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Teacher Awareness of Students' Anxiety in Math Classroom: Teachers' Treatment vs Students' Anxiety

Nugroho Wanda Yanuarto *
University of Muhammadiyah Purwokerto

Abstract

Math anxiety is a common phenomenon which can have a negative impact on numerical and arithmetic performance. However, so far little is known about the underlying neurocognitive mechanisms. This mini review provides an overview of studies investigating the neural correlates of math anxiety which provide several hints regarding its influence on math performance: while behavioral studies mostly observe an influence of math anxiety on difficult math tasks, neurophysiological studies show that processing efficiency is already affected in basic number processing. The purpose of this study is to provide some treatments to overcome students' anxiety in math classroom at The University of Muhammadiyah Purwokerto, Indonesia especially in Math Department, but before it has attempted to investigate the factors that students' anxiety can possibly stem from, both within the classroom environment and out of classroom in the wider social context.

Keywords: *Math anxiety, teachers' treatment*

*Wanda Nugroho Yanuarto, Department of Math Education, University of Muhammadiyah Purwokerto Indonesia
E-mail: wandanugroho86@gmail.com

Introduction

Mathematics is a universal language; it uses symbols and its terms have different definitions than if they were used in a setting that was not math related. Because math is so unique, individuals who have another learning disability will usually also develop math anxiety. A student who is diagnosed with dyslexia or dysgraphia might also develop difficulties when faced with a mathematical situation (Wadlington & Wadlington, 2008). Mathematics is similar to writing, in the sense that there is a process, procedures, steps, and a sequence to follow. If a student cannot express his or her understanding in linear thoughts the student then becomes frustrated and math anxiety will stem from his or her reading disability. Because other learning disabilities are easier to diagnose several students will never be treated or properly taught how to overcome their anxiety. It is more difficult for students with mathematics anxiety to meet the high expectations of today's society.

Math anxiety effects and overwhelming part of the population, Jean Thilmany (2009) stated that 60% of university students in her study have had or currently have math anxiety. This negative attitude about math is becoming a growing problem and barrier for the proper development of many individuals. Females are socialized to dislike math, and even if they are good at math, many female students will fall under the pressure of their peers to believe that all women are not good in mathematical situations. Most girls do not develop a math anxiety until around the fourth grade. The National Assessment of Educational Progress shows that fourth grade girls actually outperform boys on the math portion of the test; these scores however disappear and fall behind by the eighth grade. Girls are thought to only be good at math because of their hard work, while boys are good at math because they are talented (Geist, 2010). Universally, girls and boys are equally as good at math but stereotypes feed into the myth that females and numbers should not be mixed. In actuality, boys do better mathematically simply because they have higher levels of confidence (Walton, 2010).

Mathematical anxiety can be mild to severe; however, it should not be confused with dyscalculia, a neurological based disorder of math, which is in fact a learning disability. Around 6% of school-aged children have dyscalculia; it is as common as a reading disorder (Wadlington & Wadlington, 2008) but unfortunately is overlooked too many times. In Wadlington and Wadlington (2008) stated, "many people have problems with mathematics. Because these people often have great strengths in other areas, their mathematical difficulties tend to be unexpected or ignored".

According to Ertekin, Dilmac, and Yazici (2009), "anxiety is a state of arousal that surfaces through bodily, emotional, and mental changes an individual experiences when faced a stimulus". Many symptoms include but are not limited to the feelings of helplessness, panic, difficult breathing, shame, inability to cope, sweaty palms, nervous stomach, loss of concentration (Malinsky, Ross, Pannells, & McJunkin, 2006). Other symptoms include tension, nervousness, worrying, edginess, impatience, confusion, fear, and developing a mental block (Thilmany, 2009). There are two main focuses of mathematical anxiety. Specific mathematical anxiety is when a person is anxious about a particular math situation, such as being fearful of fractions. Global mathematical anxiety is when a person is stressed in all mathematical situations regardless of type of problem (Wadlington & Wadlington, 2008).

The current study intends to investigate the current affective states of students studying in Math Classroom in The University of Muhammadiyah Purwokerto. Specifically, this research would like to know if these math classroom experiencing students' anxiety. The study intends to address the following research questions:

1. What could be some preponderant causes of anxiety in math anxiety among students learning Math in The Univesity of Muhammadiyah Purwokerto, Indonesia?
2. What teachers' treatment provided to overcome students' anxiety in math classroom?

Method

This research is descriptive qualitative case study method (Creswell, 2012; Fraenkel, 2010). This method will examine the status of a group of people associated with an object, a condition, a thought or an event that occurred at the present time. The goal is to get an idea on how to find solutions to math anxiety in mathematics education students Muhammadiyah University in Purwokerto when learning Math to get a settlement systematic research, factual and accurate information based on facts or symptoms which has been investigated. The study was conducted in Mathematics Education Study Program Guidance and Counseling (Faculty of Teacher Training and Education) UMP (The University of Muhammadiyah Purwokerto). The research was conducted from August 2014 through September 2015. The population of this study are students of the 3rd semester Mathematics Education courses of Muhammadiyah University Purwokerto. Of the population were taken to assess whether the treatments adopted to anticipate and resolve problems of students' anxiety in math classroom.

Methods of data collection in this study were: 1) Observation. Observations made during the learning process. Implementation of the observations made by several observers. The observation is used in the form of observation sheet. Observation sheet used is the observation sheet learning activities. The observation sheet in the form of questions about the implementation of learning, and the findings can be used as a basis for decision making. These findings could be photos of events, videos, and field notes of the observer during the learning process; 2) Task. The task is given in order to find solutions to problems that are going on, among other tasks assigned informants interviewed for reporting on learning math in the classroom.

Results and Discussion

Mathematics anxiety has been defined as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations Math anxiety can cause one to forget and lose one's self-confidence (Tobias, S., 1993).

Research confirms that pressure of timed tests and risks of public embarrassment have long been recognized as sources of unproductive tension among many students. Three practices that are a regular part of the traditional mathematics classroom and cause great anxiety in many students are imposed authority, public exposure and time deadlines. Although these are a regular part of the traditional mathematics classroom cause great deal of anxiety. Therefore, teaching methods must be re-examined. Consequently, there should be more emphasis on teaching methods which include less lecture, more student directed classes and more discussion.

Given the fact that many students experience math anxiety in the traditional classroom, teachers should design classrooms that will make children feel more successful. Students must have a high level of success or a level of failure that they can tolerate. Therefore, incorrect responses must be handled in a positive way to encourage student participation and enhance student confidence.

Studies have shown students learn best when they are active rather than passive learners (Spikell, 1993). The theory of multiple intelligences addresses the different learning styles. Lessons are presented for visual/spatial, logical/mathematics, musical, body/kinesthetic, interpersonal and intrapersonal and verbal/linguistic. Everyone is capable of learning, but may learn in different ways. Therefore, lessons must be presented in a variety of ways. For example, different ways to teach a new concept can be through play acting, cooperative groups, visual aids, hands on activities and technology. Learners are different than they were forty years ago. These learners today ask questions why something is done this way or that way and why not this way? Whereas years ago learners did not question the why of math concepts; they simply memorized and mechanically performed the operations needed.

Cognitive reflection was found to be negatively related to temporal discounting (i.e., the tendency to prefer smaller, immediately available rewards over larger rewards which will be available later), and positively related to choosing gambles with higher expected values (Frederick, 2005). Further studies showed that the class was also related to some typical heuristics and biases (Liberali,et.al., 2012; Oechssler, 2009; Toplak,et.al., 2011). One could argue that these relationships are unsurprising, given that the class is based on mathematical word problems, and many of these judgment and decision-making tasks also contain numerical information. However, the class was also related to tasks containing no numerical information (for example, syllogistic reasoning, which measured the effect of beliefs on logical reasoning (Toplak, 2011)). Furthermore, although the class correlates with measures of intelligence and numeracy (e.g., (Frederick, 2005; Galli,et.al., 2011; Liberali,et.al., 2012; Oechssler,et.al., 2009; Toplak,et.al., 2011, Cokely & Kelley, 2009)) it was found to explain additional variance in reasoning and decision-making tasks when it was administered together with measures of intelligence and numeracy (Liberali,et.al., 2012; Oechssler,et.al., 2009; Toplak,et.al., 2011, Cokely & Kelley, 2009; Campitelli & Gerrans, 2014). Overall, these results demonstrate that the class is a very powerful predictor of a person's ability to make unbiased judgments and rational decisions on a variety of tasks.

In sum, in the studies that we report below we tested the hypothesis that maths anxiety might be related to performance on the class. We based this prediction on the observation that maths anxiety leads to a tendency to generate and accept responses quickly, without taking the opportunity to check solutions and correct mistakes, and to accept incorrect responses even when these are highly implausible (Faust,et.al., 2006). In other words, it seems that maths anxiety reduces cognitive reflection.

It could be argued that a potential link between maths anxiety and cognitive reflection would be unsurprising, given that the class problems contain numerical content. Thus, we also aimed at showing that even when the effect of mathematical abilities or mathematical achievement is controlled

for, the link between maths anxiety and cognitive reflection would still be present. We based this prediction on earlier claims that the class is “not just another numeracy scale” (Liberali, et.al., 2012), but also a potent indicator of a person’s ability to avoid tempting, easy-to-generate heuristic responses (Frederick, 2005). This prediction is also in line with Campitelli & Gerrans (2014) who found that the ability to inhibit the effect of beliefs on logical reasoning explained additional variance in the class, when the effects of numeracy were already taken into account. The prediction that the link between the class and maths anxiety is not fully mediated by maths knowledge or maths achievement is key to our account, as we aim to show that mathematical anxiety is negatively related to individuals’ ability to avoid the typical pitfalls of reasoning and decision-making.

Students today have a need for practical math. Therefore, math needs to be relevant to their everyday lives. Students enjoy experimenting. To learn mathematics, students must be engaged in exploring, conjecturing, and thinking rather than, engaged only in rote learning of rules and procedures.



Figure 1. Students enjoy learning as exploring, and discussing in team

Students’ prior negative experiences in math class and at home when learning math are often transferred and cause a lack of understanding of mathematics. According to Sheila Tobias, millions of adults are blocked from professional and personal opportunities because they fear or perform poorly in mathematics for many, these negative experiences remain throughout their adult lives.

Math is often associated with pain and frustration. For instance, unpaid bills, unforeseen debts, unbalanced checkbooks, IRS forms are a few of the negative experiences associated with numbers. Parents should show their children how numbers are successfully used by them in positive pleasant ways, such as in cooking, sewing, sports, problem solving in hobbies and home repairs. Math must be looked upon in a positive light to reduce anxiety. A person’s state of mind has a great influence on his/her success. Many games are based on math concepts. Some games that are beneficial to learners and are enjoyed are cards playing, Life, Yahtzee, Battleship and Tangrams.



Figure 2. Students play the secret inside the balloon game in class

Mathematical anxiety is not something a person is born with, like dyscalculia. People who believe that they are not good at mathematics develop a fearful avoidance of mathematical situations; this has taken the title of math anxiety. Mathematical anxiety is a cycle that has to be stopped before it spins out of control. It starts with a person who feels as if they are going to fail with math, which builds anxiety, which then leads to failure. Their failure fosters the idea that they are not good at math which then creates even more anxiety, creating more failure (Wadlington & Wadlington, 2008).

Cooperative groups provide students a chance to exchange ideas, to ask questions freely, to explain to one another, to clarify ideas in meaningful ways and to express feelings about their learning. These skills acquired at an early age will be greatly beneficial throughout their adult working life. However, anxiety is not innate but is acquired and developed (Ertekin et al., 2009). The influences that develop mathematical anxiety incorporate several different variables. Math is part of a person's environment from an early age. Parents who fear math can also pass on the negative attitude towards their children. Many elementary teachers have math anxiety and are uncomfortable teaching math; this negative attitude then is also passed on to influential students (Geist, 2010). Other variables effecting the development of a student's mathematical anxiety can also include gender stereotypes, socioeconomic issues (Kesici & ErdoGan, 2010), shyness and personality (Woodard, 2004), other learning disabilities (Wadlington & Wadlington, 2008), memory and thought process (Prevatt, Wells, & Li, 2010), learning styles, teaching styles, and the motivation of the student; anxiety is an outcome of an attitude (Ertekin et al., 2009).

Typically students with lower or negative self-esteem will have higher levels of anxiety (Kesici & ErdoGan, 2010). In middle school, students will usually begin to compare themselves to other students and individuals in society. What students do not realize is that in math, they cannot compare themselves to other persons but need to focus on personal growth and development (Kesici & ErdoGan, 2010).

Mathematical anxiety does not just effect the poor, the rich, the ones with low self-esteem, but it can also play a major role in the lives of gifted students. Gifted students are often considered or categorized as perfectionists. A perfectionist is a person who not only holds himself to high standards but also is overly critical when doing self-evaluations. Because gifted students are perceived to be highly intelligent, it is hard for them to be diagnosed with a math anxiety. In a study of how timed and untimed math tests affect gifted student Tsui and Mazzocco (2007) discovered that when math anxiety increases the discrepancy in math performance decreases. Timed tests provokes anxiety in high and low performing students but when a student is given an untimed test the students with higher math anxiety take longer than when given a timed test. Most students with mathematical anxiety use avoidance as their coping mechanism. If a student with anxiety is faced with a timed test he or she will try to solve the problems as quickly as possible and fail to use the self-correction tool of 'checking' which then also leads to more errors which then resets the cycle of anxiety and failure (Legg & Locker, 2009).

Learning style is another major variable that affects the development of math anxiety. Boys tend to be able to adapt better to traditional teaching methods (Geist, 2010) because of this skill, boys are not as apt to fear math, like a girl student would. When a teacher's style of learning does not match with the student's learning style it can become a major factor in developing math anxiety, especially for young female students. When learning and teaching styles are aligned, there are exuberant amounts of positive progress in learning math (Ertekin et al., 2009).

As mathematical anxiety continues to grow rampantly, it is evident that there will be consequences. It is not a surprise that those with a math anxiety avoid careers and college courses that incorporate large or 'difficult' mathematical topics (Ashcraft, 2002). Mathematics disabilities and anxiety play a key role in the drop out rate of students (Prevatt et al., 2010). The students who have dropped out tend to have a lower paying job, and when these drop out students give birth to other children, the children will then grow up in the environment that does not like, use, or understand math, embedding the negative attitude that math is hard and worthless; starting the cycle of anxiety at an early age. Thilmany's (2009) research of university students stated that health science majors feared math the most and students would chose a field of study due to the amount of math needed to complete such degree.

It is also not known whether teacher identification of anxiety in their students is moderated by child characteristics such as age and gender. (The Achenbach et al., 1987) meta-analysis reported that, in general, cross-informant agreement was higher for 6- to 11-year-olds than adolescents. Conversely, Kolko and Kazdin (1993) reported that, of a range of variables, only child age accounted for differences between teachers and children in their ratings of child internalizing symptoms with younger age associated with poorer agreement. Epkins (1995) found no effect of age, sex, socioeconomic statues (SES), or race on teacher-child concordance in the domain of anxiety (agerange:8-12 years). Stanger and Lewis (1993) found no effect of child sex on parent and teacher ratings; the effect of age was not evaluated. Given the few studies that have evaluated the potential impact of child age and gender on teacher awareness of internalizing symptoms and the lack of consistency among the results related to age, additional research is needed in this area. This is especially true given that age and gender differences in the presentation of anxiety have been identified in epidemiological and treatment studies.

Across these studies, one of the most common and robust findings has been that females endorse more anxiety symptoms than males (Compton SN, Nelson AH, March JS, 2000; La Greca AM, Lopez N, 1998; Rudolph K. Gender, 2002). In their longitudinal study of 1,420 children age 9 to 13, Costello et al. (2003) reported that the 3-month prevalence rates for the following disorders were higher in females: generalized anxiety disorder, social phobia, panic disorder, and agoraphobia. Lewinsohn et al. (1998) reported that among 1,709 adolescents, females had significantly higher anxiety symptom scores than did males. Further, they reported that this gender difference emerges at an early age: by age six, twice as many girls as boys had experienced an anxiety disorder.

In terms of age, perhaps the most commonly reported difference between children and adolescents involves the diminishing of separation anxiety symptoms with increasing age (Compton SN, Nelson AH, March JS, 2000; Costello EJ, Mustilo S, Erkanli A, Keeler G, Angold A, 2003; Westenberg PM, Siebelink BM, Warmenhoven NJC, 1993). In some studies, this was the only age difference identified (Costello EJ, Angold A, Burns BJ, Stangel DK, Tweed DL, Erkanli A, et al, 1996). Another common finding involves the increase of social anxiety with age (Compton SN, Nelson AH, March JS, 2000). Crick and Ladd (1993) found that fifth graders endorsed significantly greater levels of social anxiety than third graders. Costello et al. (2003) reported that adolescence was marked by a rise in social phobia. The results of these studies demonstrate that anxiety symptom presentation can vary according to child gender and age.

When compared to other countries the United States continues to fall behind with their math scores. Anxiety leads to decreased amounts of motivation, which then in turn encourages the student to take less math classes. Fewer math classes then lead to less exposure, and the exposure is at a lower level. These lower level classes then produce lower scores and the gap between what is expected of students and what they are actually scoring on their math test widens considerably (Ashcraft, 2002). Timed tests are also a negative towards helping students overcome their math anxiety. High-stakes standardized tests, such as the MAP, are timed which then create more anxiety that lead to inaccurate scores.

Unfortunately teachers can also do more harm than good when it comes to mathematical anxiety. As Eugene Giest (2010) believed for the western culture to overcome math anxiety that teachers and how students are taught needs to be examined and reexamined. Many teachers do not have the experience that is required to help mainstream students with mathematical difficulties and some teachers lack the confidence to even perform decent instruction (Wadlington & Wadlington, 2008). Marci Malinsky and colleagues (2006) stated, "math anxiety has its roots in teaching and teachers, and has been tied to poor academic performance of students, as well as to the effectiveness of elementary teachers" (p. 274). Marsha Walton (2010) agrees that math anxiety is taught in the classroom. Elementary education majors have the highest rate of math anxiety than any other college major; the fact is that 90% of elementary teachers are female in the United States; this imposes a problem on defeating math anxiety as a whole. Female elementary teachers who taught first and second grade who displayed high math anxiety had girls with lower scores in math than boys by the end of the year (Walton, 2010).

Girls need a visible female role model who excels in math to help them overcome the anxiety and stereotype that math and women do not go hand in hand. Mothers also have an important impact of preventing math anxiety; if students see their mothers not 'caring' about math, the girls will develop the idea that it is not necessary to learn. Teachers also need to help demonstrate that being smart and glamorous is possible. It needs to be taught to middle school girls that math makes you feel smarter, prepares you for the better paying jobs, and helps you think more logically (Walton, 2010).

When it comes to treatment, it is like being blind trying to find a needle in a haystack. Treatment is rather difficult because most students are not ever properly diagnosed. Because math anxiety is not a disability, but rather a thought process; students and people need to learn how to overcome the anxiety using everyday tools and concepts. Teachers can do the following to help individuals overcome math anxiety: provide a safe classroom environment where grades are not mentioned, use visual cues that help stimulate the understanding process of math, chart progress of students to help encourage and motivate, give out frequent praise, discuss famous people with disabilities, let students know they are not alone, and incorporate math games into the curriculum, seat students towards the front, provide appropriate test, allow extra time for assignments and tests, keep a mathematical journal, and maintain a positive outlook on math, make word problems applicable to real life situations, teach how to properly read and solve word problems (Wadlington & Wadlington, 2008).

Mathematical anxiety is not something that should be ignored or avoided. It is a serious issue that continues to increase. The vicious cycle of failure and anxiety has to come to a halt at some point if the United States wants to continue to be a forerunner in the industrialized global economy. Parents

and teachers alike are the main sources of the cause but also the treatment for this challenging and unexpected disability. Without the help of parents and schools this cycle will continue to produce individuals, who are capable, but simply lack basic math skills leading to serious consequences in both daily and work life.

Conclusion

In conclusion, math anxiety is very real and occurs among thousands of people. Much of this anxiety happens in the classroom due to the lack of consideration of different learning styles of students. Today, the needs of society require a greater need for mathematics. Math must be looked upon in a positive light to reduce math anxiety. Therefore, teachers must re-examine traditional teaching methods which often do not match students' learning styles and skills needed in society. Lessons must be presented in a variety of ways. For instance, a new concept can be taught through play acting, cooperative groups, visual aids, hands on activities and technology. As a result once young children see math as fun, they will enjoy it, and, the joy of mathematics could remain with them throughout the rest of their lives.

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