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Empowering Teacher Leadership to Address Math Anxiety in Today's Schools

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Cover Page Footnote
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Empowering Teacher Leadership to Address Math Anxiety in Today's Schools

Abstract

Math anxiety is an uneasiness or worry when dealing with doing mathematics, ranging from slight nervousness, nausea, to complete panic. It prevents students from learning math and makes them more likely to give up. Math anxiety is common in many math classrooms today. Teachers can work together and take a real leadership role in addressing this problem to build math confidence. Solutions range from undergoing therapy to changing teaching styles to being more inclusive of students with math anxiety. This paper looks at ways teachers as leaders can work together to address math anxiety in their schools. School leaders can empower math teachers to work together to prevent and reduce math anxiety with a goal of improved math achievement school-wide while addressing math anxiety by teachers taking on active leadership roles in their schools and classrooms. This paper gives many recommendations to address math anxiety.

KEYWORD: Math Anxiety, Teacher Leadership, Best Practices, STEM, K-12

Introduction

An elementary school principal from the school that this data in this paper is from said once that she always interviews all new students coming into the school and always asks students, "What is your favorite subject?" She said that most of the younger children always say to her, "math." The same school had decided as part of their Southern Association of Colleges and Schools (SACS) accreditation as a K-12 international school (USA based curriculum) in Latin/South America, to survey 25% of their students at each grade level (they have approximately 100 students per grade), Grades 1-12, and administer the Abbreviated Version of the Mathematics Anxiety Rating Scale(MARS) (Alexander and Martray, 1989) to see how their students feel about their math attitudes (See Figures 1 and 2). The results are somewhat inconclusive, but the graph shows, primarily, that as students increase in grade level, their degree of math anxiety increases for the most part (See Figures 1 and 2). This may not be a complete surprise and seems consistent with the Third International Mathematics and Science Study (TIMSS) math results in the USA, where students increase in grade level but their degree of math achievement drops significantly from elementary, to middle, then to high school (Schmidt, 1998). Ingersoll, Sirinides, & Dougherty (2018) contend that teachers' role in improving schools is critical and they play an important leadership role in making decisions and for improving

a schools' performance. When teachers are given opportunities for collaboration and sharing best practices, they can plan for and incorporate better teaching strategies during instruction in order to improve student performance. This paper explores how teachers as leaders together with the principal can address math anxiety issues in school to work toward improving math performance and confidence.

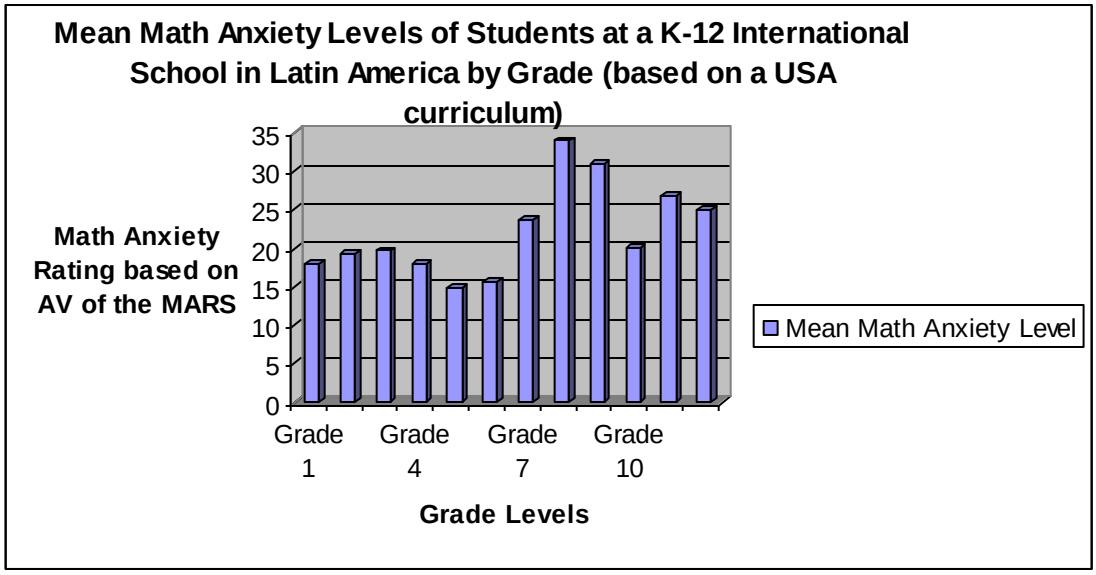

Figure 1. Mean Math Anxiety Levels by Grade

Grade	Mean Math Anxiety Level from AV of the MARS
Grade 1	18
Grade 2	19.3
Grade 3	19.7
Grade 4	18
Grade 5	15
Grade 6	15.7
Grade 7	23.8
Grade 8	34
Grade 9	31
Grade 10	20
Grade 11	26.8
Grade 12	25

Figure 2. Raw Data of Math Anxiety Levels by Grade

According to Reuters (2007) and the American Association for the Advancement of Science in San Francisco, math anxiety depletes working memory to do mathematics. Often times, worrying about doing math takes up a large part of a student's working memory which then spells disaster for the anxious student who is taking high-stakes tests. Today math teachers from around the world almost have to take on the role of counselors in their classrooms to address the many students who dislike or are fearful of mathematics. Mathematics teachers are encouraged to work with school counselors in helping to address the many math anxious students in today's schools. It has become a pandemic in our society where so many young people and adults have negative feelings and poor experiences with mathematics instruction. Metje, Frank, & Croft, (2007) believe that math anxiety is a worldwide phenomenon and that many people are not going into math fields, including engineering, and that more and more math instructors at the university level are not prepared to deal with the increased number of students who are unsuccessful at math due to this increased fear which has crippled their confidence. Addressing math anxiety has become one of the largest challenges for college professors.

Anyone can easily take an informal poll on the street or classroom and find that most respondents will not report positive experiences, feelings, or attitudes toward mathematics. However, we are now living in an age that depends so heavily on one being good at mathematics and problem solving. We are living in a world in which our students will soon be competing with young people from all parts of the globe for jobs. It is imperative that our students develop positive dispositions toward mathematics and the sciences in an information age of which has become so technologically oriented. Young people today need to be well prepared in the areas of math, science, and technology for all career choices. Nurses, engineers, architects, lawyers, teachers, along with many other fields will continue to use more advanced forms of technology that require one to know more mathematics and problem solving to perform their jobs effectively. Sequencing, ordering, patterning, logic, spatial sense, and problem solving are some of the basic skills that all careers require (NCTM, 2000). By the time our young people reach middle school they have developed certain dispositions toward mathematics. Students' confidence and ability to do mathematics and apply these skills in many diverse settings is essential for success; therefore, our young people need to be well prepared to do the mathematics of the 21st century.

Steen (1999) found that "national and international studies show that most U.S. students leave high school with far below even minimum expectations for mathematical and quantitative literacy." Neunzert (2000) contends that we have to understand ourselves as MINT-professionals, where MINT is M=mathematics,

I=informatics, N=natural sciences, T=technology. Neunzert (2000) believes that mathematics is critical for people living in the 21st Century for them to be successful. Neunzert feels as educators we need to encourage our students in all countries to study more mathematics and to see it as a tool for success in life.

What is Math Anxiety?

What is math anxiety? Simply put, it is a fear when confronted with math, especially about one's own performance in solving math problems. It can range from slight nervousness to all-out panic. This anxiety makes it more difficult for students to focus in class, learn math, and solve math problems. Frequently, students would rather give up than have to face their fears. This means that they never get better at math and can, therefore, never overcome their anxiety. If this anxiety is not overcome, the student may suffer their entire life, even beyond their time in school. Math anxiety is a well-documented phenomenon that has affected our society for over sixty years, and not enough is being done to address it in our classrooms or in the way we teach math (Beilock & Willingham, 2014; Boaler, 2008; Dowker, Sarkar, & Looi, 2016; Geist, 2010; Metje, Frank, & Croft, 2007). Negative attitudes toward mathematics and math anxiety are serious obstacles for students in all levels of schooling today (Geist, 2010). Beilock and Willingham (2014) state that "Because math anxiety is widespread and tied to poor math skills, we must understand what we can do to alleviate it" (p. 29).

What Causes Math Anxiety? Math anxiety is caused by a combination of external and internal factors; however, we cannot change internal factors within the student, so as teachers it makes more sense to focus on what we can control (Chernoff & Stone, 2014). Studies show that math anxiety is caused primarily by the way the student learns math: the type of authority the teacher uses, an emphasis on right answers and fear of getting wrong answers, requirements that the student respond with an answer sooner than he or she might be ready, and exposure to the rest of the class and their potential condemnation of a student who responds poorly, in short the traditional way of teaching math (Chernoff & Stone, 2014, Finlayson, 2014). Traditional teaching emphasizes:

- "Basic skills
- Strict adherence to fixed curriculum
- Textbooks and workbooks
- Instructor gives/students receive
- Instructor assumes directive, authoritative role
- Assessment via testing/correct answers
- Knowledge is inert
- Students work individually." (Finlayson, 2014)

Unfortunately, these methods can cause and increase math anxiety in the classroom (Finlayson, 2014).

Math anxiety can also be transmitted and learned from others, usually from parent to child or teacher to student, but occasionally student to student. If someone teaching math, whether to their own child or to a class, experiences math anxiety, they are more likely to rush through things in order to "get it over with". They wouldn't be sure of their methods, so they would focus more on the correct answer. Like the student with math anxiety, they are also likely to become exasperated and give up rather than continue helping the student. This teaches the student that math is something to be afraid of and that, if they are not good at it, their parent or teacher may become upset with them and potentially leave. They also learn in class that, if their peers realize they are bad at math, they may be ridiculed publicly. Embarrassment is an enormous concern for students, especially in middle and high school.

Another problem for those who suffer from math anxiety is the nature of anxiety itself. According to Rubinstein et al (2015), anxious individuals tend to focus on negative stimuli more than positive stimuli, essentially making themselves more anxious. The same thing is true of individuals with math anxiety; the only difference is that for people with math anxiety, math is the negative stimuli (Rubinstein et al, 2015). This suggests that math anxiety could be handled through therapies designed to lessen anxiety, such as cognitive behavioral therapy and exposure therapy (exposing a person little by little to the thing that they are afraid of) (Rubinstein et al, 2015). While this is not something that a teacher could do with a full class to manage, it is something that tutors could be trained to help with; naturally, a licensed therapist would be the best option, but not all therapists are trained to help students with math. A combination of the two fields would be optimal.

Math anxiety remains a perplexing, persistent, and only partially understood problem from which many people suffer, NCTM (1991, p. 6) says, "Classrooms should be mathematics communities that thrive on conjecturing, inventing, and problem solving, and that build mathematical confidence. Unfortunately, many kids and adults today do not feel confident in their ability to do math. Math anxiety in students has become a concern for our high-tech world. Is it possible that only about seven percent of Americans have positive experiences with math classes from kindergarten through college study (Jackson, C. D. & Leffingwell, 1999)? Burns (1998) in her book *Math: Facing an American Phobia* tackles an interesting subject and has found that two-thirds of American adults fear or loathe math. Whether it is 93% or two-thirds of

Americans experiencing negative math experiences it is clear that there is a problem and we need to do something about it as educators. If math anxiety is such a problem, one has to wonder, what is being done about it in our schools today?

Evidence of students' poor attitudes and high levels of anxiety toward math is abundant. In the midst of a technological era, declining mathematics (math) scores on the Scholastic Aptitude Test (SAT) have been widely publicized. Some reports have shown that American students rank last when compared with students from all other industrialized countries on 19 different assessments. The TIMSS study has shown a trend in U. S. students' math scores as they decline as students increase in age group from grade four to grade twelve (Schmidt, 1998). What is happening to our students that so many of them lose interest in math and lack the confidence to do and take more math classes?

How Do We Fix Math Anxiety in our Schools?

To put it simply: better teaching. Finlayson suggests the constructivist style of teaching which emphasizes these ideas:

- "Begin with the whole – expanding to parts
- Pursuit of student questions/interests
- Primary sources/manipulative materials
- Learning is interaction – building on what students already know
- Instructor interacts/negotiates with students
- Assessment via student works, observations, points of view, tests. Process is as important as product
- Knowledge is dynamic/change with experiences
- Students work in groups" (2014)

This style of teaching is very different from the traditional style which can cause and increase math anxiety. The constructivist style is much less intimidating and doesn't emphasize timed assessments or correct answers; instead it focuses on the process of doing mathematics. Students are also likely to feel more engaged in class due to the more participatory style of teaching, making them want to work harder, instead of "getting it over with" heedless of how this affects their performance.

However, frequently the problems in the classroom that cause math anxiety are due to a teacher with math anxiety (Chernoff & Stone, 2014). These teachers choose the easiest ways of teaching (rote memorization of formulas, practice using one method to get one right answer, timed tests, etc.) in order to

minimize their own math anxiety, not realizing that they are passing their anxiety onto their students (Chernoff & Stone, 2014). Therefore, we must first remove math anxiety from teachers, so they may teach their students not to experience math anxiety. Math is not inherently frightening, but that is the message that is told to many children, even from their parents and teachers.

As mentioned previously, math anxiety is a form of anxiety and therefore treatable through the same types of therapy we use to treat general anxiety and phobias (Rubinstein et al, 2015). This may prove especially helpful for adults with math anxiety, especially teachers; by working to handle their own math anxiety, adults would be able to prevent transmission of their anxiety to their children or students (Chernoff & Stone, 2014).

Discussing the Data from the K-12 School's Math Anxiety Levels Presented in this Study

The major trend from this data show a notable upward trend in math anxiety in students as students increase in grade level (See Figures 1 and 2). As students take more math classes and are exposed to more math teaching, unfortunately their level of math anxiety increased in this data set of a K-12 International School in South America with a US-based curriculum. In discussions with the administrators and teachers, little is often done year to year with students as they pass from grade to grade in respect to addressing a students' math anxiety. This math anxiety can fester and continue to pass on and increase as students continue through their studies. The author of this paper worked with this school for two years during this data collection in the school as part of the SACS accreditation. He also worked as the 9th Grade Geometry teacher for the first year prior to the data collection year and has extensive expertise in math anxiety research and implemented extensive math anxiety reduction and prevention techniques. The author employed these techniques with the 9th Grade mathematics students the year prior to the data collection. It is visible to see that the 10th Grade Students had reduced levels of math anxiety, likely due to the preventative and reductive math anxiety techniques used. Preventative strategies, like using "Best Practice" in mathematics, include using: manipulatives, cooperative groups, discussion of math, questioning and making conjectures, justification of thinking, writing about math in math journals, using a problem-solving approach to instruction, content integration, using technology Geometer's Sketchpad, and assessment as an integral part of instruction, such as homework, quizzes, and math portfolios. Along with math anxiety, reductive strategies include using: psychological techniques such as anxiety management, desensitization, counseling, support groups, bibliotherapy, and classroom

discussions of how students feel about math and what they are learning. These insights can help us understand why the 10th Grade class had significantly lower math anxiety than the other middle school and high school grades. Students in elementary school often start out with little math anxiety, but this anxiety can increase as students go from grade to grade in their learning process. It is critical in an age of STEM (Science, Technology, Engineering, and Mathematics) that schools and teachers work to correct this trend of increased math anxiety as students advance from Grades K-12. More schools need to include affective aspects into their improvement plans, like checking for math anxiety, and then compare such data to their students' achievement levels. Unfortunately, like TIMSS revealed for US schools, the trend of math achievement went down as students increased in grade similar to this study which showed a likely correlation between math anxiety and student performance in math School leaders need to empower their teachers to take on a leadership role to start looking at both affective and cognitive aspects of learning to see the relationships and to better address achievement and performance of their students in mathematics and likely all subjects.

Math Teachers as Leaders

Higgins' (2013) research found that teacher leadership and professional learning are both present in the math department on formal and informal levels. While the level of leadership and learning may not be important, what is important to ask is, how do we sustain leadership and learning for teachers in schools today to impact student learning? Then more importantly, is it enough to sustain the organization? It has been recommended by Hargreaves (1999) that if you build the "intellectual capital, the knowledge and abilities of the staff," you will in turn create "organizational capital" based on the collective knowledge of the group (p. 124). Sustainability, according to Fullan (2002), is developed in a social environment where learning is vital and leadership at all levels is essential. Ingersoll, Sirinides, & Dougherty (2018) have found that when teachers are empowered and are allowed to be leaders, they can use their knowledge to make change and help to improve performance in their students. Today, math teachers not only are in charge of teaching math content, but it is also their job to check for positive mathematical dispositions in the students they teach.

Suggestions for building teacher's intellectual capital lie in affecting their daily practice when teaching mathematics. Drago-Severson (2007) suggested, "We need greater knowledge about practices that support teacher learning and growth by focusing on how teachers make sense of their experiences" (p. 71). Higgins' (2013) ethnographic study hoped to gain better knowledge into how a

department of five teachers went about their daily routines and social experiences regarding learning and leadership. Underlying these experiences are the frameworks of Social and Adult Learning Theories which attempt to explain the social phenomenon that is inherently present in the learning process and what motivates adults to learn.

One endorsement considers both leadership and learning. A beam bridge consists of a horizontal beam supported at each end by piers. The weight of the beam is carried by these supports, in this case leadership and learning. Presently, the teachers are actively engaged in leadership roles, both inside and outside the department, and all of the teachers, are likewise engaged in some form of professional learning. The department members constitute a community of practice according to Wenger's (1998) definition. However, they seem to be going about their daily routines, experiencing much of the leadership and learning in isolation of the other. The further apart the piers in the beam bridge, the weaker the beam becomes. Therefore, in order to strengthen their community and the 'intellectual capital', which is necessary to change teachers' practices, we must bridge leadership and learning, thereby strengthening the beam. It is the practices of leadership-how leaders go about their work-during situations that call for their expertise that promotes a distributed leadership theory (Spillane, 2005), and it is the day-to-day discussions in the social setting that promote learning. Horn and Little (2010) posited that learning in the workplace is more likely to occur if the "talk" centers on "dilemmas and problems of practice" (p. 183). To effect teachers' practices leadership and learning must be bridged-they must not be isolated entities.

In order to accomplish bridging leadership and learning, another suggestion is the need for critical reflection in teaching. Taylor (1998) identified three themes that are central to Mezirow's transformational learning: experience, critical reflection, and rational discourse. The teachers are, again, engaged in experiences of leadership and learning, and discussion, or rational discourse, is evident. However, critical reflection is a missing element in their learning experience. According to Taylor (1998), critical reflection is the most important aspect needed to transform a person's way of thinking. The process of questioning our beliefs and assumptions and reconsidering new ways of thinking occurs when individuals self-reflect on experiences. An earlier discussion about the math teachers thinking in 'black and white' terms, as a barrier to professional learning, is a specific example of the need for critical reflection. Having time to reflect on their own practices may open their minds to other possibilities and make change easier; what works and what does not are all critical in the process of teaching effectively.

Higgins (2013) also found that the involvement of teachers in more aspects of their professional life is critical. Little (1982) showed that a characteristic of a successful school was the involvement of teachers in the curriculum planning, research, evaluation, and preparation of the material. This parallels with the recommendation for teachers to use critical reflection. Currently, the department chair receives and relays information to the teachers and, if necessary, a discussion took place. The recommendation is to strengthen that practice further, having teachers become involved together with the planning, research, data analysis, and program evaluations. This recommendation follows the research of Drago-Severson (2008) and the four pillar practices that support transformational learning.

In teaming, the first pillar consists of creating teams of colleagues to discuss, evaluate, and consider the other opinions regarding curriculum, student work, instructional strategies, and philosophies on teaching and learning. The second pillar allows transformational learning to take place when teachers are provided leadership roles that will offer new challenges and develop new perspectives. The idea of distributed leadership should not be confused with a distribution of duties, but instead should be viewed as a culture where leaders emerge as needed. The third pillar uses collegial inquiry to help teachers "become more aware of their assumptions, beliefs, and convictions…about their practice" so that they can improve their learning and improve the "overall organizational learning that may produce stronger student achievement outcomes" (Drago-Severson, 2008, p. 62). The final pillar, mentoring, provides support on an individual level.

The last recommendation is the consideration of time for professional learning and leadership. Higgins (2013) found in her study with interviews that a critical barrier to learning is time. Teachers in the department were concerned about student learning and knew of best practices that they would like to incorporate into their classrooms if only they had the time. Two teachers gave concrete examples of wanting more time to use data and the *GeoGebra* program to enhance student learning and understanding. School administration must be part of the solution for incorporating more time for teachers. While this is not a new discovery in education, time is one the keys to growing professional learning and leadership within an organization. In summary, there are four recommendations that may help strengthen professional learning and leadership:

1. Professional learning and teacher leadership should be bridged for any change to happen in teachers' practices.

2. Teachers should use critical reflection to understand their beliefs and to reconsider new ways of thinking.
3. Teachers should be involved with planning, research, evaluation, and preparation of their professional programs.
4. Time for learning must be a consideration.

For educators, professional learning and leadership are two areas that may be of high importance when we consider the impact of math anxiety on the quantitative development of our children. Consequently, the need for teachers to collaborate, share, and discuss their day-to-day practices with one another may never have a more meaningful time than now. Teacher leaders need to be prepared to help provide suggestions, strategies, and data driven solutions to their colleagues. With their content knowledge, cultural awareness of their department, and leadership skills, they become an invaluable piece of the educational puzzle. Harris (2003) reiterated that as work demands and distributed leadership practices increase in schools, it is also necessary for governments that are considering leadership accountability to bear in mind measures that will fairly assess a collective leadership style.

TIMSS data from 2011 show that we have not made statistical gains in mathematics achievement. Using data from Grade 8, there was a one-point difference between the U.S. average mathematics score in 2007 and the average score in 2011 (National Center for Educational Statistics, NCES). According to the NCES, a higher percentage of Florida fourth- and eighth-graders performed at or above the international benchmarks (2011). Looking at national data from the National Assessment of Educational Progress (NAEP, 2009) Florida's 12th graders are below the national average in mathematics. The *Foundations for Success: The Final Report of the National Mathematics Advisory Panel* (NMAP) was in reply to a "presidential executive order" to examine mathematics education in the United States (Spillane, 2008, p. 638). This document signified the on-going governmental influence in education policy and practice. Spillane (2008) argued that the Russians in 1957 have involved the government in educational matters since the launching of Sputnik. The federal government has used state and local governments to carry out many of its programs, including the Elementary and Secondary Education Act of 1965 and the No Child Left behind Act of 2001 (NCLB) (Spillane, 2008). While the federal government is behind the Race to the Top and the Common Core State Standards (CCSS), there seems to be more leeway for teachers to teach than previous programs. However, there are still many unanswered questions about the CCSS, including how will the standards be implemented and what part does the teacher play in the design of the curriculum and assessments? Also, are there affective factors teacher need to

consider when teaching, things like checking for dispositions toward the subject and making connections and monitoring this throughout all their years in school? If educators are going to do more for increasing student achievement in mathematics, they are also going to have to take a key role in addressing math anxiety and factors that influence how students feel about the subject as well.

It has been said that to improve the quality of schools, the quality of teaching must also improve (Cochran-Smith, 2006; Stronge et al., 2007). There are many reasons that contribute to a student's success; these range from internal reasons connected to curriculum, leadership, and school structures, to external reasons involving families, support structures, and other resources. "Nonetheless, students' learning depends fundamentally on what happens inside the classroom as teachers and learners interact" (Ball & Forzani, 2011, p. 17). Therefore, understanding how teachers learn professionally and how, ultimately, that learning may influence student achievement is important in creating change and ultimately improving student achievement.

More explicitly, teachers' mathematical knowledge is an important component to teacher effectiveness and improved student achievement in mathematics. Researchers agree that teachers' knowledge of mathematics is a crucial component to improving mathematics education (Ball et al., 2001; Hill & Ball, 2004), as well as the leadership that is needed to move learning communities forward. The implications of this research are to improve the understanding of how teachers can learn professionally and the leadership opportunities that may affect learning. Since school administrators, department chairs, and lead teachers are a major factor of learning and leading in a school-by their utter words, they can influence, motivate, discourage or encourage.

Teachers should have time to work together, sharing, and talking about their practice. Elmore (2007) wrote that teachers who work in isolation create "self-sabotage." If school improvement is to happen, then schools must move towards a "culture of shared practices" (p. 32). Subject departments have the power to affect change-these "powerful subcultures" can provide professional learning and leadership opportunities (Heng & Marsh, 2009, p. 530). School leaders can use this research to realize the impact that having a conversation with the teachers and learning about their learning, and then taking steps to improve their learning is what Hargreaves (1999) said will build intellectual capital which will then sustain and improve the organization. Having teachers work together as a team of leaders, to learn about math anxiety research, and talk about what they see in their classrooms with their students and then making a plan to employee some of the math anxiety strategies here together in their classrooms to compare

notes, talk about student success and feeling and confidence building can really impact student success when teachers take a more active leadership role to address issues like math anxiety in their department. If math teachers and school administration do not take an active leadership role in addressing math anxiety in a STEM world then we are inherently creating an injustice for our young people today.

Summary

Math anxiety is a concern facing students and teachers in today's classrooms. As educators, our goal should be to work together to minimize the effects of anxiety through utilizing better teaching strategies, as well as using teacher leadership and professional learning to advance teacher knowledge in this area. As adults, we need to be aware of our own anxiety in order to prevent it from being transmitted to our children and students; for those who are unduly impacted by math anxiety or for those who are more likely to transmit this anxiety to children, it may be helpful to receive assistance from a therapist. As teachers, we need to make our classrooms a safe haven for students with math anxiety by altering our teaching styles; this will help all students, not just those with math anxiety. In order to fix this problem, we need to go straight to the source, even if that source is in our own anxieties. Only then can we prevent future generations from becoming part of the pandemic of math anxiety. Teachers of mathematics need to take on the role of counselors to address the math anxious students they have in their classrooms. Ingersoll, Sirinides, & Dougherty (2018) state that "leadership matters, that good school leadership actively involves teachers in decision making, and that these are tied to higher student achievement." (P. 17).

School leaders have a responsibility to bridge the teacher leadership and professional learning so that it will impact student achievement and address the issues of math anxiety. Building confidence in math by using the many suggestions and recommendations mentioned in this article in classrooms/schools may help to prevent or reduce math anxiety. Teachers must take on leadership roles and use collegial inquiry to address this very serious concern in a STEM-enriched society. Additionally, helping teachers become aware of their own assumptions and beliefs of mathematics is important as more and more teachers realize the need to put on their educational psychologists' hats in their classrooms to help address the important issue of math anxiety. Teachers may also want to encourage learning opportunities for parents such as family math nights where parents and children can come together to "do math" and see its importance and value in life. As a society, we must work together to extinguish this discomfort that our students are having toward mathematics, especially as they increase in

age. It is important that all students feel confident in their ability to do mathematics in an age that relies so heavily on problem solving, technology, science, and mathematics. Today's educators must make the difference in our children's attitudes toward math. Math teachers need to work together as a team of leaders who strive toward creating mathematically literate and confident young people for the new millennium. Math teachers should, not only, be teaching content but also checking for dispositions toward the subject. They need to ask their students how they feel about mathematics. It would be nice to hear more young people and adults say, "Math was my favorite subject" or "I am great at math!" We need to reverse the trend and not allow the data to create an escalating bar graph of increasing anxiety levels as students increase in grade level.

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Appendix A: Standards and Strategies to Address Math Anxiety by Math Teacher Leaders

Mathematics teachers need to be leaders and work together to address math anxiety…
What NCTM says about Mathematics Anxiety and Dispositions Toward Mathematics

Standard 10: Mathematical Disposition (NCTM 1989)

As mathematics teachers it is our job to assess students' mathematical disposition regarding:
-confidence in using math to solve problems, communicate ideas, and reason;
-flexibility in exploring mathematical idea and trying a variety of methods when solving;
-willingness to persevere in mathematical tasks;
-interests, curiosity, and inventiveness in doing math;
-ability to reflect and monitor their own thinking and performance while doing math;
-value and appreciate math for its real-life application, connections to other disciplines
and cultures and as a tool and language.

A Synthesis on How to Reduce Math Anxiety

1. Psychological Techniques like anxiety management, desensitization, counseling, support groups, bibliotherapy, and classroom discussions.

2. Once a student feels less fearful about math he/she may build their confidence by taking more mathematics classes.

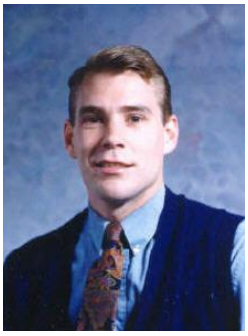
3. Most research shows that until a person with math anxiety has confronted this anxiety by some form of discussion/counseling no "best practices" in math will help to overcome this fear.

A Synthesis on How to Prevent Math Anxiety

1. Using "Best Practice" in mathematics such as: manipulatives, cooperative groups, discussion of math, questioning and making conjectures, justification of thinking, writing about math, problem-solving approach to instruction, content integration, technology, assessment as an integral part of instruction, etc.

2. Incorporating the NCTM *Standards* and your State Standards into curriculum and instruction.

3. Discussing feelings, attitudes, and appreciation for mathematics with students regularly



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