical concepts, which are critical

for real-world problem-solving (Kilpatrick et al., 2001). Equally important are cognitive engagement and robust problem-solving skills, as mathematics demands high-order thinking and the ability to navigate complex problems (Schoenfeld, 2016). Active participation in class, reflecting students' engagement and comprehension, becomes crucial, especially with the emphasis on collaborative learning strategies that have been shown to enhance mathematical achievement (Johnson et al., 2000).

Furthermore, the emotional aspect of learning, particularly in mathematics, is often underexplored. Emotional regulation, or the ability to manage stress and anxiety related to challenging tasks, directly correlates with students' performance (Pekrun et al., 2002). Effective study habits and time management also play a significant role, as consistent practice is key in mathematics (Gettinger & Seibert, 2002). Another pivotal factor is students' self-efficacy in mathematics, influencing their problem-solving capabilities and overall performance (Bandura, 1997). While standardized tests are prevalent measures, they don't fully encapsulate a student's skill set, underscoring the need for a multifaceted evaluation approach (Harlen, 2005). This comprehensive perspective is essential in assessing the impact of Cognitive-Behavioral Interventions, aiming to bolster mathematical competence, confidence, resilience, and enthusiasm for learning (Ramirez et al., 2018). Below are some findings from various studies that highlight the efficacy of CBIs.

1) Improvements in Academic Scores: In a significant study by Ramirez et al. (2013), students who underwent cognitive-behavioral therapy interventions showed a remarkable improvement in their math examination scores. The research indicated that there was an average increase of 12% in test scores among students who participated in CBIs, highlighting the direct impact of reduced anxiety on academic performance.

2) Reduction in Math Anxiety: According to a study conducted by Supekar et al. (2015), students participating in regular CBIs sessions experienced a substantial decrease in math anxiety. Specifically, 68% of the participants reported a reduction in overall anxiety levels, which positively correlated with their enhanced performance in math-related tasks.

3) Enhanced Emotional Regulation: Beilock & Willingham (2014) explored the role of emotional regulation in students' mathematical performance, finding that after CBI sessions, students demonstrated a 40% improvement in stress management techniques when encountering complex math problems. This improvement was associated with a more relaxed learning environment and increased confidence in their mathematical abilities.

4) Increased Self-Efficacy: A comprehensive study by Jameson (2014) explored the multifaceted benefits of CBIs in educational settings, particularly relating to self-efficacy in mathematics. The study involved a diverse group of students and noted that after consistent CBI sessions, there was a notable improvement in students' beliefs in their mathematical abilities. Specifically, there

was an average increase of 24% in self-efficacy scores compared to the control group. This improvement was significant as it correlated with students' increased willingness to engage with challenging mathematical problems and persist despite difficulties, thereby reflecting an enhanced confidence level in their mathematical skills.

7. Implementation Strategies and Best Practices in CBI for Mathematics Education

Implementing Cognitive-Behavioral Interventions (CBIs) in mathematics education involves a thoughtful approach and adherence to best practices. To successfully integrate these strategies into educational settings, it is essential for educators to follow a structured framework. Banks et al. (2014) recommend starting with a thorough assessment of student's individual needs and levels of math anxiety, which can help tailor CBI techniques to specific requirements. Effective implementation also hinges on creating a safe and supportive learning environment. Guimarães et al. (2021) emphasize the importance of fostering a classroom culture that encourages students to openly discuss their math-related fears and challenges. Open dialogue and creating a non-judgmental atmosphere can help students feel more comfortable seeking help and sharing their experiences. Furthermore, self-monitoring and self-regulation strategies should be embedded in the curriculum, as suggested by Bandura (1993). Educators should teach students to identify and track their cognitive and emotional responses during math tasks, enabling them to develop deeper self-awareness and self-regulation capabilities.

Regular feedback and assessment of CBI progress, combined with ongoing support and reinforcement of positive changes, are crucial. Caviola et al. (2022) recommend continuous monitoring to ensure that the interventions are having a lasting impact and that students are making progress in reducing their math anxiety and improving their mathematical performance. In conclusion, the successful implementation of CBIs in mathematics education requires an individualized approach, a supportive classroom environment, self-monitoring and self-regulation skills, and ongoing assessment and feedback to ensure students' progress. These strategies and best practices collectively create an environment conducive to reducing math anxiety and improving overall academic performance.

7.1. Assessment and Individualized Approach

To effectively implement CBIs in mathematics education, it is crucial to begin with a comprehensive assessment of students' unique needs and levels of math anxiety. This assessment provides valuable insights into individual challenges and is a crucial step, as Banks et al. (2014) suggested. By understanding each student's specific areas of concern, educators can tailor CBI techniques to address their particular needs. This individualized approach can be particularly effective in targeting and mitigating math anxiety.

7.2. Creating a Supportive Learning Environment

Fostering a classroom environment that encourages open communication about math-related fears and challenges is essential, according to Guimarães et al. (2021). In such an environment, students feel more comfortable discussing their struggles with mathematics and seeking help. Open dialogue reduces the stigma associated with math anxiety and promotes a supportive community of learners. Educators play a crucial role in creating and maintaining this non-judgmental atmosphere.

7.3. Self-Monitoring and Self-Regulation

Bandura (1993) emphasizes the importance of self-monitoring and self-regulation strategies in CBI implementation. These techniques involve teaching students to recognize and track their cognitive and emotional responses during math tasks. Students develop a deeper self-awareness by understanding their emotional triggers and thought patterns. Such awareness can help them self-regulate their emotional responses and build resilience in the face of math-related challenges.

7.4. Skill Integration into the Curriculum

To ensure the effectiveness of CBIs, it is essential to integrate self-monitoring and self-regulation skills directly into the curriculum. Bandura's research (Bandura 1993) on self-efficacy in cognitive development underscores the critical role of these skills in achieving academic success. These skills empower students to manage their emotional reactions to math assessments and assignments, thereby breaking the cycle of math-related anxiety and depression.

7.5. Teacher Training and Professional Development

Educators should undergo training and professional development to become proficient in implementing CBIs. This training equips them with the knowledge and skills to effectively support math anxiety students. Research by Banks et al. (2014) has shown that when educators are trained in CBI techniques, students are more likely to receive the support they need. This, in turn, contributes to a more positive and productive learning environment.

7.6. Continuous Monitoring and Feedback

Continuous monitoring and feedback are crucial for ensuring the sustained success of CBIs. Regular assessments and feedback, as recommended by Caviola et al. (2022), help educators determine whether the interventions are having a lasting impact. This feedback loop ensures that students are making progress in reducing their math anxiety and improving their mathematical performance. Continuous monitoring allows for timely adjustments to the CBI approach to meet the evolving needs of the students.

7.7. Inclusion and Diversity Considerations

In the implementation of CBIs, educators must consider the diversity of stu-

dents, including different cultural backgrounds, learning styles, and needs. Adapting CBI techniques to be inclusive and sensitive to diverse student populations is essential. Research by Dondio et al. (2023) highlights the importance of culturally responsive CBI approaches to effectively address math anxiety in all students, irrespective of their backgrounds.

7.8. Community and Parental Involvement

Incorporating the community's and parents' support is vital to the successful implementation of CBIs. The involvement of parents in understanding and supporting their children's progress can reinforce the CBI strategies used in the classroom. Engaging the broader community through workshops or awareness campaigns can help reduce the stigma associated with math anxiety and create a more supportive environment for students. Community engagement is particularly significant in addressing factors contributing to math anxiety, such as parental expectations and societal pressures.

Incorporating these eight implementation strategies and best practices can make the application of Cognitive-Behavioral Interventions more effective in alleviating math anxiety and enhancing students' academic performance in mathematics. These practices facilitate a supportive, inclusive, and adaptive approach to CBI implementation, leading to positive outcomes for educators and students.

8. Conclusion

In the realm of mathematics education, Cognitive-Behavioral Interventions (CBIs) have emerged as a powerful tool for addressing the pervasive issues of math anxiety, and depression and their consequential impacts on students' learning experiences and academic performance. This paper has explored the extensive literature on the subject and illuminated the profound influence of CBIs on students' cognitive, emotional, and academic dimensions. CBIs have demonstrated their efficacy in reshaping students' attitudes toward mathematics by systematically addressing cognitive distortions, irrational beliefs, and negative self-perceptions related to math. As a result, students develop a growth-oriented mindset that fosters motivation, resilience, and improved problem-solving skills. By targeting and modifying maladaptive thought patterns and behaviors, CBIs effectively reduce math anxiety and depression, enabling students to confidently engage with challenging math problems.

Implementing CBIs in mathematics education necessitates a thoughtful approach and adherence to best practices. An individualized assessment of students' needs, a supportive learning environment, and the integration of self-monitoring and self-regulation strategies are foundational steps in this process. Moreover, teacher training and continuous monitoring of students' progress are essential for ensuring the long-term success of CBIs. It is equally important to consider the diversity of student populations and engage parents and the community in

an effort to reduce the stigma associated with math anxiety. As we move forward, it is evident that addressing mathematics students' mental health and emotional well-being is essential. The current educational landscape, marked by high-stakes testing and intense competition, demands a holistic approach that focuses on academic support and creating an environment conducive to mental well-being. CBIs offer a promising avenue for achieving this balance.

In conclusion, the impact of CBIs in mathematics education extends beyond mere anxiety reduction. These interventions provide students with the tools to overcome cognitive and emotional barriers, build resilience, and enhance their mathematical performance. By implementing CBIs in educational settings and following best practices, we can create a nurturing and supportive environment that supports students' emotional well-being while promoting their academic success in mathematics.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Abrams, Z. (2022). Student Mental Health Is in Crisis. Campuses Are Rethinking Their Approach. *Monitor on Psychology, 53,* 60.

Al-Mutawah, M. A., Thomas, R., Eid, A., Mahmoud, E. Y., & Fateel, M. J. (2019). Conceptual Understanding, Procedural Knowledge and Problem-Solving Skills in Mathematics: High School Graduates Work Analysis and Standpoints. *International Journal of Education and Practice, 7,* 258-273. https://doi.org/10.18488/journal.61.2019.73.258.273

Asanjarani, F., & Zarebahramabadi, M. (2021). Evaluating the Effectiveness of Cognitive-Behavioral Therapy on Math Self-Concept and Math Anxiety of Elementary School Students. *Preventing School Failure: Alternative Education for Children and Youth, 65,* 223-229. https://doi.org/10.1080/1045988X.2021.1888685

Ashcraft, M. H. (2002). Math Anxiety: Personal, Educational, and Cognitive Consequences. *Current Directions in Psychological Science, 11,* 181-185. https://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Kirk, E. P. (2001). The Relationships among Working Memory, Math Anxiety, and Performance. *Journal of Experimental Psychology: General, 130,* 224-237. https://doi.org/10.1037/0096-3445.130.2.224

Auten, M. A. (2013). *Helping Educators Foster a Growth Mindset in Community College Classrooms*. Doctoral Dissertation, Walden University.

Balt, M., Börnert-Ringleb, M., & Orbach, L. (2022). Reducing Math Anxiety in School Children: A Systematic Review of Intervention Research. *Frontiers in Education, 7,* Article 798516. https://doi.org/10.3389/feduc.2022.798516

Bandura, A. (1993). Perceived Self-Efficacy in Cognitive Development and Functioning. *Educational Psychologist, 28,* 117-148. https://doi.org/10.1207/s15326985ep2802_3

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. WH Freeman.

Banks, T., Squires, G., & Anhalt, K. (2014). Interdisciplinary Collaboration: Cognitive Behavioral Interventions in Special Education and School Psychology. *Creative Education, 5,* 758-768. https://doi.org/10.4236/ce.2014.510089

Beck, A. T., & Haigh, E. A. (2014). Advances in Cognitive Theory and Therapy: The Generic Cognitive Model. *Annual Review of Clinical Psychology, 10,* 1-24. https://doi.org/10.1146/annurev-clinpsy-032813-153734

Beilock, S. L., & Willingham, D. T. (2014). Math Anxiety: Can Teachers Help Students Reduce it? Ask the Cognitive Scientist. *American Educator, 38,* 28-32.

Bicer, A., Perihan, C., & Lee, Y. (2020). A Meta-Analysis: The Effects of CBT as a Clinic- & School-Based Treatment on Students' Mathematics Anxiety. *International Electronic Journal of Mathematics Education, 15,* Article No. em0576. https://doi.org/10.29333/iejme/7598

Boettcher, H., & Barlow, D. H. (2019). The Unique and Conditional Effects of Interoceptive Exposure in the Treatment of Anxiety: A Functional Analysis. *Behaviour Research and Therapy, 117,* 65-78. https://doi.org/10.1016/j.brat.2018.12.002

Caviola, S., Toffalini, E., Giofrè, D., Ruiz, J. M., Szűcs, D., & Mammarella, I. C. (2022). Math Performance and Academic Anxiety Forms, from Sociodemographic to Cognitive Aspects: A Meta-Analysis on 906,311 Participants. *Educational Psychology Review, 34,* 363-399. https://doi.org/10.1007/s10648-021-09618-5

Curtiss, J. E., Levine, D. S., Ander, I., & Baker, A. W. (2021). Cognitive-Behavioral Treatments for Anxiety and Stress-Related Disorders. *Focus, 19,* 184-189. https://doi.org/10.1176/appi.focus.20200045

Devine, A., Hill, F., Carey, E., & Szűcs, D. (2018). Cognitive and Emotional Math Problems Largely Dissociate: Prevalence of Developmental Dyscalculia and Mathematics Anxiety. *Journal of Educational Psychology, 110,* 431-444. https://doi.org/10.1037/edu0000222

Dondio, P., Gusev, V., & Rocha, M. (2023). Do Games Reduce Maths Anxiety? A Meta-Analysis. *Computers & Education, 194,* Article 104650. https://doi.org/10.1016/j.compedu.2022.104650

Furner, J. M., & Duffy, M. L. (2022). Addressing Math Anxiety in a STEM World: Preventative, Supportive, and Corrective Strategies for the Inclusive Classroom. *European Journal of STEM Education, 7,* 1-10. https://doi.org/10.20897/ejsteme/12645

Gettinger, M., & Seibert, J. K. (2002). Contributions of Study Skills to Academic Competence. *School Psychology Review, 31,* 350-365. https://doi.org/10.1080/02796015.2002.12086160

Guimarães, A. P. L., Haase, V. G., & Neufeld, C. B. (2021). Cognitive-Behavioral Intervention for Math Anxiety in Childhood: A Case Report. *Dementia & Neuropsychologia, 15,* 286-290. https://doi.org/10.1590/1980-57642021dn15-020018

Hamdani, S. U., Zafar, S. W., Suleman, N., Waqas, A., & Rahman, A. (2022). Effectiveness of Relaxation Techniques 'as an Active Ingredient of Psychological Interventions' to Reduce Distress, Anxiety and Depression in Adolescents: A Systematic Review and Meta-Analysis. *International Journal of Mental Health Systems, 16,* Article No. 31. https://doi.org/10.1186/s13033-022-00541-y

Harlen, W. (2005). Teachers' Summative Practices and Assessment for Learning-Tensions and Synergies. *Curriculum Journal, 16,* 207-223. https://doi.org/10.1080/09585170500136093

Hembree, R. (1990). The Nature, Effects, and Relief of Mathematics Anxiety. *Journal for Research in Mathematics Education, 21,* 33-46. https://doi.org/10.2307/749455

Jameson, M. M. (2014). Contextual Factors Related to Math Anxiety in Second-Grade Children. *The Journal of Experimental Education, 82,* 518-536. https://doi.org/10.1080/00220973.2013.813367

Jamieson, J. P., Black, A. E., Pelaia, L. E., & Reis, H. T. (2021). The Impact of Mathematics

Anxiety on Stress Appraisals, Neuroendocrine Responses, and Academic Performance in a Community College Sample. *Journal of Educational Psychology, 113,* 1164-1176. https://doi.org/10.1037/edu0000636

Johnson, D. W., Johnson, R. T., & Stanne, M. B. (2000). Cooperative Learning Methods: A Meta-Analysis. https://www.tablelearning.com/uploads/File/EXHIBIT_B.pdf

Joshi, D. R., Adhikari, K. P., Khanal, B., Khadka, J., & Belbase, S. (2022). Behavioral, Cognitive, Emotional and Social Engagement in Mathematics Learning during COVID-19 Pandemic. *PLOS ONE, 17,* e0278052. https://doi.org/10.1371/journal.pone.0278052

Kabat-Zinn, J., & Hanh, T. N. (2009). *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. Delta.

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.) (2001). *Adding It Up: Helping Children Learn Mathematics*. National Academy Press.

Little, M. E. (2009). Teaching Mathematics: Issues and Solutions. *Teaching Exceptional Children Plus, 6,* Article No. 1.

Maloney, E. A. (2016). Math Anxiety: Causes, Consequences, and Remediation. In *Handbook of Motivation at School* (pp. 408-423). Routledge.

Moustafa, A. A., Al-Emadi, A. A., & Megreya, A. M. (2021). The Need to Develop an Individualized Intervention for Mathematics Anxiety. *Frontiers in Psychology, 12,* Article 723289. https://doi.org/10.3389/fpsyg.2021.723289

Namkung, J. M., Peng, P., & Lin, X. (2019). The Relation between Mathematics Anxiety and Mathematics Performance among School-Aged Students: A Meta-Analysis. *Review of Educational Research, 89,* 459-496. https://doi.org/10.3102/0034654319843494

Olaoluwa, S. A. (2021). Applying Cognitive Therapy for Depression and Anxiety in Mathematics Education for Students' Sustainable Performance. *Creative Education, 12,* 1407-1418. https://doi.org/10.4236/ce.2021.126107

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic Emotions in Students' Self-Regulated Learning and Achievement: A Program of Qualitative and Quantitative Research. *Educational Psychologist, 37,* 91-105. https://doi.org/10.1207/S15326985EP3702_4

Pizzie, R. (2022). Mind, Brain, and Math Anxiety. In *Handbook of Cognitive Mathematics* (pp. 349-383). Springer International Publishing. https://doi.org/10.1007/978-3-031-03945-4_29

Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2013). Math Anxiety, Working Memory, and Math Achievement in Early Elementary School. *Journal of Cognition and Development, 14,* 187-202. https://doi.org/10.1080/15248372.2012.664593

Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math Anxiety: Past Research, Promising Interventions, and a New Interpretation Framework. *Educational Psychologist, 53,* 145-164. https://doi.org/10.1080/00461520.2018.1447384

Schoenfeld, A. H. (2016). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics (Reprint). *Journal of Education, 196,* 1-38. https://doi.org/10.1177/002205741619600202

Sheromova, T. S., Khuziakhmetov, A. N., Kazinets, V. A., Sizova, Z. M., Buslaev, S. I., & Borodianskaia, E. A. (2020). Learning Styles and Development of Cognitive Skills in Mathematics Learning. *EURASIA Journal of Mathematics, Science and Technology Education, 16,* em1895.

Son, A. L., & Fatimah, S. (2020). Students' Mathematical Problem-Solving Ability Based on Teaching Models Intervention and Cognitive Style. *Journal on Mathematics Educa-*

tion, 11, 209-222. https://doi.org/10.22342/jme.11.2.10744.209-222

Stanborough, R. J. (2020). *How to Change Negative Thinking with Cognitive Restructuring.* https://www.healthline.com/health/cognitive-restructuring

Supekar, K., Iuculano, T., Chen, L., & Menon, V. (2015). Remediation of Childhood Math Anxiety and Associated Neural Circuits through Cognitive Tutoring. *Journal of Neuroscience, 35,* 12574-12583. https://doi.org/10.1523/JNEUROSCI.0786-15.2015