Math Anxiety: The Influence of Teaching Strategies and Teachers' Attitude

Sunming Zhang(✉)

Beijing Royal School, Beijing, China
3170400167@caa.edu.cn

Abstract. Math anxiety appears when people deal with math, such as when they have to manage numbers, solve mathematical problems, or are exposed to an evaluative circumstance related to math, they experience feelings of dread and elevated physiological reactions. Since math anxiety has a close relationship with teaching strategies and teachers' attitude, this study will measure the impacts of teaching strategies and teachers' attitude on students' math anxiety. While rigid curriculum and boring styles of teaching could foster math anxiety to the largest extent, Relative Performance Feedback (RPF) from teachers will reduce or even prevent the anxiety effectively, which could be taken into account by schools in order to help students get a better math performance and also cure their psychological barriers against mathematics. Apart from teaching strategies, teachers' attitude also plays an important role in students' math anxiety. Giving encouragement frequently and focusing on the achievements students have made would be a better way to reduce their math anxiety than telling students that they are hopeless and ignoring their efforts. After realizing the importance of paying more attention to students' math anxiety on campus, school should also examine whether teacher has set a positive example during students' math learning and make some changes in teaching strategies and attitudes.

Keywords: Math anxiety · Teaching strategies · Teachers' attitude · Relative performance feedback

1 Introduction

Nowadays, with the measurement standards of achievement in mathematics increasingly high, the level of students' math anxiety has increased correspondingly. Math anxiety exists as a widespread problem that can be found in students from different areas, with a negative correlation between math anxiety and the competence of students toward math [1].

Students with math anxiety are more likely to report the feeling of hopelessness or depend on those forbidden tools when solving complicated math problems [2], and these consequences reveal the negative impact of math anxiety on students' math performance. According to the assessments made by the Program for International Student Assessment in 2019, a high percentage of secondary school students worried about math and were in tension when they were doing math homework [3].

J. Sun et al. (Eds.): SSESD 2022, ASSEHR 684, pp. 202–208, 2023.
https://doi.org/10.2991/978-2-494069-13-8_27

In addition, previous research has demonstrated that anxiety about mathematical scores is an essential predictor of numerical knowledge, computational accuracy and computational speed scores [3]. This made a further explanation of the close relationship between math anxiety and math performance, which is why math anxiety is a worth-discussed issue.

However, there are still limitations that existed throughout previous research. It is well known that the teacher plays an indispensable and important role during students' schooling. We should therefore emphasize how much teachers are aware of how anxiety affects kids' math proficiency. Additionally, since students' performance can be easily influenced by their mental state, an experiment should be conducted to determine which teachers' practices encourage students' math anxiety and which teachers' practices give students a scaffold to develop a more positive attitude toward math learning [4]. Just as Radišić and his colleagues claimed, "the absence of classroom discipline is similarly associated to higher levels of math anxiety, a factor that, to our knowledge, has not been thoroughly studied in connection with math anxiety" [4].

Overcoming math anxiety means we have to focus on the classroom atmosphere and the process of teaching math in the classroom, which is known as the strategies teachers practice in math class. As Finlayson has emphasized, changing children's self-confidence and self-esteem, as well as their anxiety levels and self-esteem, is vital for improving their attitudes toward math [5]. Moreover, it is important to investigate teacher factors, which are the crucial factors in the classroom that determine students' sense of belonging in mathematics [6]. Therefore, this review would mainly identify and discuss the influence of teachers' teaching strategies and teachers' attitude on students' math anxiety by conducting several steps and eventually obtain appropriate solutions for reducing the degree of students' math anxiety.

2 Methods

A massive amount of literature was searched during the review with the support of the academic database Science Direct. Throughout the whole research, the keywords "math anxiety", "teaching strategies" and "teachers' attitude" were used to filter the related literature. In addition, other related literature cited were found in Springer Link and Research Gate. The research was picked up if it fits the following criteria: (i) must be published after 2010. (ii) empirical research was conducted to reveal the impacts of teaching strategies and teachers' attitude on students' math anxiety quantitatively. (iii) studies could also be identified if they test and provide a favorable teaching strategies teacher can be applicated to students, such as Wang et al.'s study [7]. Overall, 16 studies were used as arguments in this review.

3 The Impact of Teaching Strategies on Math Anxiety

Based on prior studies, teaching strategy is tightly linked with math anxiety and teacher's behavior is the prime factor that causes students' math anxiety. For [5], the Traditional Delivery Method (2013) has been used mostly when teaching

mathematics in the traditional classroom, and it is characterized by an inflexible teaching environment. For instance, the teacher basically gives the information, and students have to receive the knowledge without any opportunity to ask questions. Similarly, 'strict adherence to fixed curriculum' is another element mentioned in this method. Attractive teaching materials teachers use in class is an essential element in math class to help students absorb the knowledge, especially when the knowledge within the curriculum is hard to understand.

3.1 Definition of Math Anxiety

Math anxiety is characterized by feelings of unease and heightened physiological reactivity when people engage with math, such as when they have to manage numbers, work out mathematical equations, or are exposed to an evaluative circumstance related to math [8]. Considering the circumstance of learning math in school, there are different dimensions to measure math anxiety. For instance, math anxiety among students may arise from the fear of their math teacher [9]. Although theories and measuring instruments vary considerably in differentiating mathematical anxiety, almost all of them agree that three facets were classified: test, classroom, and numerical anxiety [8].

3.2 The Impacts of Teaching Strategies on Students' Math Anxiety

Students' math performance is positively related to their satisfaction with the teacher's teaching method [10], which means that the greater the satisfaction students get, the better their results. The study also stated that teacher plays the role of the catalyst during students' studying, where they should emphasize how to apply relevant and efficient strategies that motivate students and help them acquire skills like critical thinking. Therefore, proper methods will be one of the main factors affecting students' math performance.

According to students' activities and the degree of self-independence in learning, the teaching method can be divided into two branches: traditional and non-traditional [11]. The three main methods of teaching are passive, active, and interactive. Students must understand those materials through the teacher's passive method. However, if teachers carry out the active or interactive method in a class, there will be more opportunities for students to be involved in the process and build confidence. Therefore, more discussions and activities are included in the active and interactive method, whereas more tasks are involved in the passive method. In addition, if math teacher apply passive teaching method which means requirements are involved more among the sessions. In most classroom, teacher usually interpret the curriculum with no creative activities. Since teacher just output knowledge towards student passively, student receive education under this kind of environment will be soon losing enthusiasm to continue studying and are likely to feel anxious at mathematics.

In the traditional classroom, teaching controlling style was the significant cause of anxiety. When a teacher spends too much time concentrating on finishing the curriculum and all the curriculum objectives, with only textbooks and exercises as auxiliary materials in class or always requiring mathematical skills and computation from students, students may quickly lose motivation to keep learning and then report a worse performance,

which can eventually lead to math anxiety under the mentioned situation [5]. Namely, the possibility of students feeling anxious when confronting math tasks will increase a lot when teacher imparting knowledge with controlling teaching mathod.

As Savicka has mentioned, students' ability will be comprehensively improved more considerably if schools combine traditional, interactive and active methods [11]. For instance, create a link between mathematics and real-life situations [8], where the student will discover broader interests and absorb knowledge through a more acceptable method.

Independent learning combined with interactive teaching is a method that can enhance students' capacity comprehensively (e.g., creative thinking and self-organization skills). Unfortunately, research has shown that most teachers always ignore fostering students' awareness to study independently, which often results from the teacher's lack of interactions with students [12]. Take an example, if a teacher does not show interest in a student's math achievement, the student will then lose motivation and begin to think little of their study. Overall, using independent learning during teachers' teaching can stimulate students' interests and determination to investigate mathematics. Otherwise, the student will hardly keep learning and produce good results.

3.3 Applications

Given that persons who lack motivation for arithmetic may experience higher degrees of stress and discomfort, which may be linked to a more severe reduction in effort and worse performance [13], the school should seek more intriguing strategies to reduce student' math anxiety effectively. As students who perceived more teacher support reported being more involved in math learning and experienced less math anxiety [14], one feasible method is to use Relative Performance Feedback (RPF). RPF is a method that focuses on the feedback about students' improvement and achievement from teachers according to students' performance within a period. A study conducted by Hermes and his colleagues has shown that this type of feedback enhances students' motivation and their effort will be transferred to actual learning results revealed in math performance [15]. Furthermore, underachievers showed higher levels of mental stress as well as improved math self-efficacy and a more positive outlook on the competition. [15]. This method indicated that after a period of learning, teachers should provide specific feedback to each individual considering their math performance. Since feedback from teachers can reflect significantly improve problems found in students' learning, students will have a more evident target about what they should achieve in the next stage and will not feel anxious about their math.

On the other hand, teachers could adopt more attractive curricula that will push students to concentrate more on class. For instance, teachers can assign homework related to art (e.g., posters, designs) to find students' interests through those colorful elements. Once students get attracted by math class, they will not feel reluctant to gain knowledge. These activities also benefit students' creative thinking and self-exploration skills, which can foster students' study of math independently.

4 The Impact of Teachers' Attitude on Math Anxiety

4.1 Teachers' Negative Attitude Affect Students' Math Anxiety

It is believed that teachers' attitude toward students when evaluating achievement can modify the degree of students' math anxiety [8]. As an illustration, teachers may modify their educational expectations for a student in response to their track placement. Student accomplishment will be much higher if teachers have high expectations for the student as opposed to having low expectations for the student's ability to attend college. [16]. One of the reasons that teachers foster math anxiety in the classroom is because they may point to the fact that math ability is inborn, and success is up to talents. In addition, they may emphasize that achievement in math depends on effort and perseverance [8]. While the former may reduce students' confidence, and the latter will pressure students and imply a message that the only way to perform well in math is to study full-bore, full-time.

4.2 Teachers' Positive Attitude Affect Students' Math Anxiety

In contrast, a positive attitude and encouragement would reduce students' math anxiety to a large extent. [8] have also mentioned some beneficial behaviors toward students' math performance in their study: Firstly, emphasize that mistakes are also a part of successful learning. Second, appeal to their students' motivation and sense of self-efficacy and self-concept (e.g., make specific judgments of student achievement and provide proper self-assurance or feedback). Furthermore, a teacher plays a non-neglectable role in students' studying, especially when they are in the teen stage. Adolescents' performance could be affected easily by their teachers' expectations. Thus, a positive attitude from teachers can provide a proper target for students in math learning.

4.3 Applications

Since it has been proved that teachers' attitude is an indispensable factor in determining whether students are prone to feel anxious about mathematics, schools and teachers should be concerned about the attitude shown in class. For those who feel a lack of confidence, teachers should prevent showing negative thoughts during the teaching and apply encouragement once students make some achievements. Therefore, teachers should focus on what successful students have had instead of making them doubt themselves. With these positive behaviors, students can pick up confidence and will be able to face the rest challenges.

5 Implications

The aim of this review was to discuss the impact of teachers' teaching strategies and attitudes in math class toward students' math anxiety and find some possible solutions to optimize teaching strategies and teachers' attitude with a reduction of math anxiety. After clarifying the definition of math anxiety, which is feelings of apprehension and

increased physiological reactivity when individuals deal with math, various literature showed the close relationship between math anxiety and teaching strategies. The study conducted by Silke, Sigrid and Manuela has explained comprehensively which teaching actions can help prevent math anxiety and which behavior fosters students' anxiety [8].

In order to design a feasible solution to reduce math anxiety, studies that list the defects found in current teaching strategies are indispensable. As [5] has stated, students often get passive knowledge from teachers with requirements to focus solely on textbooks, which is the source of students' anxiety in math.

Meanwhile, Hermes et al. indicated that RPF from teachers could prevent math anxiety effectively [15]. To be more specific, it requires teachers to provide feedback to students over a period of time for the purpose of informing students of their improvements and problems.

6 Conclusions

Overall, although it may be better for some students to maintain moderate levels of math anxiety to make their learning and testing materials moderately challenging [13], high math anxiety level has also been found to have detrimental effects on students' mathematical performance. Especially for students with learning difficulties in maths, a high level of math anxiety will lead to destructive effects in different dimensions.

However, if the teacher encourages and talks to students frequently during the math study with a corresponding RPF, students will find a certain goal they need to reach and discard their anxiety soon. Therefore, whether students feel anxious about mathematics has a direct correlation with their teacher's strategies of teaching.

In conclusion, attractive materials used in class and sufficient supports from the teacher are the two most important things to reduce students' math anxiety. In addition, after having the class, positive feedback and encouragement can urge students to pay more effort to math studying to accomplish better performance. However, still, the issue needs to be measured in futuristic discussion from the various aspects in order to reduce this phenomenon radically as soon as possible.

References

1. Beilock, S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? *Ask the Cognitive Scientist, American Educator, 38*, 28–33.
2. Cipora, K., Szczygieł, M., Willmes, K., & Nuerk, H. C. (2015). Math anxiety assessment with the abbreviated math anxiety scale: Applicability and usefulness: insights from the polish adaptation. *Frontiers in Psychology, 6*(34), 1833. https://doi.org/10.3389/fpsyg.2015.01833
3. Commodari, E., & La Rosa, V. L. (2021). General academic anxiety and math anxiety in primary school. The impact of math anxiety on calculation skills. *Acta Psychologica, 2021*, 103413. https://doi.org/10.1016/j.actpsy.2021.103413
4. Radišić, J., Videnović, M., & Baucal, A. (2014). Math anxiety—Contributing school and individual level factors. *European Journal of Psychology of Education, 30*(1), 1–20. https://doi.org/10.1007/s10212-014-0224-7

5. Finlayson, M. (2014). Addressing math anxiety in the classroom. *Improving Schools, 17*(1), 99–115. https://doi.org/10.1177/1365480214521457
6. Jessica, M. C., & Graham, S. (2021). Do I belong in my math class? The importance of perceived racial/ethnic context and math course sequence. *Contemporary Educational Psychology, 67*, 102012. https://doi.org/10.1016/j.cedpsych.2021.102012
7. Wang, Z., Borriello, G. A., Oh, W., Lukowski, S., & Malanchini, M. (2021). Co-development of math anxiety, math self-concept, and math value in adolescence: The roles of parents and math teachers. *Contemporary Educational Psychology, 67*, 102016. https://doi.org/10.1016/j.cedpsych.2021.102016
8. Silke, L., Sigrid, W., & Manuela, P. (2018). Spotlight on math anxiety. *Psychology Research and Behavior Management, 11*, 311–322. https://doi.org/10.2147/PRBM.S141421
9. Ganley, C. M., & McGraw, A. L. (2016). The development and validation of a revised version of the math anxiety scale for young children. *Frontiers in Psychology, 2016*, 7. https://doi.org/10.3389/fpsyg.2016.01181
10. Iurea, C., Neacsu, I., Safta, C. G., & Suditu, M. (2011). The study of the relation between the teaching methods and the learning styles-the impact upon the students' academic conduct. *Procedia - Social and Behavioral Sciences, 11*, 256–260. https://doi.org/10.1016/j.sbspro.2011.01.072
11. Savicka, C. I. (2012). Use of ICT teaching-learning methods make school math blossom, *69*, 1481–1488. https://doi.org/10.1016/j.sbspro.2012.12.089
12. Red'ko, L., Yuzhakova, M., & Yanushevskaya, M. (2015). Creative independent learning for developing students' professional competencies. *Procedia - Social and Behavioral Sciences, 214*, 319–324. https://doi.org/10.1016/j.sbspro.2015.11.651
13. Wang, Z., Lukowski, S. L., Hart, S. A., Lyons, I. M., & Petrill, S. A. (2015). Is math anxiety always bad for math learning? The role of math motivation. *Psychological Science, 26*(12), 1863–1876. https://doi.org/10.1177/0956797615602471
14. Li, H., Zhang, A., Zhang, M., Huang, B., Zhao, X., Gao, J., & Si, J. (2021). Concurrent and longitudinal associations between parental educational involvement, teacher support, and math anxiety: The role of math learning involvement in elementary school children. *Contemporary Educational Psychology, 66*, 101984. https://doi.org/10.1016/j.cedpsych.2021.101984
15. Hermes, H., Huschens, M., Rothlauf, F., & Schunk, D. (2021). Motivating low-achievers—Relative performance feedback in primary schools. *Journal of Economic Behavior & Organization, 187*, 45–59. https://doi.org/10.1016/j.jebo.2021.04.004
16. Andersen, I. G. (2018). Pygmalion in instruction? Tracking, teacher reward structures, and educational inequality. *Social Psychology of Education, 21*(5), 1021–1044. https://doi.org/10.1007/s11218-018-9452-z