

Challenges and Benefits Those New Technologies Bring to Teaching Mathematics

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Abstract

Math anxiety is sometimes viewed as a topic where is nothing new to add. As a result there may be challenging to keep collegial conversation fresh and focused on potentially helpful strategies.

In recent years, all these old problems have resurfaced in online education. New issues also arise due to the loss of face-to-face communication between students and instructor.

Math anxiety develops early on and is not easily alleviated. We believe that the biggest factor in easing math anxiety is the teacher. But many of them suffer from math anxiety themselves, especially at the elementary school level, where most teachers are not math specialists. Therefore, we believe that training teachers to be math anxiety-free is crucial. In this study, we present some strategies that we have found to be effective to relieve math anxiety for online prospective teacher students and conduct a survey to determine how effective they are.

In many research papers, most investigators focus only on one or two factors contributing to math anxiety. Our study is based on our many years of experience teaching math at the university level, and focuses on math teacher preparation. Our analysis shows that only a combination of different strategies utilized with a practical approach can yield a positive result.

Examples of those strategies and how to combine them will be shown. . New challenges of online education in math and methods to overcome math anxiety for future teachers will be presented.

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Introduction

Strong mathematics skills are critical for many careers in modern technological society. At the same time, the term "math anxiety" is so common that it became almost a synonym of mathematics. Numerous researches have been made about mathematics anxiety and how to cope with it; for example, you can find a very good list of references in Hellum-Alexander's review (2010).

Mathematics anxiety, according to Ashcraft (2002) is "commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance"

That feeling comes from early school years, goes to college, and even students at university level with mathematics major still experience math anxiety in a great degree (Zakaria, Nordin, 2008).

Tapia (2004) stated that students having little or no anxiety scored significantly higher in motivation than students with some or high mathematics anxiety. Ma (1999) found that "effective motivation was a predictor of mathematics achievement", and "the relation between mathematics anxiety is significant, a high level of anxiety is associated with a lower level of achievement" (Quilter, Harper, 1988). This connection is easy to understand because students with high motivation usually enjoy doing mathematics problems and absorb mathematics concepts better while solving problems. Students' attributions or beliefs about the causes of their success and failure have been repeatedly linked to their engaging and persisting in learning activities. Students' self-regulation improves mathematics learning.

Many authors investigate a contribution of teachers and their individual methods to student mathematics anxiety. For example, Greenwood (1984) stated that the principal cause of mathematics anxiety is based on teaching methodologies.

While the literature indicates that many factors contribute to math anxiety, it frequently mentions the instructional methods used by teachers as significant in influencing students' attitudes toward math. Cavanaugh (2007), however, noted that there has been relatively little empirical research examining the effect of classroom instructional methods on math anxiety despite many investigations of the effect of the problem on student performance and cognitive processes. Boaler (2008) states that the design and presentation of mathematics in schools foster math anxiety. The standard method of instruction in many math classrooms is a significant factor leading to poor performance, which is the first identified phase of math avoidance and anxiety.

In most classrooms, the teacher presents math problems in a didactic manner, with the students disengaged from the learning process and discouraged or prevented from discussing the material or asking meaningful questions. Add to this pressure from the expectation that students must master the concepts and procedures that will be assessed on standardized and high stakes tests, and what evolves is rigidity in curriculum and teaching approaches.

In some cases, a teacher's poor mastery of the material can increase math anxiety in students because the teacher communicates uncertainty in presentation and in response to questions (Cavanaugh, 2007). In addition, a teacher with poor mastery of the subject or appropriate teaching methods may not be able to remedy the difficulties of students in understanding the material.

Test anxiety and mathematics anxiety have been found to relate to mathematics performance in both children and adults. That study (Racheal McAnallen, 2010) investigated mathematics anxiety in elementary teachers and whether those who experience mathematics anxiety also have professional anxiety about teaching mathematics.

A researcher-developed instrument called the McAnallen Anxiety in Mathematics Teaching Survey (MAMTS) was administered to a sample of 691 teachers from eight states representing geographically diverse areas of the United States in rural, urban, and suburban communities. Responses were used to investigate mathematics anxiety in elementary teachers as well as several demographic questions.

The majority of the respondents had only taken Algebra I as their most advanced course in high school, and approximately 40% of these participants had enrolled in lower level or what might be considered remedial level mathematics courses in college. Approximately 33% of the participants reported that they had mathematics anxiety and higher levels of mathematics anxiety led to decreased feelings of enjoyment about mathematics. Mathematics anxiety was initially experienced in the primary grades by 12% of respondents, in the elementary grades by 26%, in middle school by 22 %, and later by the remaining 40 % of those who experienced mathematics anxiety.

The participants who reported having mathematics anxiety attributed it to negative elementary or secondary interactions with teachers about mathematics, poor teaching practices while they were in school, and/or negative experiences taking algebra or geometry in high school (Racheal McAnallen).

Math anxiety is the result of a cycle of math avoidance that begins with negative experiences regarding mathematics.

We believe that in order to break that vicious circle we should start from preparing teachers with “no math anxiety” skills.

Rationale of Study

The purpose of this observation was to incorporate several strategies to the learning process in order to help students (future teachers) to lower and overcome their mathematics anxiety. Based on results of different researches, the main idea was to establish a strong motivation for students to enjoy mathematics and see its value in modern society.

Usually, researchers prefer to deal with measurable parameters and statistical analysis. Someone can say that such approach even more applicable when you talk

about mathematics although it is mathematics anxiety. Our understand of the problem is that because it is an "emotional reaction" on one particular discipline, you should find out first what parameters, or factors are involved in forming mathematics anxiety. The list of such factors includes, but not limited:

1. previous negative experience with math starting from kinder garden, elementary school, etc.
2. test failure
3. low self-esteem
4. low achievements
5. poor teaching methodologies
6. low grades in math
7. uncaring attitude of teachers
8. genders of learners
9. age discrimination.

Of course, other researchers can extend that list far more.

Being mathematicians we can say that the problem with that big number of parameters cannot be solved by just considering one or two variables without measuring effects of other variables. On the other hand, a practical solution can be as valuable as any other measurable investigation. Being practitioners, we just found our own effective way to cope with student mathematics anxiety.

We could not find any specific research about coping with math anxiety for online students; so, we developed our own study on that topic. A survey containing eight questions was given to a sample of 30 students, and the results are given below:

1. Are you math anxious?
 - a. Agree – 18%
 - b. Neutral – 39%
 - c. Disagree – 43%
2. Is math helpful for other classes you are taking?
 - a. Agree – 43%
 - b. Neutral – 32%
 - c. Disagree – 25%
3. Do you memorize math rules?
 - a. Yes – 71%
 - b. No – 25%
 - c. N/A – 4%
4. Is math anxiety a familiar feeling for you in online classes?
 - a. Agree – 39%
 - b. Neutral – 36%
 - c. Disagree – 25%
5. Is math helping you in everyday life?
 - a. Agree – 39%
 - b. Neutral – 54%

- c. Disagree – 7%
- 6. Do the math rules used to solve problems make sense to you?
 - a. Agree – 61%
 - b. Neutral – 28%
 - c. Disagree – 11%
- 7. Do you feel like studying math requires a lot of time?
 - a. Agree – 48%
 - b. Neutral – 48%
 - c. Disagree – 4%
- 8. Do online classes help you to overcome math anxiety?
 - a. Agree – 53%
 - b. Neutral – 11%
 - c. Disagree – 36%

Our sample for the study was selected randomly, and we believe (based on our experience) that the picture is very typical.

The results of the survey show that math anxiety is very common among online students, and even among those who are “neutral” it still exists in some degree. It can be easily predicted, but the question is: how to overcome that syndrome when you cannot meet students on regular face-to-face base.

During last few years, we developed several steps strategy which allowed us to decrease or even get rid of math anxiety for our students. Those steps are the following:

1. Send an encouraging and enthusiastic letter at the beginning of the course. In those letters, we usually say that we know how often students have different level of math anxiety, and then we say: Let us help you to be successful in this math class, and we will show you that math can be enjoyable, human, and fun.
2. Put a number of jokes on mathematicians and struggling students to recognize that our students are not the only ones suffering from math;
3. New technologies allow us to make online classes similar to regular onsite ones, and we organize a short live session/seminar explaining what is math anxiety and ways to overcome that phobia. We ask students to share their own experience in studying math. It is more difficult to detect math anxiety in online students, but we have the opportunity to talk one-to-one to each student on the live sessions.
4. Send students a check list with some questions regarding their previous math study experiences such as: early childhood math encounter, math incompetent teacher, math myths, low grades on math tests, and importance of math in their life. It allows students to make a kind of inventory of what problems and fears they have, and be ready to cope with them.
5. There is a myth saying that usually people don't need math in their regular life. We give many examples of really helpful hints math can provide to everybody like which mortgage or credit cards are better, why they need to know how to make estimations etc.

6. We also develop a test taking strategy which we present to our students in the form of a few critical statements like:
 - Work first on the problems that come most easily for you;
 - Does your answer make sense?
 - Does your answer fit your estimate?
 - Recalculate.
 - Do your problem twice.
 - Check your usage of signs.
 - Check your decimal points.
 - Recheck your writing.
 - Check your exponents.
 - Reread visuals.
 - Substitute your answer.
7. From the very beginning, we provide our students a number of reliable and worthy tutorial resources. Nowadays, everybody can find tons of internet resources, so, as instructors, we believe that only a limited number of them should be recommended.
8. Also, we realized that a frequent interaction with online students and encouraging positive support built students' confidence and alleviate their math anxiety.

Conclusion

An early and continued focus on preparing “math anxiety free” students is critical, especially if they are going to be tomorrow’s teachers.

Many students who experienced math anxiety believe that they cannot be successful in mathematics for different reasons, based on their previous educational experience. The impact of early childhood, elementary school teachers, and frustrating experience with memorization instead of understanding should not be underestimated.

Under such conditions, our approach to focus on alleviating math anxiety in future teachers is a critical element in preparation of future generation of the people who would enjoy math and find the right place in the modern society.

“Today’s teachers can and must learn to serve as mathematical linguists, artists, musicians, and dancers so they can instill the joy and wonder of mathematics to generations of students in the future” (Rachel R. McAnallen).

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