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Addressing Math Anxiety with Incoming High School Freshman: An In-Depth Look at a High School Principal Constructed Action Research Project

This paper describes an action research project in a high school located in the Southeast, U.S. addressing math anxiety reduction with 9th grade students starting high school in an Intensive Math and Reading course with a Special Education teacher using a math anxiety reduction protocol focusing on bibliotherapy, self-reflection, and other math anxiety reduction techniques. The paper shares the need, the research, the protocol, an analysis, and a conclusion for this action research project at the high school it was conducted at. This research is from a previously published paper with more in-depth analysis and resources to be used in clinical settings for other educators.

Keywords:

Math Anxiety, Freshman, High School, Bibliotherapy, Action Research, Math Anxiety Reduction

Introduction

“Literature has been soothing anxious souls for millennia.” -Bijal Shah (n.d., www.booktherapy.io)

The student’s essay was quite clear regarding their feelings about mathematics, “I am in Algebra I and I do not like it. It is the second semester and I have a better grade, but still hate math.” Unfortunately, this is all too common in high school classrooms, especially for those students who have struggled with mathematics throughout their elementary- and middle-school years. Students who face this deficit may be limiting their opportunities for college and career choices. There is a need for students, entering high school, to have support that focuses on building math skills and addressing math anxiety. We are in a world that is increasingly being driven by technology and communication where employers are now listing flexible, empowered, strategic, curious, and innovative as preferred skills. Globally, the international tests indicate that American students still fall short when compared to student performance in other countries. The Organization for Economic Cooperation and Development (OECD) released the latest Programme for International Students Assessment (PISA) results from 2015. In mathematics, the United States’ mean score was

470, 20 points below the OECD mean score of 490 (Kang, 2016; OECD, 2018).

The purpose of this action research project was to better understand why students continue to struggle with high school level mathematics, particularly algebra, and to understand the role that math anxiety may play in their quantitative development. This particular paper is a more in-depth overview of a published paper related to this study (Higgins, Furner & Gerencser, 2020). This paper gives more detail, steps, and resources used to conduct this protocol in school settings. This action research project was used to obtain information in an effort to change classroom practices to better aid students in learning mathematics; this project was initiated by the school principal based on previous year’s observations of students struggle with math and reading concerns of incoming freshman. Higgins (2013) found that math teachers working together, sharing a common purpose and working towards a goal would have a bigger impact on student learning and success. Frankel, Wallen, and Hyun (2015) write that “practical action research is intended to address a specific problem within a classroom, school or other ‘community...Its primary purpose is to improve practice in the short term as well as inform larger issues” (pg. 588). The guiding question

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used throughout the project was, “How can the use of bibliotherapy, writing, and personal reflection activities help students reduce math anxiety?” This project envisioned by the Professional Development Professor, Principal, and ESE Teacher is in line with work by Venables (2014) on how teachers can turn data and results into action research to assist them in understanding student success rates at the school, “In all cases, our ultimate purpose in reviewing and responding to data is to improve some aspect of our students’ learning” (pg. 19).

The school where this study took place is located in the South-eastern United States. Approximately 500 students are enrolled in grades 9 -12. 9th-grade students are placed in support classes for math using data from the High School Placement Test, grades, teacher recommendations, and standardized test scores from middle school. Additionally, the school is interested in adding more STEM (Science, Technology, Engineering, Mathematics) opportunities to the curriculum for students. Teachers and administrators are discussing project-based learning that will incorporate strategies across the STEM disciplines, and mathematical understanding is crucial to producing a work force that is strong in STEM areas and who can compete globally. (Furner, 2017a). Strong math skills help students with critical decision making and are essential to successfully completing higher level math and science courses. The importance of this research is to add to the body of literature on math anxiety and to propose strategies and activities that may help students reduce their math anxiety.

There are several factors that can influence math anxiety, some of which are cues from teachers, parents, and society, “information about positive and negative aspects of math can be found in the classroom, and it seems, at first glance, that not only do kids pick up on this negativity but it also carries implications for their math achievement across the school year” (Beilock & Willingham, 2014, pg. 31). Most mathematics teachers do not have an understanding of math anxiety and are not equipped with classroom strategies that can help students. Algebra is the foundation for success to higher-level mathematics. If students do not have a strong foundation in algebra, the subsequent courses of geometry, algebra II, and pre-calculus will continue to be a challenge, if not almost impossible. A high degree of math anxiety will force students to avoid higher-level

courses which will ultimately deprive them of careers in these fields.

The research project on math anxiety took place in the first semester of the 2017/2018 school year. Students in the Intensive Reading and Math class were introduced to bibliotherapy, an approach that uses “reading to produce affective change and to promote personality growth and development” (Furner, 2004; Forgan, 2002 and 2003; Sridhar & Vaughn, 2000; Doll and Doll, 1997; Lenkowsky, 1987). Group discussions exposed students’ attitudes and experiences with math. In addition to bibliotherapy, the ESE teacher also used a math anxiety test, math autobiographies, surveys, and journaling to recognize the students’ level of math anxiety. The research project includes a review of literature, the math anxiety protocols used by the ESE teacher during the first semester and a log of activities, an analysis of data, personal insights from students, ESE teacher, principal, professor, and a summary and conclusion.

Math Anxiety Research

Math Anxiety has been a concern for many years now. Reuters (2007) and the American Association for the Advancement of Science (AAAS) in San Francisco contend that math anxiety drains one’s working memory when doing mathematics. It is believed that worrying about doing math takes up a large portion of a student’s working memory which then can lead to disaster for the anxious student who is taking high-stakes tests. Today math teachers all around the world have to take on the role of counselor or psychologist in their classrooms to address the many students who dislike or are fearful of mathematics. Math teachers are encouraged to work with school counselors and special education teachers in helping to address the many math anxious students in today’s schools. It has become a pandemic in our culture where so many young people and adults have negative feelings and poor experiences in the past with mathematics instruction. The researchers Metje, Frank, & Croft, (2007) found that math anxiety is a universal phenomenon and that many people avoid STEM fields, like engineering, because of this fear. More and more math instructors at the university level are also not prepared to deal with the increased number of students who dislike math which ultimately impacts their instruction to students. Addressing math anxiety and supporting students in overcoming their fear of

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mathematics has become one of the largest challenges for educators.

Anyone today can easily do an informal survey on the street and find that most respondents will not report positive experiences, feelings, and dispositions toward mathematics. However, we are now living in an era that depends so heavily on one being good at mathematics and problem solving. We are living in a world today in which our young people will soon be competing with others their age from all parts of the globe for the same jobs. It is vital that our students develop positive dispositions toward mathematics and the sciences in the information age which is becoming increasingly advanced technologically. 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 more effectively. Sequencing, ordering, patterning, logic, geometry-spatial sense, and problem solving are some of the basic skills that all careers require (NCTM, 2000). Unfortunately, by the time students reach middle school, they have developed certain dispositions toward mathematics. Students' confidence and ability to do mathematics and apply these skills in diverse settings is crucial for success; therefore, young people need to be well prepared to do the mathematics of the 21st century.

Steen (1999) believes that studies in the U.S. and internationally confirm that most U.S. students leave high school with far below even minimum potential for doing mathematical and quantitative literacy. Research from Neunzert (2000) concluded that we have to understand ourselves as MINT-professionals, where MINT is M=mathematics, I=informatics, N=natural sciences, T=technology. Neunzert (2000) claims that mathematics is critical for people to be successful living in the 21st Century. Neunzert believes that teachers today need to encourage students in all countries to study more mathematics and to see it as a tool for a successful life.

What is math anxiety? Well, to put it simply, it is anxiety when confronted with doing 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, solve math problems, and take tests. Repeatedly students would rather give up than have to face their fear of the subject. This means that they never get better at math and can therefore never overcome their anxiety. Richardson and Suinn (1972) originally defined math anxiety as "a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551). Mathematics anxiety is the "irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (Buckley and Ribordy, 1982, p. 1). If this anxiety is not overcome, the student may suffer from this anxiety for their entire life, even beyond their time in school. Math anxiety is a well-documented phenomenon that has affected many cultures for over sixty years or more, and not enough is being done to address it in our classrooms or in the way we teach math (Andrews & Brown, 2015; Beilock & Willingham, 2014; Boaler, 2008; Dowker, Sarkar, & Looi, 2016; Furner, 2017b; Geist, 2010; Metje, Frank, & Croft, 2007). Undesirable attitudes toward mathematics and math anxiety are serious roadblocks 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 are some of the causes of math anxiety? Math anxiety may be caused by a amalgamation of external and internal influences; nevertheless, we cannot change internal factors within the student, so as teachers it makes more sense to focus on what we can control to address such anxiety (Chernoff & Stone, 2014). Many studies have shown 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, to the traditional way of teaching math (Chernoff & Stone, 2014, Finlayson, 2014). Traditional teaching emphasizes: learning basic skills; having teachers follow a strict adherence to fixed curriculum; the over use or abuse of textbooks and workbooks; the mentality that the instructor gives and the students receive; the

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instructor assumes a directive, authoritative role; the assessments focus solely on correct answers; a philosophy that knowledge is inert; and remembering that all students work individually (Finlayson, 2014). Unfortunately, these methods can cause and increase math anxiety in the classroom according to Finlayson (2014).

Math anxiety can also be conveyed 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 frustrated and give up rather than continue helping the student experience success. This can teach the student that math is something to be afraid of and that, if they are not good at it, their parent or teacher will become angry with them and potentially not help them further. They also learn in class that, if their peers see that they are not good at math, they may be scorned publicly. Humiliation is a very big deal for young people, 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 negative stimuli (Rubinstein et al, 2015). This suggests that math anxiety could be helped by using therapies designed to lower the anxiety, such as cognitive behavioral therapy and exposure therapy, this is where exposing a person little by little to the issue 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 and to address math anxiety. Often having teachers team up with counselors and ESE teachers can prove to be a support to all learners.

Math anxiety remains a confounding, tenacious, and only moderately understood concern from which many people suffer. The NCTM (1991, p. 6) says, "Classrooms should be mathematics communities that thrive on

conjecturing, inventing, and problem solving, and that build mathematical confidence.” Regrettably, many children and adults presently do not feel confident in their ability to do math. Mathematics anxiety in students has become a real 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 and dislike math. Whether it is 93% or two-thirds of Americans experiencing adverse math experiences, it is clear that there is a problem in our society and, as educators, we need to address this difficulty. If math anxiety is such a problem, one has to wonder why isn't as much being done about it in our schools today with such an emphasis on STEM?

Evidence of students’ poor attitudes and high levels of anxiety toward math is plentiful today. 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). Some might ask: “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?

Research by Finlayson (2014) found that better teaching is needed and suggested a constructivist style of teaching mathematics which emphasizes some of the following ideas: begin with the whole and then expand to the parts; teachers need to pursue student questions and interests; use primary sources and manipulative materials to teach; emphasize learning as interaction and build on what students already know; the instructor interacts and negotiates with the students; assessment via student works, observations, points of view, tests; process is valued and is as important as the product; treat knowledge as dynamic and changes with experiences; and students should work in groups.

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

Moreover, the problems in the classroom that cause math anxiety may be due to a teacher with math anxiety (Chernoff & Stone, 2014). Often these teachers select the easiest ways of teaching math (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 this anxiety onto their students (Chernoff & Stone, 2014). Therefore, we must first remove math anxiety from teachers, so they can teach their students not to experience math anxiety to begin with. Math is not intrinsically frightening, but unfortunately that is the message that many young people receive, even from their parents and their teachers.

Educators need to remember that math anxiety is a form of apprehension and consequently can be treated through the same types of treatment that are used to treat general anxiety and other phobias (Rubinstein et al, 2015). This could be especially helpful for adults with math anxiety, especially teachers; by working to handle their own math anxiety, adults would be able to avert diffusion of their anxiety to their children or students as well (Chernoff & Stone, 2014).

Math Anxiety Reduction Protocol Used for this Action Research Project

Participants for the action research project included 6-15 students in a combined Intensive Math and Intensive Reading classroom; the number of students was dependent on the daily rotation between the ESE and math teacher. Students were placed in the intensive classes due to low admission test scores, low standardized tests scores and low math grades from middle school. A few of the students were identified with a math learning disability, some other learning disabilities and Other Health Impairment (OHI) to include Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD). The group of students rotated between an Intensive Math class

and an Intensive Reading class, thus, at times there would be 6 – 8 students in each class. The time spent with students on the research project was 2- 3 days per week depending on the rotating schedule. The project took place in the first semester of the 2017/2018 school year, from August until December. Several follow-up activities also occurred in the second semester of the 2017/2018 school year.

Students were first introduced to the topics of math anxiety and bibliotherapy during the Intensive Reading group. While working with the Intensive Math teacher and through discussion with the general education math teacher, the ESE teacher wanted to see if the students' disengagement with math, frustration, avoidance, and low-test scores were perhaps the result of unrecognized math anxieties. The students in the Intensive Math/Reading groups avoid doing homework and when they do, they often do it incorrectly. The students also verbalized their dislike for math by making statements, "I am not good at math", "I hate math", or "What is the point of math?" Other comments included, "No one likes doing something they struggle with; that is why I do not like math."

The students began the semester by reading the book, "The Math Curse" by Jon Scieszka and Lane Smith. The ESE teacher read and discussed the book, as well as solved the math problems that occurred throughout the story. This led to a discussion about individual student's feelings toward math. The group discussion allowed the students to share without being judged. Through discussion, many of the students believed that it was their middle school teachers that shaped their feelings toward math. While some said their middle-school teachers created a safe and positive math learning environment, others blamed the teaching style of their teachers as the reason behind their continued math struggles and anxiety.

The discussions were one way to gauge the student's personal views of themselves as learners of math. The students also shared their views of the benefits and significance of math in society. Many students stated that they did not understand the importance of learning math and did not know what the point was since they would never use higher math in the future. The group brainstormed all of the different ways that math could be used on a daily basis, including possible career paths and the usefulness and importance of math in their daily lives.

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The students were asked to write a “Math Autobiography” (Appendix C). The purpose of the assignment was for each student to reflect on their early experiences with mathematics and to describe how they felt about mathematics. Students were encouraged to describe their attitude toward math. Students could include some of their early experiences with math classes, both positive and negative. Students could explain why they like math or didn't like math. They were expected to write a five-paragraph essay. While writing, there was open dialogue between the ESE teacher and the students regarding their feelings toward math.

The essay writing assignment took approximately two weeks to complete. During this time, students took a “Mathitudes Survey” (Appendix D) and a “Math Anxiety Test.” These were given to the students for them to gain an understanding of their feelings toward math and for the teacher to be able to identify those who may have math anxiety. Following the essay assignment, several discussions took place with the students. One topic centered on the importance of learning math and ways to help overcome negative feelings toward math. Many students continued to blame their low math ability and their disdain toward math on what they felt was previous teachers' inadequate teaching. Teaching students to now advocate for themselves when not understanding a topic was encouraged. The school has built in time within each day of the week for quiet study and tutoring. It was important to teach these students to use this time for getting extra help.

Another discussion was on the topic, “What is Math Anxiety?” The physical and psychological symptoms of math anxiety were discussed. The physical symptoms discussed included: sweating, heart palpitations, nausea, shaking and trembling. Some of the students said they recognized physical symptoms such as shaking, sweating, heart palpitations and nervous feelings in the stomach. The psychological symptoms discussed included: panic and feelings of helplessness, feelings of inadequacy, avoidance and lack of confidence. The students shared their feelings of inadequacy which led to their low confidence.

“Math Myths” gave the students an opportunity to hear some misleading facts about math: 1. You have to be born with a mathematical brain; 2. You can't be creative and be good at math; 3. Women are not as good at math as men. (Source: Anola-Ramsey Community College math faculty Nina Bohrod,

Candace Blazek, Sasha Vrhovtseva). The ESE teacher shared ways to reduce math anxiety: get plenty of rest, proper nutrition and adequate exercise before a math test, stay positive, keep a journal, seek help when needed, use the internet to research math topics not understood, use resources such as flashcards and playing games that work on core cognitive skills.

The class discussed “The Math Anxiety Bill of Rights.” Some of the “rights” discussed included: I have the right to learn at my own pace and not feel put down or stupid if I'm slower than someone else. I have the right to ask whatever questions I have. I have the right to need extra help. I have the right to ask a teacher or a tutor for help. I have the right to say I don't understand. I have the right not to understand. I have the right to feel good about myself regardless of my abilities in math. (Source: *The Math Anxiety Bill of Rights* by Sandra Davis, in Donaday & Auslander (1980) Resource Manuel for Counselors/Math Instructor: Math Anxiety, Math Avoidance, Reentry Mathematics)

A second book, “Math Rashes and Other Classroom Tales” by Douglas Evans, was read during the class time. Bibliotherapy was used in hopes of connecting students to others with similar math fears and anxieties. Class discussions continued using the characters in the book, relating their own feelings towards math.

A third, and final, book “A Gebra Named Al” by Wendy Isdell also used bibliotherapy to help reduce the students' negative feelings toward math and any math anxiety they may have. Focus on the math calculations and math content in the book was left to the Intensive Math teacher.

Strategies Used During Reading and Math

Pre-reading strategies that focused on vocabulary were used for each book. Students used a website, vocabulary.com, to understand some of the words found within the texts and they created illustrations that defined the words. Sometimes, the students would read independently and sometimes the books were read together as a group. If students wished, they could also read in a small group with the teacher or continue reading independently. Students were held accountable for their reading through formative assessments using vocabulary and comprehensive questions based upon their reading.

Journaling was another strategy used throughout the semester. Discussions focused on the characters' feelings towards math; students

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were encouraged to journal as it related to their own personal feelings towards math. Comments from the journals included, “We could relate to the character because she struggles with math like we do...” and, “She fell asleep on her book and dreamt and, sometimes I daydream during class because I am bored from taking too many notes and then I miss the notes.” Also, “This makes me get further behind.”

At the conclusion of reading the books and after Christmas break, the students were asked to complete a second “Mathitudes Survey” and take a second “Math Anxiety” test. They were also assigned to write another “Math Autobiography” so that they could reflect again on their attitudes toward math. The goal of the project was to observe any changes in attitudes towards math while using bibliotherapy and self-reflection.

The final strategy also took place at the beginning of the second semester and this focused on the student’s perception of their own study skills. Given a choice of writing a poem, drawing a picture, or writing an essay, students were asked to show what they had learned about their own study skills and what improvements they would make for the new semester in math. Student work reflected skills such as: using friends to study with; staying on task; using websites and other study resources; creating a study schedule; taking better notes; and, making flash cards.

What Worked and What Didn’t

According to the ESE teacher, the students enjoyed “The Math Curse” and “Math Rashes.” They were entertained by the stories. The students did not seem to mind writing their math autobiographies as they were able to express their feelings, as well as their frustrations. They also seemed to enjoy completing the Mathitudes Survey and Math Anxiety Tests. By sharing their thoughts and feelings through the autobiography and surveys, the students were able to relate to the other students in the class that had some of the same negative feelings as their own and it allowed the students to see that they were not alone in their struggles with feeling inadequate in math. It also gave the students the opportunity to discuss their feelings about their perceptions of what they believed to be “bad math teachers” in elementary school in a nonjudgmental environment.

The time frame for covering the project was several months. One difficulty was the disruption to learning due to the rotation of the

classes between the Intensive Reading and Intensive Math teachers. Instructional time was lost in having to remind students of previous material covered. Another challenge was the fact that students were required to receive a grade. This was especially true with the part of the project that required reading “A Gebra Named Al.” The students earned grades for their Intensive Reading class based on this lesson and it was important that reading skills were incorporated into the project. The grade seemed to take away from what the teacher had hoped to gain through the project in terms of focusing on reduction of math anxiety. Because students’ grades were dependent upon reading the novel, answering questions and learning vocabulary, it seemed to add more stress in terms of the students having to complete the required reading and lessons. It would be more beneficial to use it solely as bibliotherapy without required lessons and grades attached.

Qualitative data was gathered using a *Mathitudes Survey* and Math Autobiography. Students were asked to complete both, once in August 2017 and once in February/March, 2018. The Mathitudes Surveys and Autobiographies revealed three common themes: (a) students did not feel prepared for the concepts in Algebra I; (b) the length and complexity of the math problems increased at this level causing students to give up, and (c) students did not see the need for learning Algebra I. One student said,

Coming into high school, I was not prepared for Algebra...my teacher never moved me up to the regular math class I was supposed to be in. I never had good math teachers in middle school, especially my 8th grade year. The person who taught me math was a social studies teacher who had no idea what she was teaching.

Another student expressed that she has negative feelings towards math because she did not feel prepared after elementary and middle school, “My middle school teacher never taught me any math. She expected me to learn through an iPad screen and know everything. Since then, math has always been a subject I’ve struggled in a lot and it made me anxious.”

The complexity of math topics in high school increases so the need for a strong foundation in basic skills is essential. For example, students will begin the year with solving one-step equations but will progress to solving multi-step equations, which often include fractions and decimals. One student expressed his frustration with math as the topics

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became more complicated, “Long problem solving makes this even more confusing. Too many numbers can make me think things differently. Also, long problem solving can make me tired...or maybe aggravating. And when I’m aggravated, I be mad with everyone around me.” Another student wrote, “Math has been difficult for me because it is a lot of work. Sometime, doing long operations can get me off track, or it can make me lose focus.”

Understanding the need for math and how it relates to everyday life was another area of concern, “The reason why I think I feel this way about math is because it’s always been a pain to do...and I don’t see the use of algebra. You might need to know algebra for a few jobs but I don’t see a situation in life where I’m going to need to know how to do this in the future.” Another student wrote, “Math is just the one subject in my mind you will never need in life.”

The Mathitudes Survey revealed that many students’ favorite things in math were the simple operations of adding, subtracting, multiplying, and dividing, and that their least favorite thing in math was “dealing with letters” and that the math “gets harder every lesson.” These comments reinforce the themes present in the Math Autobiographies when students felt that the math was too complex. Six out of six students who took the survey said that math stresses them out because they’re not good at it. In turn, when they were asked what one thing is that they would ask for, several students wrote that they want to improve their math ability, “If I could ask for one thing in math, it would be to learn fractions better.” Another student said, “If I could ask for one thing in math, it would be to be better at it.”

When students returned for the second semester in January, they wrote an essay about their progress in math during first semester and what they might do to improve their math grade for second semester. The ESE teacher asked the students to develop a study plan after reflecting on how they prepared or did not prepare for math tests during the first semester. Students study plans now included skills such as note-taking, staying on task, using study websites and games, such as Kahoots, and studying with friends to help them be more successful.

The Mathitudes Survey was given a second time in February 2018. When asked again if math were a color, what color would it be, students continued to have a more negative outlook answering with dark colors, such as black, and colors that they personally did not

like. Additionally, when asked if math were an animal, what animal would it be, the responses, again, represented a somewhat gloomy outlook. For example, responses included a “snake,” “bull,” and “lion.” However, while math continues to be a challenge for these students, there seemed to be a better outlook for some. One student admitted that she has a passing grade in her math class now and is no longer stressed out by it, “math used to stress me out because I didn’t understand it.” Another student said that math is not stressful because, “it is my favorite class.”

Quantitative data was gathered by students using a pre and post Math Anxiety: A Self-Test (Freedman, 2017) the pre-test in August 2017 and the posttest in February 2018. Students were also asked 10 questions that focused on negative feelings towards math and their math class (See Appendices A and B). Students rated their answers using a Likert scale, 1-5, 1 = Disagree and 5 = Agree. The scores were totaled and the following scale was associated with the level of math anxiety:

40-50 points: Sure thing, you have math anxiety.

30-39 points: No doubt! The thought of doing math still makes you uneasy.

20-29 points: Perhaps some math uneasiness!

10-19 points: Wow! Possibly a math major in the making.

The average score in August 2017 was 35.25. Low score = 27; High score = 42. The average score in February 2018 was 30.25. Low score was 24; High score was 36. Overall there was a drop of 5 points in the average scores from August 2017 to February 2018, with 7 points being the biggest difference in scores.

Insights from the Researchers

The ESE Teacher

Insights gained from this research project, from the ESE teacher's perspective, include: knowing where the individual student's math anxiety comes from and how it relates to their math performance through the written autobiographies, and group discussions. The ESE teacher believes that these are the first steps in remediation of math anxiety. Giving the students the opportunity to write and discuss their thoughts and feelings freely toward mathematics can help them to understand from where their negative feelings stem, and hopefully reduce some of the anxiety they feel. Acknowledging and talking about their negative feelings may lead to less stress and better

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performance on math assessments. The use of the pre and post-written autobiographies, and the math anxiety surveys after reading and discussing the books, gave the students the chance to reflect on what did not work for them in the past, and what they can change in the future to reduce negative feelings toward math.

The time frame of covering the project over several months because of the rotating of the classes is something that could be changed. The teacher believes eliminating grades for the part of the project that required reading “A Gebra Named Al” and focusing only on discussion would be more beneficial. By eliminating the assignments that correspond with the novel and making the reading more for pleasure and bibliotherapy is a suggestion for the future. There are other books that can be incorporated into the project and going forward the teacher could research more options. The teacher believes that this is something that could be shared with the elementary and middle schools. Another suggestion for the future would be to have the students write a post-autobiography and retake the Mathitudes Survey and Math Anxiety tests at the end of the second semester.

The Principal

Some insights gained from this research project, from the principal’s perspective, include the importance of students identifying their fears of math through the different tasks -the anxiety test, the survey, and autobiography. When students are able to identify and put in writing what they feel are roadblocks to their learning, it is an important step in moving students past their fears. As mentioned, most students and teachers do not understand math anxiety. Students feel that, somewhere in their educational journey, they experienced failures in math and developed the attitude that they will never be good at it. This project shows that by working with students, through the use of bibliotherapy and self-reflection, students can start to identify and learn how to overcome some of their fears of math. The bibliotherapy, the use of stories, showed students that they were not alone with their math anxiety – others experienced the same thing and it was possible to have success if they worked at it.

The research project highlighted the need for students to not only understand their math fears, but how they could create a plan to give them future success. Having students reflect on what worked and what didn’t work during the first semester was an important task. The ESE

teacher allowed students to express this in various forms – a poem, a drawing, or an essay. Their finished product reflected study skills that included better note taking, group study sessions, and better time management. This becomes an educational experience that may help these students be successful in other classes, not just math.

The most important outcome, from the principal’s perspective, was to give students a feeling of empowerment – helping them be successful in math. The goal for future programs that use bibliotherapy and personal reflection should be to build that confidence in students so that they will continue to learn and take a chance on classes related to STEM -Science, Technology, Engineering, and Mathematics. Once we can give kids the confidence, we open up more opportunities in college, careers, and more.

The Professor/Professional Development Support

Some insights gained from the perspective of the school outsider providing professional development to the school and ESE teacher over the past few years is shared here. As a Math Education Professor for 25 years and a previous middle and high school math teacher, I have worked with many schools, teachers, and students. Being that my expertise and research is related to math anxiety prevention and reduction and I have worked with the Principal of the school for many years as a lead professor for her doctoral work, I had connections to the school. I held several workshops for the teachers on math anxiety. I have shared many articles and research. The previous year, I shared some articles about bibliotherapy (Furner, 2004 and Furner & Kenney, 2011) and addressing math anxiety. As a team, the principal, ESE teacher and I discussed concerns with math and reading deficiencies and how we could incorporate the use of bibliotherapy. An advantage of the project was that it originated from the principal and ESE teacher; they wanted to do this. I provided the groundwork and research papers, and we worked together to form a protocol for the year in employing the bibliotherapy. I brought in several books on math anxiety and bibliotherapy, as well as pieces of literature to assist students at their appropriate level. I was able to visit the school often and meet with the ESE teacher and principal, as well as visit the class and students. I read the math autobiographies and discussed the protocol and outcomes with the teacher and principal. I think

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they found it useful and the students enjoyed having the unusual opportunity to discuss and read about others who have felt anxious about mathematics. I think a program like this needs to come from within the school. School leaders need to recognize that there is a need to help students with math anxiety; they need to support the teachers when they use different strategies, such as bibliotherapy and, school leaders need to take advantage of resources that colleges and universities may be able to provide. I don't think this would have been successful if I had pushed for it myself, it had to come from the students' needs, and the teacher and principal had to be willing to do it and go through the steps and process in a systematic manner. I think we all learned that a big part of teaching is also counseling and working with students to build self-esteem and confidence and as a team this can be more successful and meaningful to the students and their future.

Summary and Conclusion

Using Bibliotherapy and Personal Reflection as tools for reducing math anxiety can be an effective method for an Intensive Math & Reading Course where students need extra support. This paper described in detail an action research project in a high school located in the Southeast, U.S. addressing math anxiety reduction with 9th grade students starting high school in an Intensive Math and Reading class with a Special Education (ESE) teacher using Math Anxiety Reduction protocol. The paper shared the need from the perspective of the principal of the school and how she felt students could benefit from reading about people who have math anxiety in order to build confidence. The research protocol is not new and has been advocated in previous research. The findings from this research recommend that teachers first consider students attitudes toward math as they begin the school year, and second, talk about past experiences in math classes, even if these experiences are negative. The research is very clear when it comes to addressing math anxiety, in order to overcome or reduce it, one needs to talk about it. They need to discuss what caused it, how they feel, and how they can cope with it and develop more confidence to overcome such anxiety. Teachers can also help students when they are better prepared to teach study skills, note taking, how to approach homework and how to prepare for quizzes and tests. Most research on math anxiety points out the distinction between reduction and prevention. The best approach for preventing math anxiety is using what is considered "best practices" for

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teaching mathematics. In turn, reduction is much different and requires more counseling and desensitization techniques, discussion, counseling, reflection and even bibliotherapy. Today, as students enter middle or high school, they should be evaluated and checked for their dispositions toward mathematics. Teachers need to take on the role of counselor or team up with other specialists to address any student who has negative feelings towards mathematics, which can hold them back or prevent them from having success during the next few years. It is believed that once a student feels less fearful about math, he/she may build their confidence by learning better study skills and then taking more mathematics classes. Most research shows that until a person with math anxiety has confronted this anxiety by some form of discussion/counseling, not even "best practices" in math will help overcome this fear. The principal, ESE teacher, and professor worked as a team in developing protocol to help 9th graders address math anxiety and other fears of quantitative reasoning. According to Venables (2014), teachers can no longer work in isolation. It is essential that teams "collectively and collaboratively" work together for the success of students (pg.103). This project has helped some of the students understand their anxiety and it has given these students the tools for studying and learning math, building their confidence.

Today school districts, universities, school leaders, and teachers need to recognize the need for addressing math anxiety early in a student's educational journey and provide better support for students experiencing a fear of math in order to give them the tools they need to not only like math, but to succeed in math. It is critical that when students graduate from high school they can say: "I like math and I can choose any career I want and I will never let math hold me back from my dreams."

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Appendix A

Outline of Math Anxiety Reduction Protocol using Bibliotherapy and Self-Reflection

Outline for Math Anxiety Reduction Research Project

Discussion on students feeling toward math

- Read “Math Curse: by Jon Scieszka and Lane Smith
- Brainstorm ways math is used on a daily basis: career paths and how math is used in daily life

Introduction of Math Autobiography, Survey and Test

- Write a six(6) paragraph autobiography
- Complete a *Mathitudes Survey*
- Take a Math Anxiety Test

Discussion: “What is Math Anxiety?”

- Physical and psychological symptoms of math anxiety
- Sharing of “Math Myths”
- Reading and discussing the “The Math Anxiety Bill of Rights”

Bibliotherapy

- Read the Story from the book “Math Rashes and Other Classroom Tales” by Douglas Evans
- Read the book “A Gebra Named Al” by Wendy Isdell (2017)
- Do Journaling as related to the readings above

Post Bibliotherapy Discussion

- Take a Post “Math Anxiety” and “*Mathitudes Survey*”
- Take a Post “Math Autobiography”

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Appendix B

Standards and Strategies to Address Math Anxiety

Mathematics teachers need to be counselors too...

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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Appendix C

Math Autobiography

The statements/questions below are a way to get you started thinking about your own Math Autobiography. You do not need to use them all, and your autobiography does not need to be as long as mine was. If you have an idea not related to these that you would like to express that relates to your prior math education, please do so.

Please do NOT merely answer all of these questions, writing on this sheet. Your autobiography should be written as you would write a story (paragraphs, complete sentences, etc.). You can either type or handwrite the assignment (just be sure I can read your handwriting!).

This autobiography allows me to get some information regarding your past math experiences, so

please share any and all information that you think will be informative.

Example: *Not enough detail:* I hated math in fourth grade, but it got better in sixth grade.

Good detail: I hated math in fourth grade because I had trouble learning my multiplication tables. I was really slow at doing problems, and I was always the last one to finish the timed tests. It was really embarrassing.

...

- ❖ My first math memory is....

- ❖ I first remember doing a math problem...

- ❖ I am the (worst/best) at doing ... I know this because ...

- ❖ I (do/don't) depend a lot on my calculator, since ...

- ❖ I prefer to work (alone/in groups), because ...

- ❖ What career are you planning for and why does this interest you?

- ❖ How do you learn best? At home working alone? Working with a group

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outside of class? When you get many of the same type of problems? When you use what you know in a new situation?

- ❖ I get the most bored in math classes when ...
- ❖ My strengths/weaknesses in math are...
- ❖ Some positive/negative experiences I've had with math are ...
- ❖ I am the most interested in math classes when ...
- ❖ I usually (like/hate) math because ...
- ❖ I am (good/bad) at math because ...
- ❖ One math teacher I remember is ... because ...
- ❖ My present attitude towards math is...
- ❖ How did your teachers and family influence you in math?
- ❖ My most memorable math moment is ...
- ❖ My most embarrassing math moment is ...
- ❖ If I were on "Who Wants to Be a Millionaire" and I needed a lifeline for a math question I would call ...

Appendix D
Mathitudes Survey

Name _____

Date _____

1. When I hear the word math I _____.
2. My favorite thing in math is _____.
3. My least favorite thing in math is _____.
4. If I could ask for one thing in math it would be _____.
5. My favorite teacher for math is _____ because _____.
6. If math were a color it would be _____.
7. If math were an animal it would be _____.
8. My favorite subject is _____ because _____.
9. Math stresses me out: True or False Explain if you can.
10. I am a good math problem solver: True or False Explain if you can

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