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MATH AFFECT & MS MATH INTERVENTIONS

Mathematical Affect and Middle School Mathematics Interventions

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Abstract

This systematic literature review gives an overview of 15 peer reviewed journal articles to determine the best interventions for middle school mathematics students. Journal articles are dated 2020-2025 and include research about middle school math students in the age ranges from 11-15 years old. The turmoil of adolescent development during middle school adds an additional factor to consider during middle school math interventions. Middle school students must have basic needs, both physiological and emotional, met before they are able to use the higher cognitive skills needed for the execution of the mathematical content during interventions.

The addition of mathematical affect with middle school mathematics intervention students helps to meet student needs, increases student self-esteem, and reduces math anxiety during interventions to improve conceptual mathematics learning outcomes.

Keywords: middle school, 6th grade, 7th grade, 8th grade, math affect, and math intervention

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Mathematical Affect and Middle School Mathematics Interventions

As a math interventionist at a school ranging in grades from kindergarten through eighth grade, I am researching how to fill in the conceptual gaps and meet the standards of my struggling students in mathematics. Exploring what each of my students is struggling with in their grade level math classes, I found the most effective strategies to help students as an interventionist involve explicit, systematic instruction on the foundational mathematics skills. Especially with middle school students, I find myself needing to meet other needs the students have, which are seemingly unrelated to mathematics. Middle school interventions also include developing a connection with the students to reduce anxiety, increase self-esteem, and build confidence in their own mathematical skills to make the interventions more effective.

Mathematical interventions focus mainly on the need for helping struggling students meet the state or national content standards. Mathematical interventions primarily consist of content intervention strategies when there are many other factors that may be barriers to learning such as affect: math anxiety, self-esteem, and attitude. How does the literature support inclusion of mathematical affect, with middle school students during math intervention to increase efficacy of students' conceptual mathematics learning outcomes?

Literature Review

The claim could be made that current mathematical intervention strategies for middle school students mostly include mathematical content interventions. The turmoil of adolescent development during middle school adds an additional factor to consider during middle school math interventions. Middle school students must have basic needs, both physiological and emotional, met before they are able to use the higher cognitive skills needed for the execution of

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the mathematical content during interventions (National Middle School Association [NMSA], 2003).

Adolescent Development

Middle school is a critical time for teachers to make sure students have a positive view of mathematics. These students have unique ways of thinking about themselves and how the world around them functions (NMSA, 2003). Middle school students are beginning to establish a sense of self and assert their independence, but they still need the guidance of trusted adults, such as teachers. While it is necessary to have needs met to reach a level to be able to learn mathematics, students may have varying needs on any given day, causing a need to adjust interactions with the students, and adjust instructional strategies. The National Middle School Association (NMSA), now known as the Association for Middle Level Educators, summarized the characteristics of young adolescents in their 2003 book. The book emphasizes the importance of remembering middle school students have many changes happening including physical development with rapid growth and hormonal changes, cognitive/intellectual development at varying levels, moral development, psychological development, and social-emotional development. All these factors add an additional element to being a middle school math student. In order to be successful academically, middle school students need to have developmental needs met first (NMSA, 2003).

Classroom Culture

Classroom culture creates a safe or unsafe environment for students to learn within. Students will avoid asking for help when a classroom teacher or peer makes the student feel uncomfortable (Ryan & Pintrich, 1997). Teachers who create a safe classroom environment and whom the students feel comfortable approaching are more likely to meet the emotional needs of

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the student and create a sense of safety than those who do not. When the students feel safe, they are in a better mental state to learn mathematical concepts. Establishing a supportive and positive classroom environment for middle school students is a complicated task (Morton, 2022). The positive classroom culture is a necessary component to a successful middle school mathematics class, as well as during mathematics intervention times. Positive emotions created by teachers in the classroom, such as enthusiasm and motivation, increase academic engagement and performance (Sakiz et al., 2012). Teachers can help students to feel more confident by creating a safe classroom environment for student learning.

Explicit Instruction

Interventionists usually focus instruction on the conceptual knowledge of math skills students are lacking. “Conceptual knowledge refers to knowledge of the underlying structure of mathematics-the relationships and interconnections of ideas that explain and give meaning to mathematical procedures” (Eisenhart et al., 1993, p. 9). Explicit instruction during conceptual mathematics intervention helps students break down problems and understand mathematics concepts. Clear directions, hands-on examples, repeated practice until mastery, and constructive criticism are important components of explicit instruction (Powell et al., 2021). Content intervention strategies for middle school math may include explicit instruction of conceptual and foundational mathematics skills to help better focus the interventions and use the time effectively. Teachers also use explicit strategies as part of helping students learn problem solving strategies, multiple representations, vocabulary and mathematical language instruction, reteaching, scaffolding, and additional practice (Powell et al., 2021). Explicit instruction during middle school mathematics interventions has a place in intervention strategies and are critical to student understanding but cannot be the only focus of mathematics interventions at the middle

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school level. There is a need to teach the entire child and ensure that the students are in the best mental space for learning before attempting to use explicit instruction for mathematical content interventions. A challenge for researchers is to recognize the interdependence of mathematical affect and mathematical reasoning (Zan et al., 2006).

Affect

Middle school mathematics students are not only thinking about math. Developmentally, adolescents are going through social, physical, and emotional changes which influence the student's ability to complete tasks and learn new mathematical concepts (NMSA, 2003). When middle school students cannot think about math because of social or emotional factors, teachers need to adjust instruction and help the students mentally prepare to facilitate thinking and learning. Mathematical affect is the role of emotions and other factors which influence mathematical learning. When students are doing mathematics, they need to be in control of their emotions, or they are not able to think or perform mathematics tasks (Goldin, 2002).

Emotions play a big part in the learning experience. Emotions require brain power which limits problem solving capabilities of the student (Mayer, 1990). Meeting the emotional needs of middle school students helps them to reach a higher level of cognition. Students are better able to do cognitively demanding tasks, such as mathematics, when their emotional needs are being met. Emotions impede attention and memory processing (Zan et al., 2006). When a middle school student is under the influence of their emotions, their ability to learn may be hijacked by their feelings. Factors of affect impacting middle school mathematics interventions include motivation and self-efficacy, which could influence levels of math anxiety (Bandura & Ramachaudran, 1994; Usher & Pajares, 2008; Zimmerman, 2002).

Motivation

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Motivation is “a theoretical construct that explains behavior and gives reasons for people’s actions, desires and needs” (San Jose, 2018, p. 31). Middle school students need motivation to learn about math and complete math tasks. Barrett 2009 describes affect as a strong emotion that involves motivation and actions to move forward with a task. The claim could be made that it is difficult to motivate middle school students because of developmental changes regularly impacting their emotions and ability to regulate their emotions (NMSA, 2003).

Self-Efficacy

“Self-efficacy, a concept introduced by psychologist Albert Bandura, refers to an individual’s belief in their capacity to execute behaviors necessary to produce specific performance outcomes” (Lopez-Garrido, 2025, para. 1). Students gain self-confidence knowing they have the ability to complete a mathematical task. When a middle school student believes in their own ability to complete a mathematical task, they are more likely to be successful with that task (Pajares & Miller, 1994). When students have lower levels of self-efficacy this may increase mathematical anxiety.

Mathematical Anxiety

Mathematical anxiety is “feeling of tension, apprehension or even dread, that interferes with the ordinary manipulation of numbers and the solving of mathematical problems” (Ashcraft & Faust, 1994 p. 98). Anxiety, specifically related to mathematics, runs deep within teachers and students. Just mentioning it is time for math class causes changes in body language and attitude of many students (Tang, 2021). Many people are afraid of mathematics or specific topics related to mathematics (Goldin, 2002, p. 63). Middle school students may avoid math or math related topics as a result of math anxiety. This may result in a situation where the student does not learn the necessary math to be a better mathematics student and therefore creates more math anxiety.

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As educators we need to find a way to reduce math anxiety for middle school math students to help increase the learning outcomes.

Theoretical Framework

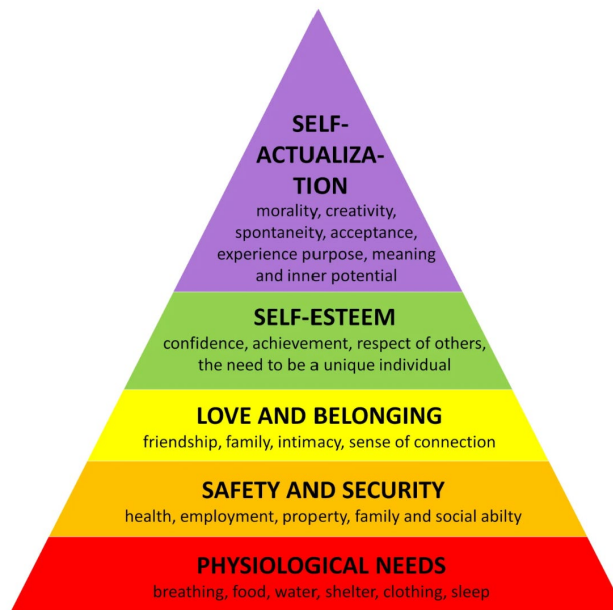
The following section includes a theoretical framework which guided the research for the systematic literature review. It explores the basic human needs to help students reach a higher level of cognition to be able to learn mathematics during interventions.

According to Maslow's Theory of Human Motivation (see Figure 1), summarized from Simply Psychology (McLeod, 2025), physiological needs are the basic survival needs including food, water, shelter, clothing, and sleep. If these needs are not met, there will be little incentive for students to do other things. Maslow's next level includes safety, security, love and belonging which are psychological needs. When these needs are met, humans can move to the next level. The next level includes self-esteem, confidence, and achievement. "Satisfaction of the self-esteem need leads to feelings of self-confidence, worth, strength, capability and adequacy of being useful and necessary in the world" (Maslow, 1943, p. 382). When students have increased self-esteem, they believe in their own abilities to complete tasks. As each level of Maslow's Theory of Human Motivation increases, the needs become more complex and harder to meet, resulting in behaviors that may be determined by more than one need at a time and a desire to control their environment.

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Figure 1

Maslow's Theory of Human Motivation



Simply Psychology Simply Psychology (McLeod, 2025)

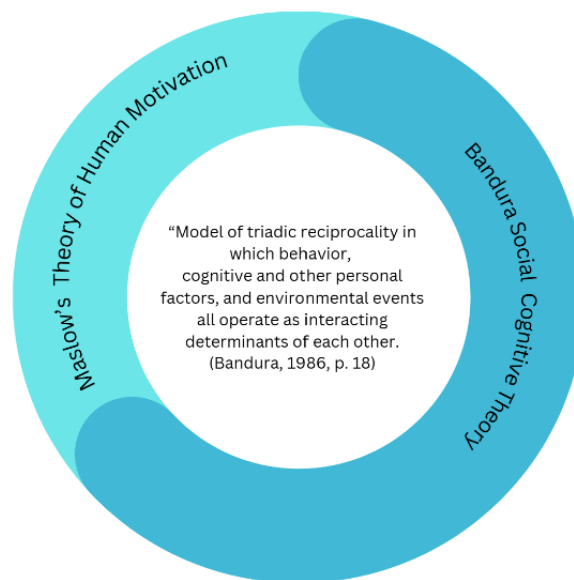
Schools are a social environment lending little control to the children. Bandura's Social Cognitive Theory says children who believe they have a sense of control over experiences are more willing participants in their own learning. A positive learning environment where students are gaining knowledge, acquiring skills, and increasing confidence all create a higher likelihood of the child being able to use and remember knowledge in the future. "Based on the theory of Bandura (1993), children who believe that they can control their experiences and master complex subject matters affect their motivation, interest, and academic achievement" (Shaw, 2008, p. 18). Meeting the needs of the child physically and emotionally gives students a sense of control over their environment and improves the way a child thinks. This also improves the child's self-esteem, reduces anxiety, and increases the ability to master complex skills such as mathematics.

Human needs are not easily separated from thinking and emotions. "Human functioning is explained in terms of a model of triadic reciprocity in which behavior, cognitive and other

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personal factors, and environmental events all operate as interacting determinants of each other” (Bandura, 1986, p. 18). Triadic reciprocity is a psychological term Bandura used to describe the interconnect relationship of a social environment, the way a person thinks, and their behaviors (Bandura, 1986). These factors all influence the other factors and are inseparable (see Figure 2). Bandura’s Social Cognitive Theory links the need to meet both the physical and emotional needs of the middle school mathematics intervention students and give them a sense of control over their environment before the attempt to intervene with the cognitively demanding tasks required during mathematics interventions.

Figure 2
Theoretical Framework Model



The main purpose of this research is to determine the best interventions for middle school mathematics students. When the mathematics students struggle with needs that are lower on Maslow’s Theory of Motivation and are influenced by the cognitive, personal, and environmental elements from Bandura’s Social Cognitive Theory (See Figure 2), will the interventions that include mathematical affect improve conceptual interventions because the students are in a better

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mental space for learning. Conducting a systematic literature review will help determine the best practices to increase student self-esteem and reduce math anxiety, which increases the effectiveness of conceptual understanding during mathematics interventions with middle school students.

Research Questions

This research was guided by the following questions:

1. What is the relationship between self-efficacy, self-esteem, and anxiety in teaching conceptual math interventions?
2. How does the literature support the inclusion of mathematical affect with middle school students during intervention to increase efficacy of students' conceptual mathematics learning outcomes?

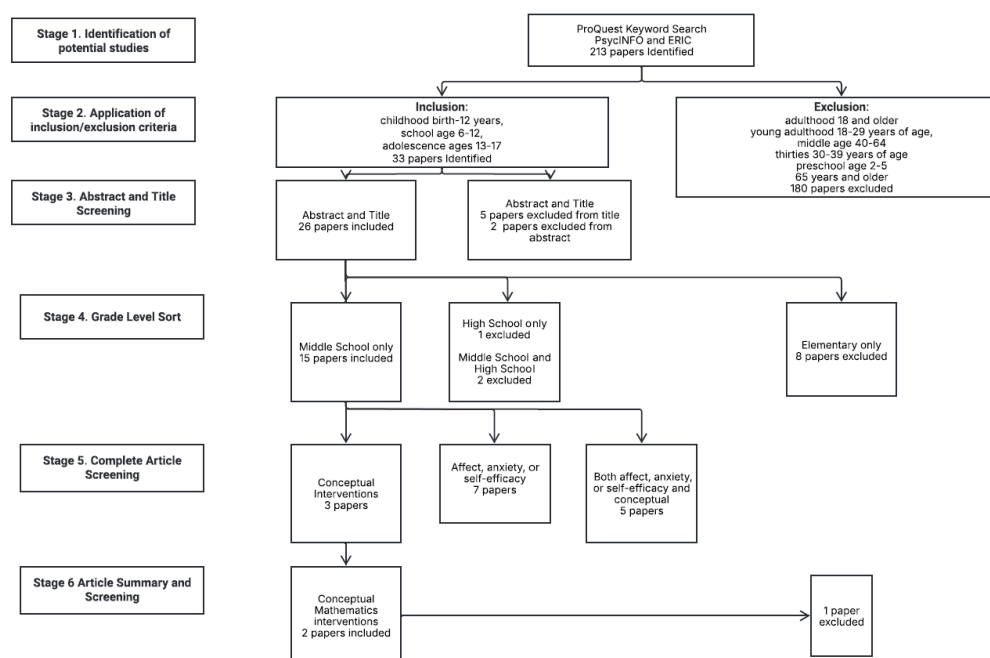
Method

This paper is a systematic literature review about the need for interventions to help struggling mathematics students increase conceptual knowledge and reduce math anxiety for better educational outcomes. I used the ProQuest Platform to search the databases PsycINFO and ERIC simultaneously. These databases were selected because they include articles about education, behavioral and social sciences, and education from a psychological perspective. The search for literature included keywords: middle school, junior high, 6th, 7th, 8th, math* affect, and math* intervention. The articles in this search were all peer-reviewed and written after January 2020. Articles written after 2020 will highlight perspectives on increasing social emotional concerns with students post-Covid and be more applicable to current classroom education. The language the articles were written was limited to English and did not include Spanish, Chinese, or Japanese. This initial search resulted in 213 articles (see Figure 3). The additional inclusion

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criteria included age categories of: childhood birth-12 years, school age 6-12, adolescence ages 13-17. The exclusion criteria age groupings were: adulthood 18 and older, young adulthood 18-29 years of age, middle age 40-64, thirties 30-39 years of age, preschool age 2-5, and 65 years and older. The reason the age categories were included or excluded was to find articles written about the middle school aged students who range from 11-15 years of age.

Figure 3
Literature Search Flowchart



After the additional search inclusion and exclusion criteria were added, this resulted in 33 articles. Based on titles alone, 5 articles were eliminated because the title did not fit with research questions. Based on the abstract reading, 2 articles were eliminated because they did not fit with research questions. The remaining 26 articles were sorted into categories of elementary only (8), high school only (1), middle school and high school (2), or middle school only (15). The articles that mentioned elementary or high school populations were eliminated. Elementary and high

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school students have different needs conceptually and emotionally than middle school students. “Adolescence is a particularly dynamic period of brain development, second only to infancy in the extent and significance of the neural changes that occur. The nature of these changes—in brain structures, functions, and connectivity—allows for a remarkable amount of developmental plasticity unique to this period of life, making adolescents amenable to change” (Committee on the Neurobiological and Socio-behavioral Science of Adolescent Development and Its Applications et al., 2019). The research about elementary and high school students would not be easily generalized to middle school students so, articles were excluded as the primary area of focus of this literature review is middle school math students. Articles, including only middle school, were read and summarized for further analysis. These articles were sorted again with 3 articles that are only conceptual interventions, 7 articles that are only affect, anxiety, or self-efficacy and 5 articles that are both affect, anxiety, or self-efficacy and conceptual. One more article was eliminated after reading because it was not about conceptual interventions. Leaving 14 articles for the literature review.

Systematic Literature Review

Results

Research Question 1: What is the relationship between self-efficacy, self-esteem, and anxiety in teaching conceptual math interventions?

Answer 1: We cannot tell from literature in the last 5 years.

The results of the systematic literature review since January 2020 indicate that many researchers are focusing only on math anxiety with middle school students, and not choosing to explore self-efficacy, or self-esteem. This could be part of the school culture post-Covid where teachers and support staff are experiencing difficulties with student behaviors, conceptual holes,

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learning loss, all as a result of shutting down schools during the Covid-19 pandemic and online learning delivery. Students and teachers are experiencing higher levels of general or trait anxiety, which might also increase the levels of math anxiety. “Overall, COVID-19 stressors led to a significant increased risk of psychological problems, depression, anxiety, post-traumatic stress disorder, physical, emotional, and sexual violence, poverty, teen pregnancy, and suicide attempts among adolescents” (Garza Schuster, 2022, p. 3). The search for self-efficacy, self-esteem and teaching conceptual mathematics interventions at the middle school level is an area researchers need to explore more. Students with self-efficacy and higher self-esteem would be more successful in learning mathematical concepts but the research over the last five years has not focused on these topics occurring together.

Table 1
Conceptual Intervention Related Articles

Study	Summary
Namkung & Bricko (2021)	Explicit, concrete interventions on algebraic equation solving to improve conceptual and procedural knowledge of 6 th grade mathematical students.
Hwang & Riccomini (2021)	Researchers developed an algorithm based on the student errors during fraction computation reflecting misconceptions at each stage of the computation.

The two articles in Table 1 (Namkung & Bricko, 2021 and Hwang & Riccomini, 2021) discussed only conceptual mathematics interventions, both emphasizing the benefits of explicit conceptual interventions to help students be successful in mathematics. Neither of these articles mentioned self-efficacy, self-esteem, and anxiety in teaching conceptual math interventions.

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The first of these articles was about an algebraic equation solving intervention. For students with learning difficulties to understand algebraic equations, teachers need to help them make sense of the tasks. Middle school math students are transitioning from concrete concepts to abstract concepts and need to be explicitly taught how to represent these concepts (Namkung & Bricko, 2021).

The second article about conceptual interventions discussed fractions and helping teachers to analyze error patterns to better inform intervention instruction. If students cannot comprehend fractions and apply the learning, future mathematics tasks will be difficult (Hwang & Riccomini, 2021, p. 132). The findings of this research helps to better inform instruction of students at varying levels of understanding and determining which students might have “specific problematic areas requiring more intensive instruction and intervention” (Hwang & Riccomini, 2021, p. 133). This research is only about the conceptual misconceptions and errors with fractions. It does not discuss how educators support the relationship between self-efficacy, self-esteem, and anxiety in teaching conceptual math interventions.

Both conceptual articles discuss the need for additional research at the middle school level and future conceptual intervention needs of middle school students. “Mathematics research and evidence-based interventions on algebra for secondary students with [math difficulties] are scarce” (Namkung & Bricko, 2021, p. 111). Therefore, educational and mathematics researchers need to focus research on middle school students’ mathematical interventions to help teachers improve student learning outcomes.

Research Question 2: How does the literature support the inclusion of mathematical affect with middle school students during interventions to increase efficacy of students’ conceptual mathematics learning outcomes?

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Answer 2: The research of the literature about mathematical affect found articles focused on reducing mathematical anxiety during interventions to increase conceptual outcomes, but do not directly address self-efficacy and self-confidence. Self-efficacy and self-confidence are implied or addressed in other terms such as self-image or student attitude.

Table 2
Physical Response to Math Anxiety

Study	Summary
Suárez-Pellicioni et al. (2021)	Neurocognitive mechanisms were studied to explain why mathematics attitudes can predict improvement in mathematical performance.
Tang (2021)	Respiratory Sinus Arrhythmia of students with high math anxiety but low trait anxiety and how it influences mathematical performance.

The anxiety some people experience because of mathematics can be caused by several different factors such as level of conceptual understanding, emotional regulation, behavior regulation, or lack of interest. Anxiety may cause a physical response in the body such as changes in brain activity, heart rate, or respiration rate. Teachers need "targeted interventions that aim to reduce math anxiety" (John et al., 2023, p. 230) so middle school students have improved conceptual mathematics learning outcomes.

Math anxiety influences brain activity, heart rate, respiration rates, and response times in middle school mathematics students. Two articles displayed in Table 2 (Suárez-Pellicioni et al., 2021 and Tang, 2021) discussed the physical effects on middle school students who experience math anxiety compared to student who did not experience math anxiety. The first article

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discussed fMRI brain scans to see how the brain responds to multiplication facts when a positive attitude towards mathematics is present or not. Middle school students who had a positive attitude showed increased improvement in conceptual mathematics learning outcomes indicating that the brain processes better when it does not have to work so hard to retrieve the information.

The second article discussing the physical responses related to math anxiety in middle school students looked at the Respiratory Sinus Arrhythmia (RSA) rates as it related to the mathematical response times. The researchers used an EKG (electrocardiogram) to study the middle school students while they completed mathematics tasks and their Response Times (RT) to the tasks. “These results suggest a key role of the affective component of specific math anxiety in explaining the variance of math performance” (Tang et al., 2021, p. 7). The study showed middle school students with math anxiety will take longer to complete math tasks which may reduce the conceptual mathematics learning outcomes.

Table 3

Affect and Reducing Math Anxiety

Study	Summary
Yang et al. (2024)	Meeting students at the conceptual level and building on that level benefits students learning, especially lower-level students.
John et al. (2023)	Relationship between gender identity, peer support, and math anxiety and mathematical achievement.
Namkung et al. (2023)	Computation data of middle school students gathered to determine if separating the cognitive and affective elements makes a difference in math anxiety or not.
Weissgerber et al. (2022)	Math anxiety and self-concept influenced working memory and performance while learning about linear functions.

Modrek & Ramirez (2021) Regulation types as predictions for academic achievement.

Yang et al. (2024) did a study to investigate how meeting middle school students at their current conceptual level reduces anxiety and has positive mathematics learning outcomes. When students have a higher level of conceptual understanding their anxiety is lower, so meeting students at their level of understanding helps them be more successful with future concepts (Yang et al., 2024). This research shows the importance of knowing what concepts middle school students are missing, how to fill in those missing concepts, and how learning the best way to motivate students can help to alleviate their math anxiety to increase mathematical learning outcomes.

Two of the articles from Table 3, (John et al., 2023 and Namkung et al., 2023) discussed the emotional factors and took a gender-based approach to researching the emotional factors in reducing math anxiety. Boys are less likely to feel anxious about math than girls because boys are supposed to be good at math based on gender stereotypes. Peer support showed positive academic results, especially in mathematics with girls. “Despite an abundance of research linking math anxiety to reduced math outcomes, social-contextual correlates of math anxiety are not well understood. Attaining a deeper understanding of these correlates will provide insight into potential avenues for targeted interventions that aim to reduce math anxiety” (John et al., 2023, p. 230). These articles find some evidence for the emotional factors in reducing math anxiety but also identify a need to research more about math anxiety and achievement during adolescence. It may be important to undertake both cognitive and affective aspects of math anxiety to help students have the best conceptual outcomes (Namkung et al., 2023).

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Another article by Weissgerber et al. (2022) discusses math anxiety and self-concept influencing working memory and a students' ability to control their behavior. Middle school students find it difficult to learn when working memory is occupied with other things. "The optimal development of math capabilities may be compromised by math anxiety; good math abilities and low math anxiety may both be prerequisites for long-term learning success" (Weissgerber et al., 2022, p. 977). The thoughts and behaviors impact students' ability to learn mathematics.

Table 4
Affect to Engage and Reduce Math Anxiety

Study	Summary
Cuder et al. (2024)	Implementation of interventions at the middle school level helps to ensure students do not have negative affective-motivational factors in mathematics and science to ensure future STEM choices.
Zappala-Piemme et al. (2023)	Interventions were not mathematically focused but included lessons to build growth mindset and grit increasing.
Gutica & Petrina (2021)	Investigated student attitudes, affect/emotions toward the game Heroes of Math Island and how they react to the animated monkey as an emotional agent resulting in increased math performance.
Cai et al., (2020)	Augmented reality-based learning applications positively influenced students' probability and statistics learning and attitudes.
Van de Weijer-Bergsma & Van der Ven (2021)	Enjoyment and cognitive load were examined as potential ways to personalize mathematics instruction and increase word problem performance. Personalization did not increase student performance.

Cuder et al. (2024), studied the impact of math anxiety on future STEM choices. Middle school students who were better at math showed lower levels of math anxiety and affective-motivational factors. Students were more likely to choose a STEM school in the future for their

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high school options leading to future STEM careers. This study recommends that teachers implement interventions at the middle school level to help ensure students do not have negative affective-motivational factors in the future.

Part of working through mathematics tasks is developing perseverance and stamina to do challenging things. The interventions in this study discussed perseverance and helping students feel a sense of control through creating a positive classroom environment to help students be more flexible with their thinking (Zappala-Piemme et al., 2023, p. 2986). The article says when middle school mathematics students feel they have a sense of control it increases the students' capacity to handle stress and anxiety which improve academic learning outcomes. This article was not specifically about mathematics interventions but discussed positive learning outcomes for mathematics scores for middle school students when improving mind set and establishing a level of personal control over the situations.

The remaining three articles (Gutica & Petrina 2021, Cai et al. 2020 and Van de Weijer-Bergsma & Van der Ven 2021) discuss ways to make mathematics more engaging for middle school students. There were two articles using computer game based or augmented reality with a positive impact on student learning outcomes. The third article attempted to use a way to personalize the mathematics to help better engage the students in the learning, but the results showed personalization did not have an impact on the mathematics learning outcomes.

Interventions combining gaming and emotions may lead to increased teacher awareness and additional implementation of other interventions supporting the psychological needs of middle school students (Gutica & Petrina, 2021) because the results showed positive learning outcomes, as well as positive student attitudes toward games and the mathematics interventions.

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Middle School mathematics students need interventions to help increase student engagement and desire to learn mathematics. This also helps to reduce anxiety and increase the conceptual learning.

Discussion

Middle school students who do not understand critical mathematics concepts are hard to motivate to participate during math tasks. A lower level of conceptual understanding and lack of motivation may cause math anxiety. Middle school mathematics students need teachers to intervene with both the concepts and mathematical affect to increase efficacy of students' conceptual mathematics learning outcomes.

Adding mathematical affect to mathematics interventions helps keep middle school students entertained and better engaged in the learning. Teachers can help to make the concepts easier to understand and applicable to the individual situations of the students. Teachers need to know their students, what reduces the students' math anxiety, and when to push them to reach a higher level of conceptual mathematics learning so students will be able to better participate in mathematics tasks and have improved mathematical learning outcomes (Yang et al., 2024).

As Maslow's Theory of Human Motivation states, teachers can help to meet physiological and psychological needs to increase students' motivation. The feeling of safety, security, love and belonging increases self-esteem, confidence, and eventually conceptual mathematics learning outcomes. Students with positive math attitudes have greater improvement in conceptual mathematics skills. When a student does not believe they have the necessary skills to complete a task, they are less likely to put forth the effort to attempt to complete the task (Pajares & Miller, 1994, p. 201). Teachers who include interventions to help students have a more positive math attitude and build confidence will motivate students to perform better.

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(Zimmerman & Martinez-Pons, 1990). A positive self-image and focusing on positive behaviors help students learn, feeling supported, reduces mathematical anxiety, and increases mathematical achievement. If middle school students can regulate their thoughts, and behaviors, it helps them to remain on task both physically and mentally which improves mathematical learning outcomes.

By incorporating Bandura's Social Cognitive Theory and remembering the elements of triadic reciprocity, teachers can provide students with math interventions which connect the social aspects of middle school and influence the way the students think and behave to improve mathematical learning outcomes (Zappala-Piemme et al., 2023; Zimmerman & Martinez-Pons, 1990). When teachers adjust their teaching practices to better meet the physical and emotional needs of the individual middle school mathematics students during mathematics interventions, the social environment is impacted in a positive manner and students will feel they have a better sense of control over their school environment. "Children who were more autonomous were more likely to be interested, enthusiastic, and enjoy learning activities, whereas children who were less autonomous were more likely to be bored, anxious, and even angry in the classroom" (Skinner et al., 1998, p. 178). This sense of control will lead to improved conceptual mathematics learning outcomes. This means when teachers add mathematical affect to mathematics interventions, students will have better mathematical outcomes.

Limitations and Future Research Recommendations

Limitations of this systematic literature review include lack of studies available researching mathematics interventions at the middle school level. Initial findings of many studies are the elementary or high school level but did not include many articles about middle school students. Another limitation with the initial findings included interventions that were not mathematics related, such as reading interventions.

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An area for future research needs to focus more on the middle school student population as a whole. Middle school students are a complex population and have unique developmental needs. It is difficult to generalize results from elementary students or high school student studies and apply the findings to the middle school population. Further studies about middle school mathematical interventions would help teachers better implement mathematics interventions for middle school students. However, there is a possibility researchers hesitate to study middle school students because of the complexity of developmental needs contributing to difficulties isolating variables that effect results.

Conclusions

When middle school students' needs are met, they are more comfortable in the learning environment. They are better able to advocate for themselves when they begin to struggle and choose mathematics in the future, thereby learning more math concepts. Creating a safe place to meet the students' needs during math interventions allows the students to better focus on the mathematical concepts, reduce math anxiety, and improve conceptual learning outcomes.

Middle school students need teachers to help meet their physical and emotional needs to reduce anxiety before they are cognitively able to execute mathematical tasks. If teachers meet the physical and emotional needs of middle school mathematics students, the students will have increased self-esteem, a better attitude towards mathematics, and improved learning outcomes. Middle School students need to trust teachers and peers, and not be afraid to ask questions, or make mistakes. "Students' mental health is an important teaching concern, and math anxiety is the most prominent emotion in mathematics learning" (Yang et al., 2024, p. 19556). Reducing the body's physical response to math anxiety increases response times to mathematical tasks.

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Meeting students at the current conceptual level and working from there reduces math anxiety and improves conceptual learning outcomes. Helping middle school mathematics students work to support each other and to talk through tasks, learn from mistakes, and describe mathematical thinking also reduces math anxiety. Helping students to persevere when the math tasks are difficult and creating engagement by making the mathematics interventions more interesting all help students to enjoy mathematical tasks and increase conceptual learning outcomes. Implementation of mathematics interventions at the middle school level helps to ensure students do not have negative affective-motivational factors in mathematics and hopefully throughout their lives. As an interventionist, I want my students to have skills to be successful in life, and not just mathematics.

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