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**Math Anxiety in Education:
Confident and Calming Classroom**

By

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Submitted in partial fulfillment
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Upon hearing the words from your teacher, “Please take out your calculator and a pencil as we are about to start our quiz today.” Your heart begins to race, breath shortens, and your leg uncontrollably bounces at the edge of your seat as you take your last glance at your notes. You have completed all your homework and came in for extra help, but why do you experience this rush of emotional panic? This scenario is very common for high school students participating in math assignments and assessments. Students begin to demonstrate extremely anxious behaviors and fear that they cannot be successful in their task in math. Anxiety and anxious feelings are a part of life, however experiencing extreme anxiety can inhibit the student’s productivity, and in certain instances become psychologically crippling. There are many causes and stimulants for anxiety, and a very common stimulant in adolescents today is mathematics. Math anxiety is a negative emotional reasoning to mathematics defined as a feeling of tension and anxiety that obstructs with the manipulation of numbers and solving of the mathematical problems both in ordinary life and academic situations. This anxiety with mathematics exists due to low expectations and self-efficacy of the students in this particular content area that when interacting with the mathematics, their cortisol levels rise to a crippling amount. The ability to “not be successful” can be justified by those around them by reassuring that learning math is hard, and only some will be successful. The excuse for students not to embrace the challenge that working with mathematics presents collides with society’s recognition that mathematics is important to learn, thus fostering an environment for this anxiety to arise. This anxiety towards mathematics affects students not just in the classroom, but in real life scenarios. These students shy away from calculations and do not persevere on problem-solving if it involves mathematics. In an effort to combat this, it starts with educator’s making an effort in lessons to make the math classroom environment more confidently sound with high yet attainable expectations along with designing lessons of interacting with math in an approachable fashion

Several studies examine the relationships between math anxiety and factors of gender, environmental factors, performance, and self-efficacy, and to combat them by trying to shift the thought

of fear about mathematics to excitement. A focus on building the validation in students that they possess the ability to learn the math and be successful accompanied with a calming environment combat the negative approach to math. In recent years, researchers and educators conducted numerous studies on the causes and effects of anxiety in the classroom. One finding is that personal factors have a direct impact on anxiety levels and ability to perform. Personal factors consist of a student's self-perception because it determines what the person does with the skills and the abilities they already possess. "Low levels of self-efficacy are related to lower levels of math performance and attitudes, while increased levels of self-efficacy leads to increased persistence, higher performance and more intrinsic math" (Jameson 2014). Math anxiety can be present in students as young as first grade. Henslee and Klien stat that it states math anxiety and math performance are not always inversely related. With the "right" amount of cortisol levels, a stress related hormone, students can perform very well in math, (Henslee 2007). People that do have math anxiety decrease their likelihood of exposing themselves to math, and thus decreasing their self-confidence, their ability to understand math, and their enjoyment of engaging in math (Jameson 2014). After this repeated negative experience with the subject, the person's low self-confidence with the material solidifies and they are very likely not to pursue higher education or careers that involve mathematics. This creates a cyclical manifestation of math anxiety through a culture of students and generationally through families.

Math self-efficacy and performance are relative. The journal *Contextual Factors Related to Math Anxiety in Second-Grade Children* references the study done by Cooper and Robinson who found that "Overall, students with high self-efficacy, have low math anxiety," (Jameson 2014). Once a student maintains a high self-efficacy in math, they are encouraged by their own capabilities and reach towards a growth mindset, rather than stunted by failure. The anxiety about the content decreases because failure is accepted, and the student longs to deepen their understanding instead of becoming anxious. The gender of the student interacting with the content also affects math anxiety. This influence of the gender of the student emerges in adolescents, according to Jameson's journal, stating that middle school girls report

more math anxiety experiences than boys by 20%; however this does not necessarily mean that the boys performed better than the girls. Women are just now starting to be recognized as equals in the work force versus the gender role of the housekeeper, that there are often negative connotations that women do not have the same high expectations in STEM classes or in the STEM workforce. The negative stereotypes with girls in mathematics causes judgement in the efficacy of the young boys and girls. “Girls are directly affected by math anxiety and have low self – efficacy in math, when boys experience math anxiety when due to the importance of the math and are more willing to face challenging problems.” (Jameson 2014). Young girls unconsciously absorb the idea that mathematics possess a sort of masculine trait, along with the excuse that they do not have to be successful in math due to their gender role, and therefore are less willing to challenge that based on the this societal outlook.

Environmental and behavioral factors affect math anxiety and self – efficacy because students compare themselves to others and witness persuasions that solidify their perception that they are unable to master the content. Parents and guardians typically exist as major influences on children and adolescents. Parental influence has an effect on their interest in math content because if a parent excuses the failure in math because they did not have the best experience, it allows the child to avoid accountability for learning the material. If students see other peers excelling in a topic while they are not understanding, it lowers their self – efficacy and feel lesser to their peers if they do not have that confidence built up within themselves to embrace the challenge. Students in any subject need to have a growth mindset developing from a high self-esteem in order to be resilient against difficult tasks in education. Challenging students through mathematical problems and exercising their logical thinking when students are willing to challenge themselves swiftly deepens understanding of content and provides students the opportunity to take responsibility for their learning. “High self-esteem students participate more, persist longer, work harder, and have fewer emotional restrains” (Jameson 2014). The behavior and the environment affect the students and their belief in their ability they receive from their environment build up esteem in students.

Another option to reduce anxiety is to create a testing environment emulating a place of peace for the class period. Senses play a major role in the ability for the mind and the body to relax. Flannery describes a ninth grade science classroom in Ohio where the teacher burns peppermint-scented candles because peppermint is said to stimulate brain activity, and other teachers turn on relaxation tapes with soothing sounds of raindrop or ocean waves (Flannery 2008). Another teacher in Clifton, New Jersey takes her middle schoolers on a “journey to contentment ” on testing days. She does this by having them close their eyes as she narrates them through calming scenarios appealing to their senses and it lets the minds wander to somewhere peaceful. This “spa-like” guided imagery with music, smells, and thoughts has reached students in the past (Flannery 2008) and implementing multiple interventions and consistency with the interventions has shown positive results in reducing math anxiety in adolescents.

Due to the evidence done in prior studies, this study somewhat emulates the focus on creating that spa-like environment in the classroom through classical/meditational music. Accompanying the change in the classroom environment, students will relate back to their prior successes in math through having something physical to reference as well as guided imagery. This study took place in two Accelerated Geometry classes consisting of freshmen students at Fenton High School in Bensenville IL. Prior to taking the assessment, the administrator/educator assigned the students the task of finding a problem/assessment/assignment that they have successfully done recently and to place that paper in a clear folder in their mathematics binder. In an effort to reduce math anxiety, relaxing meditation /classical music plays during the assessments. From then on, students have an instance of mathematical success to reference when they feel defeated. While the music is playing, the administrator asks students to close their eyes and channel the feeling of being successful in math. Then as a class, they are instructed to take a deep breath and say, “we can do it.” After this is completed, then the assessment is distributed.

As a reflection of this process, this routine requires a high level of care and time from the educator. The educator has to break from a traditional ideology and make the decision to invest time in reassurance, positive thoughts, and the more calming environment. If this technique becomes more of a

routine, the time needed to implement should decrease because this routine will become more natural to the students and some might even do this on their own without having to be lead through the process.

In order to gauge the students' initial measure of math anxiety, a Pearson Math Anxiety Self-Test was administered with paper and pencil on February 24th, 2019. This way there can be comparative data from pre-intervention and post-interventions. The teacher explained that this is to be done individually as benchmark data because interventions will be put in place later. Below is the questions that students responded to:

(1) = Disagree, (2) = Somewhat disagree, (3) = Neutral, (4) = Somewhat Agree (5) = Agree.

1. I cringe when I have to go to math class. 1 2 3 4 5
2. I am uneasy about going to the board in a math class. 1 2 3 4 5
3. I am afraid to ask questions in math class. 1 2 3 4 5
4. I am always worried about being called on in math class. 1 2 3 4 5
5. I understand math now, but I worry that it's going to get really difficult soon. 1 2 3 4 5
6. I tend to zone out in math class. 1 2 3 4 5
7. I fear math tests more than any other kind. 1 2 3 4 5
8. I don't know how to study for math tests. 1 2 3 4 5
9. It's clear to me in math class, but when I go home it's like I was never there. 1 2 3 4 5
10. I'm afraid I won't be able to keep up with the rest of the class. 1 2 3 4 5

After the 44 students' responses, their scores were totaled and evaluated through certain ranges also provided by Pearson below:

40-50 Sure thing, you have math anxiety. **5 students**

30-39 No doubt! You're still fearful about math. **12 students**

20-29 On the fence!. **19 students**

10-19 Wow! Loose as a goose! **8 students**

The majority of the students' responses demonstrates that math anxiety is definitely present in the classroom. The individual data also shows that students feel the most anxious about math assessments compared to any other assessment.

After the data was gathered, I instructed the students on March 20th 2019, to find a problem/quiz/assignment that they were successful in and place it in a clear divider that I passed out as a class. Prior to taking their first quiz of unit 7 on Circles on March 21st, 2019, students were asked to channel that feeling of success and take a look at their problem/quiz that they chose to designate. After the students had the opportunity to do so, the quiz was administered. The administrator/teacher also reminded students that they are intelligent mathematicians and that one quiz gives the teacher information about you on this day, not as a whole person. Once this process has been gone through, the teacher/administrator is to play a testing/calming playlist that includes classical music and music for meditation. After the assessment was turned in, students were asked to complete a survey on the google classroom sight at the following link:

https://docs.google.com/forms/d/e/1FAIpQLSdMgZvqRqZ9E3SdSkh-6jm2bTElnG_kJ46Hm2NCCoMNq75AQ/viewform

The scores of the same 10 questions from the initial self -test have the results of:

Range 40-50: 6 students

Range 30-39: 10 students

Range 20-29: 17 students

Range 10-19: 11 Students

Also, 6 out of the 44 students reported agreeing/somewhat agreeing to the statement that "Music did not help me relax while taking an assessment". Students along with the music played throughout the classroom have the option to listen to their headphones during the assessment. My prediction based off of these students' responses is that these students chose to listen to their preferred music. However, 38 of the students were either neutral about the music or thought that music was helpful /somewhat helpful in

calming themselves during the assessment. Also, only 8 out of 44 students felt confident handling in their quiz, yet 10 out of 44 students find it difficult to think of prior successes in math. This data leads me to the interpretation that even though students as a majority recognize their successes in math, they do not experience high levels of confidence upon the submission of an assessment. I interpret these students' responses by students seeking reassurance when learning new material because they have not received the validation of obtaining a score yet for their depth of knowledge. Also, the contributing factor of the grading scale I know hangs in the minds of students while taking an assessment as some of them have asked me for point values on specific questions. Students seeking scores versus seeking knowledge is demonstrated and contributes to the lack of confidence in their assessments.

Overall, students reported after their quiz that the music played did help them feel relaxed while taking the assessment. As the majority of the students felt like they can think of instances where they have been successful in math. Actually, only a couple reported saying that find it difficult to think of a time where they were successful in math, but since this group is on the accelerated track, I interpret those few responses to come from a negative and fixed mindset and not necessarily fact from past experiences.

Putting any sort of acknowledgment that math anxiety exists and there are methods in order to reduce it being implemented in class, is the first step to eradicating math anxiety in classrooms. I believe the most challenging aspect of fighting against math anxiety is getting students to commit to this idea of relaxing in class. This requires a comfort level in the classroom environment to be established prior to implementing noticeable efforts to reduce math anxiety. This short amount of time with the students to build that sort of relationship with their teacher and implement these methods should be consistently implemented in order for there to be a higher impact on the level of anxiety experienced by the student. This study I believe would be able to show a greater impact on math anxiety if I was able to begin working with students at the beginning of a year school year. This way, expectations would be set and consistently abided by in the classroom. Once the precedence of the idea that I am continuously presenting them with challenges in order to help them grow, other than saying something is "hard" or

“easy” works to change a fixed mindset that students can have. More frequently taking breaks in the classroom and teaching students how to be reflective and logical would be beneficial in being more purposeful in the self-guided reflection and imagery. As educators it is important that this profession is teaching young minds *how* to think, and so an investment of time is necessary in order for confidence to be instilled through this reflective process. I firmly believe that the methods and interventions imposed in this study can/will be effective when used thoroughly in a classroom. The adversity against this study was the abrupt and short lived focus on creating that environment designed to lower math anxiety. When working with students in the future, I plan to continue to monitor their math anxiety levels and stay consistent with building up students’ self-efficacy in math as well as working to create a calm and supportive environment.

In conclusion, the results of this study did not show a significant decrease in math anxiety of students. Students reported that they do not have a difficult time thinking of successes in math, but they become overwhelmed by other factors like their letter grade, or if their parents give some sort of consequence if they do not get a good grade. The opposite is also a factor, some students accept defeat or do not feel like they are capable of succeeding or understanding the math that it becomes crippling because they feel so far behind their peers. However, students expressed that the music helped students relax, and this overtime has the potential to reduce their anxiety in math/testing environments. The study expresses that there are underlying issues for students that prevent them from feeling secure when taking math assessments and interacting with mathematical situations. Implementing techniques to reduce anxiety on the day of the assessment may help shift their awareness momentarily, but breaking down those math anxiety barriers requires consistent work to shift the mindset of students about math.

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