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Unraveling Math Anxiety

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Abstract

This paper focuses on finding methods to assist students identify their individual math anxiety and introduce strategies to overcome or control the anxiousness. The research indicates that the more students are in touch with their own individual math anxieties, the easier it will be to overcome the nervousness. Twenty-two students took three individual assessments and a survey to help identify their math anxiety. The first assessment was timed and students were not informed if it would count toward their grade. The second handout had no time limit and it was not going toward students' grade in the class. The last assessment had to be written out in words, and the survey asked students what they thought of the assessments. Most students thought that the second assessment was the best at demonstrating their understanding of a topic, and the preferred method of testing. I discovered that majority of students found being presented with three different assessments was helpful in understanding their learning and accumulating new ideas to study. It is both the student's and the teacher's responsibility to try to overcome math anxiety by introducing new studying styles as well as getting to know the learner as an individual.

Literature Review

Math is a skill humans use everyday consciously or subconsciously and have been using since before the invention of the wheel. It is important for the human population to continue to refine our understanding of the math world to ensure a sustainable and lengthy life. As our world progresses it is more difficult for students to understand the importance of math, or to comprehend how to use the math learned in the classroom in the student's everyday life. When students struggle in math they tend to steer away from the subject as a whole, which only makes the fear grow exponentially. Students or persons with negative emotions or overwhelming sense of nervousness are described as having math anxiety (Finlayson, M. 2014; Williams, W., 1988). According to Young, Wu, & Menon, nervousness that arises when mathematical equations are present closely linked to weakened cognitive information processing in the brain, thus affecting the thought process (Young, C. , Wu, S. , & Menon, V. 2012). The nervousness that arises when tackling a math equation can disrupt the process of solving because the brain is juggling both math and anxiety.

Math anxiety is more than likely to be linked with a single or multiple past negative mathematical experiences. Thus meaning math instructors need to be extra cautious of how to present, instruct, and evaluate their students (Finlayson, M. 2014). Students are better learners when they feel like they can ask questions about what is being presented to the class; therefore it is crucial that teachers are prepared in math proficiency. If a teacher or guardian has math anxiety it is more than likely the student will adopt the negative emotions associated with math (Finlayson, M. 2014; Geist, E. 2010; Williams, W. 1988; Ramirez, G. , Gunderson, E. , Levine,

S. , & Beilock, S. 2013). Multiple studies show that a student's guardians' level of schooling as well as socioeconomic background can have an effect on the students' feelings toward math (Geist, E. 2010; Tobias, S. 1993; Martinez, J. & Martinez, N. 1996). If there is no assistance available to students at home or if math is not significant at home it makes sense that the student would then carry on those same beliefs about math.

Timed math assessments seem to be the most prone activity to cause math anxiety to arise in students (Ashcraft, M. 2002; Ashcraft, M. & Krause, J. 2007). When timed activities are presented to the learner it seems speediness takes more importance than precision, thus leading to incorrect answers. Another time issue is the pace of the classroom being set by the teacher and not the learners (Finlayson, M. 2014; Veile, A. 2013). For example if the teacher is not prepared or has math anxiety, it is likely the teacher will not take student questions and will not have an open conversation about the material being presented. Finlayson "(2014)" & Veile "(2013)" also believe that there needs to be more time devoted to teaching and comprehending math skills in the classroom. Unfortunately, teachers will move on to another subject even though they know their students did not understand the material that was presented because of time restrictions in the school day.

There are some studies that show if students understand their metacognition it will lead to lowering anxiety levels (Legg, A. , & Locker, L. 2009; Park, D. , Ramirez, G. , & Beilock, S. 2014; Vesile, A. 2013). Therefore math anxiety has to do with students not understanding the material or their own individual learning process. Once a student learns how to track their own understanding it is more likely the math anxiety will slowly depart and self confidence will rise. It is important for students to know strategies of what steps to take for different types of

equations so students can focus on how to solve the problem instead of panicking. One method that has proven to lessen math anxiety is expressive writing (Park, D. , Ramirez, G. , & Beilock, S. 2014). If teachers provide their students with time to write about their feelings toward the math being presented it will relieve some of the anxiety and make the student aware of their metacognition. Expressive writing allows students to reveal their anxious feelings so that after writing the student can better focus on the math and not the anxiety.

I encountered a concern where the more people that have math anxiety leads to less math classes taken in high school and college, and less career options especially dealing with math or science(Ashcraft, M. 2002; Geist, E. 2010; Ramirez, G. ,Gunderson, E. , Levine, S. , & Beilock, S. 2013; Williams, W. 1988). Ultimately if the population is not interested in learning math it will lead to an unpredictable economic future. It is also noted that less and less students are choosing to take math, which leads to less math majors and an overall math anxious country.

Overall math anxiety can affect anyone who is studying math or deals with math in a real life situation. The issue is that a large portion of the population have very negative and anxious thoughts when presented with math equations. Math anxiety is usually caused by a previous negative math experiences, lack of comprehension, poor working memory, and can be provoked by guardians/teachers. Expressive writing was only strategy I was able to find that seemed to successfully alleviate the anxiety. Math is a skill humans use everyday conscious or subconsciously and have been using since before the invention of the wheel. It is crucial that the population continues to analyze the subject math to refine our world as a whole.

Project Description

I worked closely with a middle school math teacher in order to develop a successful strategy to assist students overcome their math anxiety. It is possible that some students do not have math anxiety, but the project provided them with information about what some of their peers are experiencing. It was clear when choosing what teacher to work alongside with because I have known the math teacher, Mrs. Ramirez, for almost my whole life and she is recognized as one of the best teachers on the her school campus. I knew Mrs. Ramirez before she was a teacher and seeing her in the classroom motivated me to pursue the same career. Mrs. Ramirez currently teaches sixth grade math, seventh grade advanced math, and the leadership class.

Mrs. Ramirez started teaching middle school math over five years ago, and has always been a dedicated teacher. Mrs. Ramirez will spend her lunches and after school prep time assisting students to make sure there is no confusion about the material presented. The students love Mrs. Ramirez, many students will come to her class for help even though she is not their math teacher. Mrs. Ramirez is very diligent and dependable, this is why I know she will be the optimal community partner for my project.

For my capstone project Mrs. Ramirez and I have accomplished two items, decreasing her students' math anxiety as well as raising their math confidence. Together we decided to provide the students with three styles of assessments and a survey. Mrs. Ramirez and I have chosen to give her sixth grade math students three different styles of assessments that incorporate material the students are currently studying (Appendix 2 and 3). All three assessments were given a few days apart, five questions each, and all encompassing related questions with different

numbers. The students will not be informed if the first assessment is going to affect their grade as well as a time restriction of seven minutes to find the correct solutions. Assessment number one is constructed to produce a stressful situation where math anxiety would arise if present in the learner. A few days after, the second assessment was given to the students. Before the second assessment was distributed the students were informed that there will be no time limit and the assessment will not count towards their grade. For the final assessment students were required to write out the answer and scratch work using only letters, no numbers. The third assessment displays a technique of writing out math problems to better understand and reinforce the steps to take to complete the question.

After the students complete all three different styles of assessments I will provide the students with a structured questionnaire where they can write about the three opposing styles. The purpose of the questionnaire is to provide a time for students to reflect on the different styles presented and how they were affected by them. It is important for students to understand what they do and do not know as well as how they learn and perform. This project has provided students with an experience that will help them better understand themselves as a learner, how they can individually improve, as well as strategies to boost math confidence.

Results

For my project I aimed to help math students identify their strengths and weaknesses by assigning differing assessment styles in order to assist their metacognition. By improving the students metacognition they will be able to identify what studying or test taking habits work or do not. My project was successful because every student participated in the final survey, therefore each student self assessed their math capabilities. My efforts did not completely resolve all of the students math anxieties, although I do feel victorious in the sense that I informed students of alternate strategies for studying math. Showing the students there are different ways to study math encourages creativeness in finding their own style to make math easier for themselves.

The results of the survey did not catch me off guard, but the some of the written responses did. The majority of students thought the assessment that best demonstrated their knowledge was the assignment two, not timed. Nine students agreed that with no time limit they felt more at ease while testing. With only one less student vote, assessment one came in second for being the best example of knowledge. Students stated that timed tests are what they are used to, making it the best illustration of comprehension. Only a handful of students voted for writing out the answer as the best demonstration of proficiency because in order to explain how to solve the problem the student has to grasp the topic entirely.

The second question on the survey asked the students which assessment made them feel most anxious. Over half of the students voted the timed assessment brought on the most nerves.

Less than half of the students voted that writing out the answer gave them anxiety because it was something they have never practiced before, students were not sure how to properly execute. None of the students felt anxiety was raised for the assessment that was not timed.

Question three on the survey asks the students if they felt writing out the answers was hard, medium, or easy. Eight students agreed assessment three was easy and most of their comments said they had to write out what math they did in words. Four students voted for assessment 3 as hard, and ten students said felt it was medium. Students struggled with the writing portion because they were hung up on the details of what all to write in words, or how I wanted the answers presented. Some students said the task was difficult because it takes more time to write out the answer then just computing it.

In the survey I asked students if they thought writing out the answer in words only can help them study for future assessments and/or better understand math concepts. Half of the students said yes, these students made comments that made it clear they knew that writing out the answer reinforces the steps needed to take to complete the problem. A few students said that they will use writing out the answer as a new studying technique, and that it will help them gain confidence in future math classes. The students that said writing out the answers did not help also had some interesting comments as to why it did not help them. A lot of the students complained that writing out the answer was more work, took too much time, took up too much space, and one student even said by writing out the answers you could possibly forget your numbers. It seems to me that the students that voted no did not have an open mind set for this new style of assessment or needed more guidance as to how writing out the answer can improve their math abilities.

The fifth question I asked on the survey was if being presented with three different styles of quizzes has helped better their understanding of how they perform or give new ideas on how to study. Five students said that it was not helpful, two stated that they already perform well and the other three said that they prefer only one type of assessment or studying style. The seventeen students that stated the project assisted them all had intriguing answers as to why they felt that way. One student said the three different styles helped her understand how she performs, how to study more efficiently, and that having a variety was refreshing which drove her to try harder. Another student stated that by trying new ways to test take or study, the more he will know in future math classes. Other students said that having a variety of studying techniques will encourage them to study more often versus just having one method. Lastly, students said that they liked the challenge of trying something new in a math class.

My last question on the survey asked the students which assessment style they prefer in a math class. One student voted for writing out the answer, assessment 3, because if someone wanted to know how she did the problem they could read her answer. Four students chose the timed assessment as the preferred method because they like the pressure, they think faster, and that is what students are accustomed to. Seventeen students voted for the timeless assessment because it was less pressure, students could focus on the problem at hand and not worry about the clock.

After completing my project I have found a few changes that could have improved the success of my research. I was able to identify some of the issues by reading over the students written responses on the survey. The first issue was students were very anxious about writing out answer in words for assessment three. To eliminate the issue I would have given a short lesson

on how to write out a math answer using letters instead of numbers. Another issue that came up was students not wanting to participate in the assessments. In order to solve the participation problem next time I might not use the word assessment, but instead something less threatening like worksheet.

As I was putting my project together I realized that it is a very difficult task to try to eliminate students math anxiety. I soon came to the realization that I only had a semester to come up with a plan to alleviate the nervousness students have when working with math. I tried to come up with the best way to have students continue to try to decrease their math anxiety after I leave the classroom. After talking to my community partner we found that providing students with multiple strategies to study as well as improving their metacognition will be the optimal way to decrease the students' math anxiety.

After working with Mrs. Ramirez I could tell that she tries to keep her math classes interesting by creating multiple styles to provide the students with information. I was lucky to have such an amazing community partner that I know I can contact the rest of my teaching career. The most gratifying moment I had during the project was helping a student who knew no English take a math quiz. Mrs. Ramirez asked if I could take the ELL students to a private room and work with him. Although my spanish is not polished, the child knew no english and needed all the help he could get. After going over the directions for the problems on the test, he improved immensely. I could tell when I first sat down with him he was nervous. The nerves could have occurred because he was not able read the directions or I possibly could have made him nervous at first. I could tell he was getting more comfortable and asking me more questions

as time went on, and the students confidence was skyrocketing. I believe I helped alleviate the student's math anxiety by being there to answer questions with no judgement.

The greatest takeaway I had from my project were all of the written responses on the surveys. My project was intended for the students to learn more about themselves and take away skills to be a life time learner. When I read the individual responses on the survey it reinforced the importance of getting to know each student as an individual and assist the personalized math anxieties. I also found that it is key to try to mix things up in a math class to keep students engaged and curious about the topic.

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Appendix 1

Community Expert Interview

Interviewer: Student (Melissa Giorgio)

Interviewee: Middle School Math Instructor (Mrs. Ramirez)

Interview Setting: The interview was conducted at Starbucks Coffee in Livermore and took place at 5:00 PM on a Friday.

Affiliation with interviewee: I have known Mrs. Ramirez for over 10 years, helping out in her classrooms as well as being my personal mentor.

(Start of Interview)

Interviewer: From your experience, what does math anxiety look like? What are the signs students are struggling?

Interviewee: Frustration is the first sign. Their body language shows the stress as well. During a test or quiz they seem to get really nervous. After the student is stressed and nervous students can escalate to give up completely. They stop caring, doing worse on their homework by not trying every problem. They also get nervous to get called on to answer a question.

Interviewer: How can you tell a student does not want to get called on?

Interviewee: Avoiding eye contact, asking to go to the bathroom or get water, talking to their neighbor, or sharpening their pencil.

Interviewer: How would you define or explain math anxiety?

Interviewee: Being so stressed and overwhelmed about not knowing how to do a problem or identify the math problem.

Interviewer: Have you dealt with math anxiety personally? If so, when? What caused it? How did you get over it?

Interviewee: As a teacher, yes in terms of knowing the material well enough to explain or answer any questions that come up in the lesson. Now I am more comfortable telling the students I am not sure, but let's find out the answer together. As a student I don't think I had math anxiety, but I always put pressure on myself to do well in math because it was my strongest subject in school. I would get nervous about tests in general but I quickly learned the only way to help yourself is to study.

Interviewer: Have you heard of expressive writing in math classes? If so, what are your thoughts on the strategy?

Interviewee: I think that is really good, it's good to be able to articulate your thoughts through writing not just step by step process. I have given a math quiz in the past that could have no numbers on it, it is a different way of thinking and it shows they know the material that much better if they can identify why they need to isolate the variable.

Interviewer: Do you think there are specific grades students are more prone to experience math anxiety?

Interviewee: Fractions always seem to scare kids. Seems to me there is no solid foundation on the understanding of fractions.

Interviewer: I find that in my college math classes for my minor

Interviewee: I didn't see stress in first grade when I student taught, and in third grade they didn't really know if they were good or not, and by middle school they levelize you so students know what level they are at. I see the most math stress in my advanced class, I gave out 17 A+ out of 49 students. They are very competitive and it stresses them out.

Interviewer: Do you think there is a certain age when a person develops math anxiety? Or can it happen at any age?

Interviewee: Stems in elementary level depending on if the school levelised the students. If they never have a high math class students won't know more then the rest unless they participate more, but that's about it.

Interviewer: Based on your last response, do you think the anxiety has to do with students knowing they are not up to par?

Interviewee: I think anxiety has to do with the student not wanting to be the least smart in the class, and as for my advanced their stress deals with wanting to be the best.

Interviewer: Do you think math anxiety has to do with overall anxiety?

Interviewee: It depends on how much they like the subject honestly. If they don't really care about math, then no math anxiety. I do not see my students in other subject settings so it's difficult to answer.

Interviewer: Why do you think math anxiety exists, and not spelling anxiety?

Interviewee: There is a stigma about math, not sure where it came from. Maybe because it's used in everyday applications, like in the store. Spelling there is more resources. I don't know why there is more stress in math, maybe because math builds on itself. Where in spelling if you bomb one week and the next start fresh. There is never a fresh start in math, if you're struggling it's a slippery slope.

Interviewer: What do you think the future will be like if the U.S. population's math anxiety is growing?

Interviewee: In terms of are we going to all stress out and go crazy? I am kidding. But not too sure how to answer this one. Maybe more jobs being computerized.

Interviewer: Do you think math anxiety is contagious students to student, guardian to student, and even teacher to student?

Interviewee: Student to student is caused by competition, especially in my advanced classes. I can tell when I pass out quizzes or tests students get anxiety because others ask what they received for a grade. Even though I always tell my students it's rude and none of their business to ask others what they have received.

Appendix 2

Assessments and Survey

Name: _____
Date: _____**Comparing Fraction Assessment****Write the correct comparison symbol (>, <, or =) in each box.
You must show all of your work.**

1. $\frac{3}{4}$ 0.85

2. $\frac{3}{8}$ 0.3

3. $\frac{1}{20}$ 0.005

4. $1\frac{9}{12}$ 1.6

5. $\frac{31}{10}$ 0.31

Name: _____
Date: _____**Comparing Fraction Assessment #2****Write the correct comparison symbol (>, <, or =) in each box.
You must show all of your work.**

1. $\frac{1}{4}$ 0.35

2. $\frac{6}{8}$ 0.6

3. $\frac{10}{40}$ 0.05

4. $1\frac{3}{12}$ 1.3

5. $\frac{26}{5}$ 0.26

Name: _____

Date: _____

Comparing Fraction Assessment (Words Only)

Write the correct comparison symbol (>, <, or =) in each box. THEN, explain in words the step-by-step process you did in order to come up with your answer. Try to explain how you solved the problem to someone who has never seen a problem like these before. Make sure you reread your work and do not skip any steps.

1. $\frac{2}{4}$ 0.55

2. $\frac{2}{8}$ 0.15

3. $\frac{16}{20}$ 0.74

4. $2\frac{3}{4}$ 2.65

5. $\frac{36}{12}$ 3.0

Name: _____
Date: _____

Comparing Fraction Survey

Which assessment best demonstrated your knowledge on comparing fractions and decimals?

- A) Assessment 1
- B) Assessment 2
- C) Assessment 3

Why?

Which of the assessments made you feel the most anxious?

- A) Assessment 1
- B) Assessment 2
- C) Assessment 3

Why?

Was writing out the answers in assessment 3...

- A) Easy
- B) Medium
- C) Hard

Why?

Do you think that writing out the answer in words only can help you study for future assessments and or better understand math concepts?

- A) Yes
- B) No

Why?

Do you think being presented with three different styles of quizzes has helped you better understand how you perform or give you new ideas on how to study?

- A) Yes
- B) No

Why?

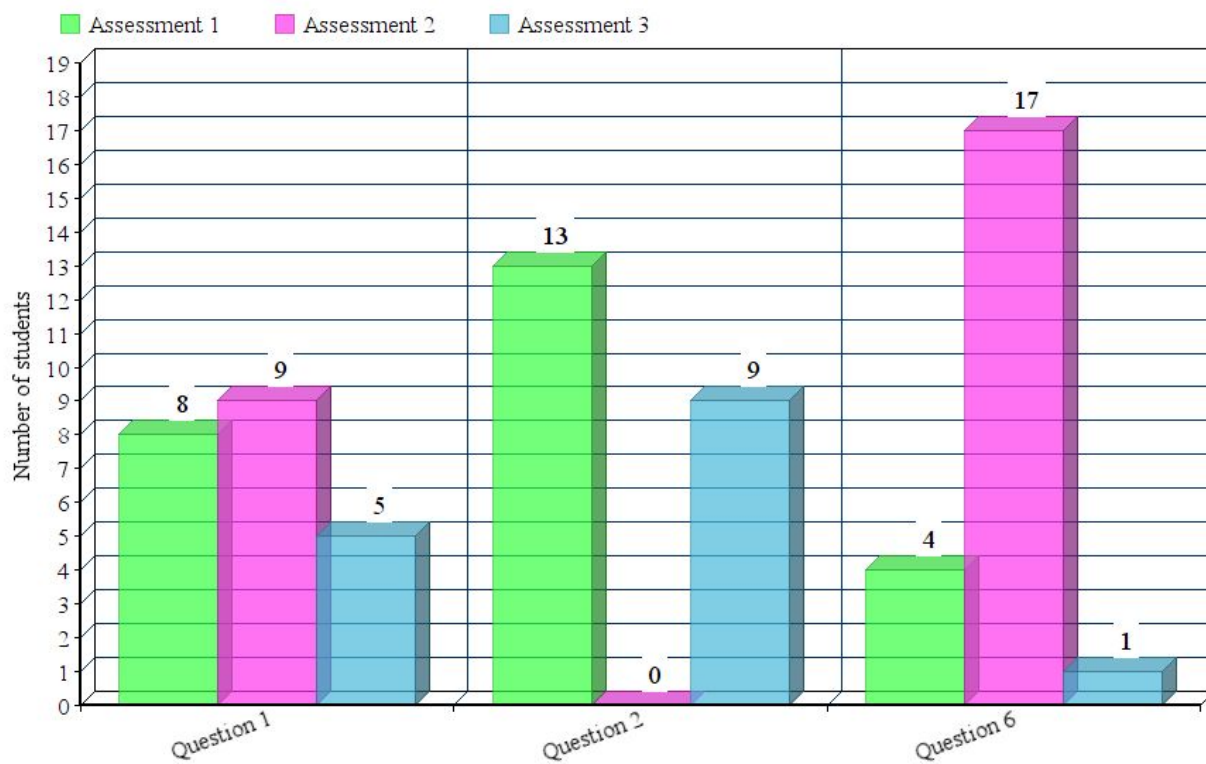
Which assessment style do you prefer in your math classes?

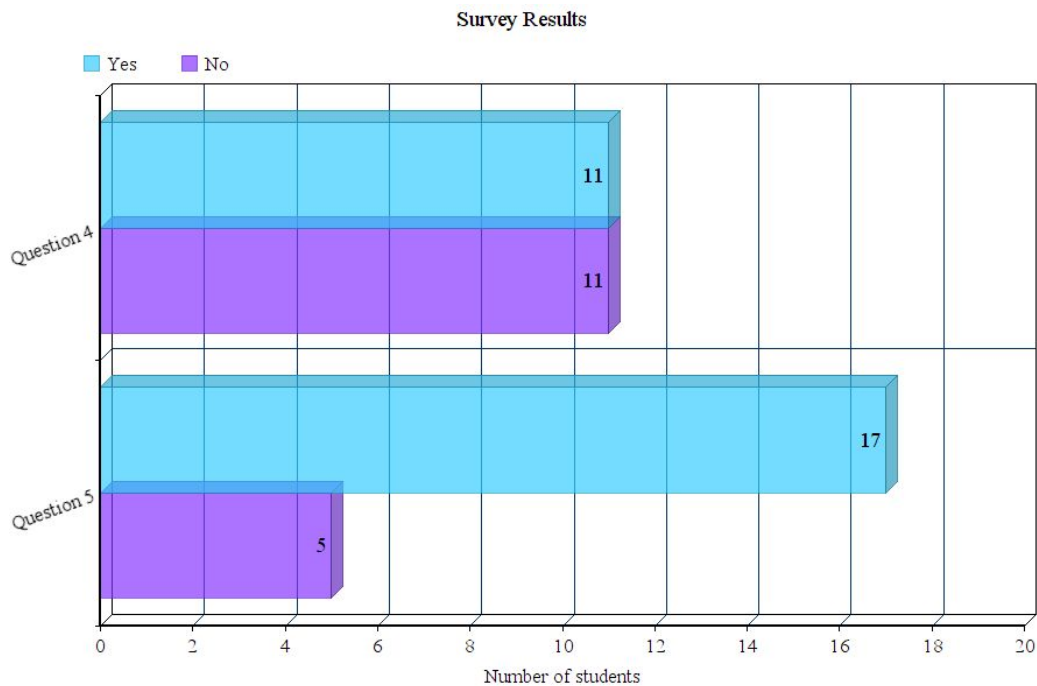
- A) Assessment 1
- B) Assessment 2
- C) Assessment 3

Why?

Appendix 3

Survey Results





Survey Question 3: Writing out the answers in assessment 3 was...

