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School Leadership's Role in the Disruption of Math Anxiety

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Abstract

Math anxiety, the discomfort or fear of math, spans the globe and affects a wide range of ages, from early childhood to adulthood. Teachers and students may experience math anxiety in a variety of contexts. Teachers who suffer from math anxiety often express negative attitudes about math and lack confidence in their pedagogical content knowledge of mathematics, which influences the instructional practices they choose to implement in their classrooms. Student math anxiety adversely affects student engagement and achievement in math. School leadership is fundamental to effective teaching and student learning and plays a vital role in teacher and student math anxiety. By identifying teachers and students who suffer from math anxiety, leaders can create the conditions to reduce and prevent this anxiety. Leading this work will involve the integration of both instructional and transformational leadership to develop a school culture that is open to sharing and strengthening their knowledge of instructional practices focused on math improvement. To address anxiety concerns and advance student achievement in mathematics, it is beneficial for school leaders to adopt some of the characteristics of a learning organization. To be a learning organization requires leadership to cultivate a climate of trust among members of the school community to develop collective efficacy. It entails school leaders and staff participating in professional learning and coaching opportunities to build the collective capacity of evidence-informed instructional practices in math. Using self-reflection, teachers can acknowledge their own feelings and potential biases towards mathematics and seek support to deepen their understanding of math concepts and pedagogy. The engagement of colleagues in the acquirement of best practices in math instruction will develop positive classroom environments that immerse students in the learning of math. By changing how leaders and teachers approach mathematics, math anxiety will decrease, and student achievement will improve.

Keywords: teacher math anxiety, student math anxiety, school leadership, student achievement in math, instructional practices in math

In the past three years, I have held the positions of a math coach and a math strategist within a large urban school district in Canada. These roles, coupled with my experience as a classroom teacher, have allowed me to work with leadership teams, teachers, and students across a variety of settings and grades to improve their understanding of mathematical concepts. Through these

experiences, it was evident that there were adults and students in every context displayed negative behaviors and attitudes towards math that influenced their confidence, instructional practices, and academic success in mathematics. These observations led me to explore teacher and student math anxiety. Through an examination of recent literature and my own lived experiences in education, there appeared to be a strong connection between math anxiety and math achievement, one that led to a decrease in a student's ability to learn mathematical concepts. With this in mind, I investigated how school leadership can influence educational practices to decrease teacher and student math anxiety to improve student achievement in mathematics.

Math Anxiety

When most often referring to math anxiety, many empirical studies cite Richardson and Suinn's (1972) definition of math anxiety, "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551). A more recent definition posited by Ganley et al. (2019) describes math anxiety as the "discomfort or nervousness that arises when thinking about or while doing math" (p. 2). Using these definitions, math anxiety appeared to span a range of developmental levels, from elementary-aged students all the way through to adulthood. Unsurprisingly, math anxiety led to lower math achievement and poor math skills (Ramirez et al., 2018). In a study conducted in the United States by Ramirez et al. (2013), they discovered that math anxiety negatively affected students' math achievement as young as grades one and two. Two other studies, one by Mutlu (2019) and another by Szczygieł (2020), also revealed that student achievement and self-esteem in math reduced in those individuals who experienced math anxiety. Understanding how math anxiety affects teachers' beliefs about math and their approaches to teaching math is also crucial. Teachers with math anxiety experienced negative feelings towards

mathematics, avoided mathematical tasks, and felt less confident in their ability to teach mathematics successfully (Rameriz et al., 2018).

Teacher Math Anxiety

Recent studies explored the relationship between teacher math anxiety and student learning (Ganley et al., 2019; Hollingsworth & Knight-McKenna, 2018; Ramirez et al., 2018). Ganley et al. (2019) posited that teacher math anxiety affected instructional methods, which influenced the achievement of students. Many teachers with math anxiety relied on traditional teaching methods based upon rote memorization without understanding, timed math tasks, and an overemphasis on correct answers (Hollingsworth & Knight-McKenna, 2018; Ramirez et al., 2018). These teaching techniques affected how students interacted and viewed mathematics. Ramirez et al. (2018) posited that, “the way teachers feel in the classroom and the indirect messages they convey through their practice may be an important factor shaping student math learning” (p. 10). There is a belief that these negative teacher feelings and messages towards math paired with poor math pedagogy and instructional practices led to lower student achievement in math (Ganley et al., 2019).

Research conducted by Ganley et al. (2019) and Ramiriz et al. (2018) determined that teacher math anxiety is more prevalent in elementary teachers than secondary teachers. Ganley et al. offered a potential explanation for this higher rate of math anxiety. They posited that many elementary teachers do not take math content-related courses as part of their teacher training, and they feel less confident in math and develop anxious feelings towards math. As a result, these teachers dedicate fewer instructional minutes to teaching math, incorporate less student participation, and have students with lower levels of achievement. Their math anxiety and the subsequent choices they made created an environment for their students that led to the development of math anxiety.

Student Math Anxiety

Several studies indicated that student math anxiety had a negative impact on math achievement (Donolato et al., 2020; Gunderson et al., 2017; Justicia-Galiano et al., 2017; Ramirez et al., 2013; Passolunghi et al., 2020; Szczygieł, 2020). In a large meta-analysis of 131 empirical studies, Namkung et al. (2019) discovered that math anxiety and math performance were negatively related in primary and secondary school students. Beilock and Willingham (2014) stated, "Math anxiety is not limited to a minority of individuals nor to one country. International comparisons of high school students show that some students in every country are anxious about math" (p. 29). With these kinds of statistics, it is not surprising that every classroom is comprised of some students with math anxiety. Qualitative case studies explored students' personal accounts of math anxiety and its effect on their learning of mathematical concepts. Students at a young age were able to effectively articulate their experiences and feelings about math, and through these descriptions, it was apparent that many students had negative feelings and attitudes towards mathematics (Carey et al., 2019; Di Martino & Zan, 2009; Larkin & Jorgensen, 2015; Towers et al., 2018).

One explanation for this decline in student achievement was that math anxiety reduced working memory (Beilock & Willingham, 2014; Ramirez et al., 2013; Ramirez et al., 2018). Working memory is "what allows you to keep several things in mind simultaneously, and to manipulate them in order to think and solve problems" (Beilock & Willingham, 2014, p. 29). When students felt anxious, they used a portion of their working memory to deal with the emotions they were feeling, which provided less working memory for completing mathematical tasks. Beilock and Willingham (2014) postulated that "Math anxiety essentially prompts students to do two things at once: solve the math problem and deal with worries about math (including worries about getting

the problem wrong, looking foolish, and what others might think of them)" (p. 30). This reduction in available working memory led to a decreased ability to complete math activities. Ramirez et al. (2013) uncovered an interesting relationship between math anxiety and working memory. They discovered that math anxiety more negatively impacted the achievement of students with high working memories than students with lower working memories. One explanation they offered for this is that "children who rely more heavily on WM when solving math problems (i.e., those with high levels of WM) are most impacted by math anxiety because worries about the situation deplete or interfere with the cognitive resources that support their math performance" (Ramirez et al., 2013, p. 196). Thus, when a student with a high working memory feels anxious, some of their working memory is focused on how they feel, leaving them with less working memory to use more advanced math strategies to complete math activities and results in poorer performance (Beilock & Willingham, 2014).

A study completed by Jameson (2013) looked at the role student self-concept played in determining students who experienced math anxiety as self-concept can significantly influence one's performance and level of math anxiety. Students who repeatedly had trouble in mathematics developed a negative attitude towards math, felt unmotivated, and were less confident in their mathematical abilities (Ramirez et al., 2013). Students became disengaged in math as their self-concept of their math abilities skewed and "students with a lower perception of personal competence may have difficulty shrugging off previous difficulties with math, which predisposes them to fear subsequent situations that involve math" (Ramirez et al., 2018, p. 152). Sometimes, students developed misconceptions about their math skills based on their interpretation of prior mathematical experiences and results. They perceived themselves to be poor math learners even though they might not be. Evidence suggested that this inaccurate self-perception of themselves in

math contributed to the development of math anxiety (Ramirez et al., 2018). Considering the detrimental effects of math anxiety, it is valuable for school leaders to examine the relationship between math anxiety and student learning.

Leadership Practice and Math Anxiety

Educational leaders can support teachers and students who exhibit signs of math anxiety. School leadership affects student learning by influencing the organizational structures that support teacher practice and instructional programming (Leithwood et al., 2020). Hallinger and Heck (2010) suggested that "leadership contributes to learning through the development of a set of structural and sociocultural processes that define the school's capacity for academic improvement" (p. 95). To elicit changes in math anxiety and student learning, leadership can create the conditions that lead to the formation of a positive school culture focused on addressing teaching beliefs and practices (Park et al., 2019). Research has shown that the more involved educational leaders are in the teaching and learning of students, the greater the likelihood of positively influencing student outcomes (Robinson et al., 2008). To build the collective capacity of evidence-informed practices proven to lessen math anxiety, involves the integration of two different leadership styles, instructional leadership and transformational leadership.

Instructional Leadership

Leadership practices in schools often place emphasis on improving teaching and student learning. Instructional leadership targets the "conditions that directly impact the quality of curriculum and instruction delivered to students in classrooms" (Hallinger, 2003, p. 338). A successful instructional leader requires the knowledge to create a supportive, trusting environment that allows for growth in teaching and learning (Le Fevre & Robinson, 2015). In

their research, Blasé and Blasé (2000) postulated "that effective instructional leadership integrates collaboration, peer coaching, inquiry, collegial study groups, and reflective discussion into a holistic approach to promote professional dialog among educators" (p. 136). Instructional leadership is responsible for developing the norms of a school community that cultivate a climate conducive to teaching and learning that aligns with the school's vision (Hallinger, 2003). In their study of different types of leadership on student outcomes, Robinson et al. (2008) found that "Leaders in schools where students performed above expected levels were more likely to be involved with their staff in curriculum planning, visiting classrooms, and reviewing evidence about student learning" (p. 667). To decrease math anxiety and build collective efficacy of mathematics pedagogy involves leaders ensuring they allocate sufficient time and resources to influence the professional learning of staff.

Transformational Leadership

There is evidence that shared leadership distributed throughout a school can positively influence teacher performance and student learning (Leithwood et al., 2020). Hallinger (2003) described transformational leadership as the sharing of leadership to increase the capacity of others in a school. He proposed, "Transformational leaders create a climate in which teachers engage in continuous learning and in which they routinely share their learning with others" (p. 338). He also suggested that often this style of leadership is distributed across the school community to develop the capacity of a range of stakeholders. This collective commitment and collaboration to change will assist with the reduction of math anxiety and the transformation of altering teacher practice (Harris & Jones, 2018). According to Robinson et al. (2008) "the types of motivational, collaborative, and interpersonal skills that are emphasized in transformational leadership research are essential to leaders' ability to improve teaching and learning" (p. 666). The

dispersed nature of transformational leadership often produces changes in how community members view change and innovation because they are more open and willing to take risks (Hallinger, 2003). This openness to change is crucial for teachers with math anxiety as they learn to adopt math pedagogy and strategies to decrease their anxiety and improve their understanding of mathematical concepts.

Integration of Leadership

Elements of instructional leadership and transformational leadership will lead to a decrease in teacher and student math anxiety. The integration of these types of leadership creates the conditions to reduce math anxiety, strengthen quality instructional practices, and develop a culture open to sharing leadership. In an empirical study by Marks and Printy (2003 as cited in Robinson et al., 2008), they discovered that combining aspects of instructional leadership and transformational leadership into an integrated model led to higher student achievement in the schools they studied. All stakeholders in the school community must invest in supporting student learning. Hallinger (2003) found that the combination of transformational and instructional leadership developed teacher leaders focused on school improvement. Ideally, the integration of these two different leadership styles will produce the desired outcomes necessary to reduce math anxiety by improving teacher practice and student learning in mathematics.

Leadership's Role in Decreasing Math Anxiety

The goal of many leaders and educators is to enhance the well-being and achievement of their students. What becomes challenging is how to do this work in schools to positively affect student learning. Bryk (2010) proposed that while teachers may have the most significant

direct impact on student learning, research has highlighted that how a leader organises and operates "a school has a major effect on the instructional exchanges in its classrooms" (p. 24). Hallinger and Heck (2010) discovered that effective school leadership was a contributing factor to school improvement and generated the organizational structures for the pursuit of academic achievement. Leithwood et al. (2020) posited that "[s]chool leadership has a significant effect on features of the school organization which positively influences the quality of teaching and learning. While moderate in size, this leadership effect is vital to the success of most school improvement efforts" (p. 6). When addressing math anxiety, school leadership must examine the causes of this anxiety and put support in place to lessen this anxiety to improve the teaching and learning of mathematics. Whether looking at teachers or students, some common causes of math anxiety emerged. Some of these causes are related to low self-confidence in math, poor math skills, parental influence, assessment practices, and classroom conditions (Carey et al., 2019; Ramirez et al., 2018; Towers et al., 2018). School leaders can influence educational practices to decrease teacher and student math anxiety and improve student achievement in mathematics.

How leaders organize and structure schools impacts instruction, the capacity of the staff, and the culture of the school community (Bryk, 2010). As Kershner and McQuillan (2016) stated, "change does not come about if people keep doing what they have always done" (p. 23). School leadership is fundamental in supporting the necessary changes required to reduce teacher and student math anxiety. Recognizing the negative influence that math anxiety has on educators and students will be important for leaders as they collaborate with teachers to identify how their personal biases towards math may be influencing their instruction and providing them with opportunities to learn evidence-informed teaching strategies to lessen math anxiety and improve student achievement.

In school settings with math anxiety, leaders can strive to change school environments by transforming the culture of the school to be collectively engaged in a common vision (Kershner & McQuillan, 2016). Tied to this notion of leaders inducing change, is collective efficacy. Hoy et al. (2006) describe collective efficacy as "the judgement of teachers that the faculty as a whole can organize and execute the action required to have positive effects on students" (p. 428). Research has shown that school staffs with greater collective efficacy are more open to taking risks and trying innovative ideas (Schwabsky et al., 2019). With respect to math anxiety, schools with collective efficacy demonstrated a strong commitment to the advancement of student learning and experienced higher student achievement in the areas of mathematics and reading (Hoy et al., 2006; Schwabsky et al., 2019). To address math anxiety and student achievement in mathematics, examining the effects leadership has on educational practices and collective efficacy is necessary. To accomplish this requires a school to assume the characteristics of a learning organization by setting goals, creating relational trust, building collective capacity, offering professional learning opportunities, and implementing coaching strategies.

School as a Learning Organization

In today's ever-changing world, leadership has an important role in advancing teacher practice and student learning. Kools and Stoll (2016) proposed that schools develop the characteristics of a learning organization to lead school-wide change and growth. They described a learning organization as "the ideal type of school organisation for dealing with the changing external environment, facilitating organisational change and innovation, and even effectiveness, i.e., improvements in students' learning outcomes and other important outcomes" (p. 10). When a school is a learning organization, there is an emphasis on continuous collective learning among the members of the school community. As part of this process, teachers need

to identify their feelings and biases related to mathematics and be open to taking risks as they collectively work to build a shared vision of the mathematical practices shown to improve student learning.

Harris and Jones (2018) posited that a change in school culture and a shift in staff beliefs were necessary for a school to become a learning organization. Based on the work of Kools and Stoll (2016), it will be essential to set school goals, develop relational trust amongst staff, and focus on the formation of collective capacity. This will involve dedicating the time and resources for professional learning and coaching opportunities aimed at the incorporation of strategies to reduce math anxiety and advance student learning in math. One of the most significant traits of a school as a learning organization is the development of "a shared vision centred on the learning of all students" (Kools & Stoll, 2016, p. 32). To support creating a collective vision, it will be crucial for leadership to work with the school community to create and set a goal focused on improving student achievement in mathematics.

Goal Setting and School Improvement

Leadership is essential for nurturing favourable school conditions to develop a meaningful goal that outlines the necessary expectations for school improvement in math. In her work on student-centred leadership, Robinson (2011) defined goal setting as "deciding what goals to set, gaining the commitment of those responsible for achieving them, and communicating them to all those with an interest in their achievement" (p. 45). Setting a specific school goal related to decreasing math anxiety and monitoring student progress in mathematics requires leadership to ensure that the teachers implementing the goal are involved in designing the goal, believe in the parameters of the goal, and are motivated to do the work associated with the goal. Teacher buy-in is critical to create the shifts in school culture required for change in

teacher pedagogy and student learning (Bryk, 2010). Ideally, schools will be environments that allow for teacher and student growth by enabling participation in professional learning that provides opportunities to implement strategies that allow for a continuous cycle of school improvement (Hallinger & Heck, 2010). One of the most vital components for a culture shift in a school is building relational trust.

Relational Trust

To reduce math anxiety and improve student achievement in math, leadership needs to ensure they have established trust with the members of their school community. Tschannen-Moran and Gareis (2015) define trust "as the willingness to be vulnerable to another party based on the confidence that the other party is benevolent, honest, open, reliable, and competent" (p. 257). This development of trust between leaders and teachers is vital for creating the optimal conditions to motivate teachers to put forth the effort to bring about organizational change. Relational trust acts "as both a lubricant for organizational change and a moral resource for sustaining the hard work of local school improvement" (Bryk, 2010, p. 27). To cultivate this trust between leadership and teachers requires leaders to demonstrate the traits and behaviours that deem them trustworthy (Tschannen-Moran & Gareis, 2015). Robinson (2011) believed that when school environments displayed higher levels of trust, teachers were motivated to take risks and this willingness to take risks led to cultural shifts and changes in teacher behaviour and student learning. With the establishment of trust between all stakeholders in a school community, success and school improvement are more likely. Tschannen-Moran and Gareis stated:

> In schools that enjoy a culture of trust, staff and students tend to have a shared focus on and expectation of student learning; teachers tend to have a shared sense that they can

> make a difference in students' lives; and they tend to respect one another, share expertise, and learn from one another. (p. 269)

This type of culture leads to a sense of collective efficacy. Collective efficacy "refers to the teachers' collective self-perception of their capabilities to positively affect student learning" (Schwabsky et al., 2019, p. 249). This relational trust and collective efficacy lead to a collaborative school climate focused on growing a shared capacity in mathematics.

Building Collective Capacity

One of the characteristics of a school as a learning organization is the promotion of staff collaboration and collective learning (Kools & Stoll, 2016). Fullan (2011) suggested that collaboration motivates team members to commit to innovation and improvement. Collaborative school cultures create an environment where staff have the time and resources to collectively learn and work together (Kools & Stoll, 2016). When a school acts as a collaborative culture and sets a core goal to reduce math anxiety, this will influence student achievement in math. Once this is established, staff can build both collective capacity and individual capacity to address anxiety in mathematics and advance student learning.

Collective capacity involves building the capacity of everyone to ensure they have the pedagogical content knowledge to support the teaching and learning of mathematics. Throughout the process, it will be essential for school leaders to learn alongside their teachers, as Robinson (2011) identified this type of collaborative learning as having the most significant influence on eliciting changes in student learning. Leithwood (2007) claimed that "Redesigning the organization so that such learning is encouraged and supported means building a collaborative professional culture in the school and creating structures to allow for such collaboration" (p.

61). Effective collaboration creates the conditions to develop collective capacity among staff members through professional learning and coaching opportunities to decrease math anxiety and improve student learning in math.

Professional Learning

Developing collective capacity requires the allocation of time and instructional resources devoted to the professional learning of staff focused on supporting teachers with strategies for addressing math anxiety and best practices in mathematics. Professional learning focuses on the continuous learning and active engagement of leaders and teachers as learners (Kools & Stoll, 2016). In their Canadian study of professional learning, Campbell et al. (2016) discovered that professional learning dedicated to improving student learning increased student achievement and decreased performance gaps. They also emphasized the significance of professional learning being appropriate and applicable to a teacher's practice. Research showed that investing in quality instructional resources and job-embedded professional learning impacted teacher growth and student learning (Robinson, 2011; Kools & Stoll, 2016). Robinson (2011) believed that teachers benefited from having "access to up-to-date, evidence-based knowledge of how students learn and of how teaching promotes that learning in diverse classroom contexts" (p. 23). She also recommended that for professional learning to be meaningful to teachers, it needed to clearly communicate a clear connection between theory and practice within a school's context.

To address teacher math anxiety, it is essential that professional learning places emphasis on increasing a teacher's confidence in their mathematical abilities and building an understanding of mathematical concepts and strategies (Ganley et al., 2019; Looney et al., 2017). Studies conducted by Geist (2015), Gresham (2017), and Sloan (2010) found that if a teacher

experienced math anxiety, it influenced the teacher's confidence and ability to teach math and their instructional choices. To help teachers overcome this anxiety and make better instructional choices for their students, they recommended offering math professional learning opportunities targeted at improving teacher confidence and pedagogical content knowledge. As a first step to reduce teacher math, Stoehr (2019) suggested identifying the experiences that may have led to the teacher developing anxiety, positively reframing those experiences so that the teacher sees that they have an opportunity to approach these mathematical concepts in a new way. Sanders et al. (2019) posited that teachers benefit from opportunities to change their perceptions of mathematics so that they can break the cycle of math anxiety and reduce the likelihood of inadvertently passing this anxiety on to future generations of students. Reducing teacher anxiety and improving pedagogical content knowledge of math will positively impact instructional decisions to create a classroom culture conducive to learning math. Knowing the effects of teacher math anxiety on student learning emphasizes the importance of discovering strategies to reduce teacher math anxiety.

Looney et al. (2017) posited that helping teachers become more proficient at teaching math could create positive emotions towards math and lead to an improvement in their teaching of math. Van der Sandt and O'Brien (2017) found that one effective strategy for reducing teacher anxiety is to offer a math content course where teachers develop a conceptual understanding of math, explore problems, and communicate their understanding in various ways. This helped to build teachers' content knowledge of mathematics and provided them with opportunities to explore a variety of math manipulatives and strategies for solving problems. They suggested exposing teachers to more problem-based learning approaches increased their willingness to try new things and decreased anxiety. A decline in anxiety also occurred when the focus became less about getting the right answer and more about the process and conceptual understanding of mathematical

concepts (Finlayson, 2014). Van der Sandt and O'Brien believed that teachers benefited from having time to collaborate with their colleagues in pairs or groups to explore math and devise solutions to problems. Sanders et al. (2019) discovered that the use of concrete materials, non-permanent surfaces (such as whiteboards), co-operative learning experiences, and opportunities for individual support led to a decrease in pre-service teacher math anxiety. They found participants developed a positive outlook towards math due to the collaborative nature of the math learning, felt less threatened to take mathematical risks, and were more confident.

Math Coaching

To lessen teacher and student math anxiety, leadership will need to focus on the behaviour and beliefs of staff and students as they relate to mathematics. One method is to distribute leadership to teacher leaders as math coaches. Math coaching is a form of teacher leadership that can positively impact student achievement. When using the coaching technique, the coach must work to build positive relationships with the teachers they are working with based upon mutual respect and trust (Luebeck & Burroughs, 2017). The first step to reduce math anxiety will be to address any negative feelings or beliefs teachers have towards math and create a positive classroom math culture. After building rapport with the teacher, the focus should be on supporting the teacher to address their own math anxiety and strengthening their pedagogical content knowledge in math.

Coaching teachers involves not only improving their knowledge of the math curriculum but also ensuring that they develop a solid understanding of how students learn mathematics (Luebeck & Burroughs, 2017). Reducing teacher anxiety and improving pedagogical content knowledge of math will positively impact instructional decisions to create a positive classroom culture for learning math, which in turn should decrease student math anxiety. To form this class culture, Ramirez et al. (2018) recommended that coaches encourage a growth mindset in teachers

and students where everyone believes that they can learn math and that making mistakes are a normal part of the learning process. Another key component of this culture is to engage and motivate students by emphasizing a mastery-oriented approach to learning math rather than a performance-based approach (Boaler, 2014; Furner & Gonzalez-DeHass, 2011). To initiate these conditions, the coach can model and collaborate with the teacher to make learning relevant by designing real-world math problems that consider the students' personal interests (Finlayson, 2014). The incorporation of concrete manipulatives and open-ended problems related to real-life experiences can increase student engagement in math and decrease math anxiety (Gresham, 2017; Kulkin, 2016). Online games, board games, and interactive websites are also fun ways to reinforce mathematical concepts and engage students (Ramirez et al., 2018).

As a component of making this educational change in math, leadership must collaborate with coaches to utilize evidence-based teaching practices that prevent and reduce math anxiety in students. Historically, teachers taught math using a direct teaching approach based upon the idea that there was only one way to solve a math problem and procedures required memorization, regardless of whether the student understood the procedure or not (Finlayson, 2014). Research has shown that this does not ensure mathematical success, especially in students who experience math anxiety (Finlayson, 2014). Furner and Berman (2003) believed that the best practices for math instruction should place emphasis on conceptual understanding and the process rather than on the final product using a variety of strategies that can accommodate an array of learning styles. This personalization of math acknowledges the importance of individual student differences. Finlayson (2014) encouraged the use of constructivist teaching where students are actively involved in learning and work in groups. Collaborative learning can help reduce anxiety because students work together to devise and share solutions to problems through discussion and cooperation. Anxious

students feel less isolated and experience both the successes and struggles with their fellow group members, which boosts self-esteem and engagement in mathematics.

Coaches can also work alongside teachers to help them incorporate literacy aspects into their practice to make cross-curricular connections. Reading and sharing math literature with students, specifically books that contain characters who display negative thoughts or misconceptions about math such as *Math Curse* and *The Number Devil: A Mathematical Adventure* will be helpful because students can relate their own thoughts and feelings about math to the characters in the books (Furner & Berman, 2003). Park et al. (2014) discovered that providing students with an opportunity to write about their anxious feelings and thoughts prior to a math-testing situation decreased math anxiety and improved student math performance. Giving students time to address their anxiety improved their confidence and ability to complete mathematical activities successfully. Writing provided students with an outlet for their negative thoughts, which positively affected their working memory (Belilock & Willingham, 2014).

When coaching teachers to implement strategies to reduce and prevent math anxiety, another important aspect to address as a leader is how teachers assess students in mathematics. Timed tests, such as mad minutes, drills, and math competitions, often heighten anxiety for students as they fear they will not finish in the allotted time or will be embarrassed for getting answers incorrect (Beilock & Willingham, 2014). Boaler (2014) discouraged the use of timed tests as they can "cause slow, strong mathematical thinkers to become discouraged in class, develop math anxiety, and turn away from the subject" (p. 471). Rather than relying on speed-related math tasks, she suggested students would benefit from engaging in low-pressure tasks that focus on learning mathematical concepts rather than on speed, such as games and number talks.

Math coaches can model for teachers how to incorporate a variety of daily formative assessments into math lessons through observations, questioning, portfolios, student work samples, exit slips, and self-evaluations. Furner and Berman (2003) believed these types of assessments provided students with several opportunities to demonstrate their understanding of mathematical concepts rather than using a summative paper and pencil test. By providing multiple modes of assessment, students feel challenged without feeling overloaded. It is also important for teachers to think about how they provide feedback to students who are struggling. Beilock and Willingham (2013) believe that consoling struggling students may reinforce that they are not good at math. They suggest a better approach would be to acknowledge that although the work might be challenging for them, they are encouraged to persevere. The message to the student is that the teacher believes they can do the work, even though it is difficult, which could help further enhance their self-esteem and achievement in math.

Conclusion

It is evident that math anxiety has detrimental effects on teacher practice and student learning in mathematics. Educational leadership influences teacher and student math anxiety by playing a transformative role in eliciting changes to teacher instruction and student success in mathematics. School leadership is crucial to ensure teachers have opportunities to reflect on their practice, partake in regular professional learning to decrease math anxiety, and collaborate with coaches to deepen their understanding of evidence-informed practices in math to promote student learning. This will strengthen pedagogical content knowledge of math and the instruction to develop the favourable conditions necessary for a decline in teacher and student math anxiety. These changes will lead to more confident math teachers, increased student engagement in learning tasks, and an improvement in the student achievement of mathematical concepts.

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