Link Between Math Anxiety and Mathematics Achievement in Chinese Primary Schools

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Abstract: Math anxiety is a common issue among students, with around 70% of primary school students in China affected. The present study study aims to explore the relationship between math anxiety and academic performance in a sample of 158 primary school students in Shanxi, China. Using a survey on math exam anxiety and students' math final scores. The study found a weak correlation (r=0.122) between math anxiety and achievement. This research shows that while math anxiety can influence performance, other factors are also involved. Both high and low-achieving students reported high levels of math anxiety. Contributing factors include pressure from parents and teachers and students' own negative feelings toward math. The study is limited by its small sample size and regional focus. Future research should examine more diverse groups of students and consider other influences on math anxiety. Addressing math anxiety may help improve students' confidence and performance in math.

1 INTRODUCTION

Math anxiety is currently a common problem at work. One student has math anxiety among five around the world (Yu, 2018). In China, there are around 70% of students have math anxiety (Yu, 2018). The cramming teaching method and exam-oriented education make math class boring, and students lose concentration and then miss significant knowledge. The missing knowledge causes the student to have low grades in math, and these students may be afraid of math later, then they get math anxiety and form a vicious circle (Yu, 2018). In Chinese society, many people usually think girls have poorer math achievement than boys, then girls are not confident in math, and many of them have math anxiety. However, they are good at math (Yu, 2018), and this problem appears in primary school in China. Previous research shows that math anxiety is highly related to academic achievement; some state that math anxiety will lead to poor achievement (Barroso et al., 2021) and one prior study state that poor academic achievement comes first and causes poor achievement (Barroso et al., 2021; Pekrun, 2006). Therefore, finding the correlation between math anxiety and academic achievement is significant.

This research aims to find how math anxiety could affect achievement. To carry out the research, this study uses a quantitative research design to explore the relationship between mathematics anxiety and mathematics achievement among 158 primary school students in Shanxi, China, selected through stratified sampling. A pilot study ensured the clarity of the questionnaire, and the final data were analysed using SPSS to assess reliability and the correlation between the two variables.

2 LITERATURE REVIEW

2.1 Math Anxiety

Math anxiety refers to students' negative emotions when working on math tasks, which can affect their ability to do well in math (Ashcraft & Ridley, 2005). This emotional response affects students' performance and lowers their confidence and attitude towards math, making it more difficult for them to improve. The characteristics of math anxiety can be broken down into four main dimensions: physical, emotional, behavioural, and cognitive. Physically, students with math anxiety may experience various symptoms, such as a rapid heartbeat, sweaty palms, or an overall feeling of nervousness when faced with mathematical challenges (Sheffield & Hunt, 2006). Emotionally, they often report negative feelings like

a strong dislike for math, frustration, or a fear of engaging in math-related activities (Ashcraft & Ridley, 2005). Behaviourally, these students may try to avoid math-related tasks or math classes altogether, feeling overwhelmed by the pressure (Sheffield & Hunt, 2006). They may also procrastinate when completing math assignments, putting off tasks because of the anxiety they associate with math (Luttenberger et al., 2018). Cognitively, students with math anxiety often struggle with negative self-perceptions, believing that they are incapable of solving or completing math problems. This mindset can seriously hinder their performance and learning outcomes (Sheffield & Hunt, 2006).

Many students in China have the problem of math anxiety. According to Huang in China, because of the increase in the difficulties in math from lower level to higher level in Chinese primary schools, many students found it hard to learn math (Huang, 2023). Meanwhile, many students in primary school have anxious feelings. The anxious feeling increases their weariness in math, causing math anxiety. Moreover, the degree of difficulty in math that Chinese primary school students face is high worldwide; therefore, students in China may more easily face math anxiety (Yu, 2018). It is significant to solve this question because there are 70% of Chinese school students have math anxiety problems (Yu, 2018).

2.2 Factors Affecting Math Anxiety

The causes of math anxiety could mainly be divided into two dimensions: external and internal. The external factors mainly include social concepts, teachers, and parents. According to Yu, many Chinese people have stereotypes about gender; they think girls are not good at mathematics (Yu, 2018). Therefore, although female students have exemplary mathematics achievements, they may also feel unconfident in math. In contrast, the boy who is not good at math may be looked down on by others. Both can feel anxious under this stereotype's concepts. At school, teachers usually transfer their anxiety to students. During the teaching process, teachers may feel anxious that students may not get good results on an exam, and then they transfer this anxiety to students (Lau et al., 2022; Smith, 2004). Moreover, teachers get angry with students when students do not understand the math problems, which harms students' confidence and causes them to have math anxiety (Smith, 2004). Many teachers think practice papers as much as possible could help students get higher scores in the actual examination, so they set too much math homework for students (Yu, 2018). Students

feel anxious about the vast amount of practice. The last factor about teachers that could cause math anxiety is that they prefer students with higher grades. According to Huang, teachers' pay more attention to students with higher grades and ignore the students who perform less, and teachers rank the students (Huang, 2023). Therefore, students who perform worse in math may lose confidence and harm their self-esteem, and then they have a sense of anxiety about math. Parents also have high expectations of their children, so they set extra work for their children after they finish their school homework, which leads their children to feel under pressure (Huang, 2023).

Math anxiety is often caused by internal factors within the students themselves. According to Huang, many Years 4 students in primary school develop a fear of math and show resistance towards learning it (Huang, 2023). This is often due to their negative feelings or attitudes about the subject. Some students dislike math initially, while others struggle with low self-esteem and a lack of motivation to study it. Many students also report that math is particularly challenging for them, which makes the learning process even more frustrating. Huang points out that these issues are mainly related to poor academic ability (Huang, 2023). When students find it hard to understand concepts or solve problems, they doubt their abilities and lose confidence.

2.3 Correlation Between Math Anxiety and Academic Achievement

As Barroso et al. point out, math anxiety is closely connected to academic achievement. Students who experience high levels of math anxiety often perform worse in mathematics (Barroso et al., 2021). Barroso et al. explain that math anxiety interferes with working memory, which is critical for solving math problems (Barroso et al., 2021). When students feel anxious about math, their working memory is occupied by the anxiety, leaving fewer resources available to focus on learning or solving problems. This leads to lower performance in mathematics. Similarly, Macleod and Mathews found that students with math anxiety tended to focus more on their negative emotions than on the math problem itself (MacLeod & Mathews, 2012). This focus on anxiety disrupts their ability to concentrate and further impacts their math performance. In this way, math anxiety makes individuals view math as a threat, distracting their attention and taking up working memory, making it harder for them to solve math problems effectively.

The relationship between math anxiety and achievement is complex, and it is difficult to determine which comes first. Some researchers suggest that poor math achievement can lead to math anxiety. According to Barroso et al., difficulties in basic math skills can create negative experiences, which may develop into anxiety during math tasks (Barroso et al., 2021).

At the same time, other studies suggest that math anxiety and math achievement influence each other in both directions. Pekrun proposed the Control-Value Theory of Achievement Emotions, which describes a feedback loop between emotions and performance (Pekrun, 2006). In mathematics, this means that high math anxiety can lead to poor performance because anxiety disrupts working memory. At the same time, repeated poor performance can increase math anxiety, creating a cycle where one issue reinforces the other. Barroso et al. support this idea, showing that the relationship between math anxiety and achievement is bidirectional (Barroso et al., 2021).

While existing research indicates a bidirectional relationship between math anxiety and math achievement, the specific causal mechanisms for Chinese primary school students remain unclear. There is limited empirical evidence exploring how math anxiety progressively impacts students' math performance or whether low math achievement gradually leads to higher levels of anxiety among Chinese primary school students. This makes it difficult to understand how these two factors influence each other during this important stage of education.

3 METHOD

This quantitative research uses the stratified sampling method to find the result. The tool used is the questionnaire. The students selected include those from Year 4 to Year 6 in primary school in Shanxi, China. Each grade contains similar amounts of participants (Year 4=53; Year 5=53; Year 6=52). Two scales will be used to collect the primary data. One is the 'Questionnaire on Mathematics Exam Anxiety for Upper Elementary Students' from Qin (Qin, 2019); another variable is the students' average mathematics scores they get. This research will combine the questions about both variables into one questionnaire and spread the print-out to the primary schools in Linfen, Shanxi, China.

The questionnaire on Mathematics Exam Anxiety is from Qin (Qin, 2019). The full name of this questionnaire is 'Questionnaire on Mathematics

Exam Anxiety for Upper Elementary Students'. This questionnaire contains 16 questions to test the anxiety level among students. The questions are related to students' responses before, during, and after the mathematics examinations. All items were scored using four ratings (1= strongly disagree, 2=disagree, 3=agree, and 4= strongly agree), except question 4 and question 14 (1= strongly agree, 2=agree, 3=disagree, and 4= strongly disagree). The higher the total score, the higher the mathematics anxiety students have. The Cronbach's Alpha of the questionnaire is 0.840 (Qin, 2019), which is higher than 0.8. This result could show that this questionnaire has high internal consistency, then with the high reliability. The correlation coefficient between each dimension is 0.431-0.685, and the correlation coefficient between dimension and total score is 0.69-0.898, indicating that the questionnaire has relatively good structural (Qin, 2019).

The method to determine students' academic achievement is asking for their math average score, which includes a quiz and the final test they usually take. Because for primary school students, the average score is the rare way to reflect their mathematics achievement, this research will show the validity and reliability of this method in the results.

This research involves 158 participants who study in primary schools in China, all from Shanxi Province. The primary school system includes various grades (including Year 1 to Year 6). This research includes Year 4 to Year 6. The study uses the stratified sampling method. The questionnaire is printed and released to primary schools in Linfen, Shanxi, China.

Before the formal investigation, a pilot study was conducted to ensure the procedure. The pilot study involved 10 participants in Year 4 and was completed on 24 December 2024. The pilot study aimed to identify any questions that were unclear and difficult to understand. After the pilot study, all 10 participants reflected that there was no problem with the questions on the questionnaire. Then, after the pilot study, a formal investigation was conducted.

After collecting all data, SPSS analyses the data, and the validity and reliability of the results will be tested to ensure the data result is reliable and can be analysed effectively. The reliability and will be assessed by measuring the internal consistency using Cronbach's Alpha, which will be analysed through SPSS. Moreover, the Pearson correlation coefficient will be used to find the relationship between math anxiety and mathematics achievement. Moreover, this research will analyse the number of students scoring 4 points on each question to investigate how

math anxiety fundamentally impacts students' achievement.

4 RESULTS

This research has collected 180 questionnaires, and 158 responses are effective. The Cronbach Alpha of the questionnaire is equal to 0.833 (>0.8). Which shows high reliability. The questionnaire also has high validity because the KMO of it is 0.836 which is higher than 0.8.

This research uses SPSS to analyse all 158 questionnaires, exploring the Pearson correlation coefficient between the sum of the math anxiety score and the average mathematics score (r=0.122) (Table 1). Although this result is positive, it still could not represent a positive relationship because the coefficient is near to zero, which shows a slightly small relationship between math anxiety and average score. Then it could be considered there is no obvious relationship between the math anxiety and math average score in this research.

Table 1. Pearson correlation between math anxiety score and average mathematics score (n=158).

		Math Anxiety
	Coefficient	0.122
Math average score	p-value	0.106
	Sample size	158

From the data collected, 59.49% (94) of students reported feeling nervous when they saw their grades. Additionally, 62.66% (99) expressed significant worry about the release of their math exam results. A further 55.70% (88) stated concerns about not performing well on math tests, while 55.56% (153) were anxious about disappointing their teachers with their math scores. While participants also reported anxiety in other areas, these four questions revealed the highest levels of anxiety among respondents.

5 DISCUSSION

The analysis shows that math anxiety is associated with academic achievement. However, compared to results from other research, this study finds a weaker relationship. This suggests that while math anxiety may affect academic achievement, other factors could also play a role.

The results show that students with higher math anxiety often perform worse in mathematics. This matches earlier research, which suggests that the effect of math anxiety on performance can depend on things like how students cope, teaching methods, or the level of support they receive (Ashcraft & Kirk, 2001). Moreover, many students in this study reported that their anxiety is from worrying about exam grades, and this worry often leads to a lack of focus when solving math problems (MacLeod & Mathews, 2012). Additionally, some students were anxious because they feared disappointing their teachers and influencing their academic performance. Therefore, it is reasonable to suggest that anxiety about academic performance can contribute to poor math achievement.

At the same time, the data also show that poor academic performance could be a source of math anxiety, as proposed by Pekrun (2006). However, poor performance is not the only factor. The analysis shows that some students with good grades also experienced high levels of anxiety. External pressures, such as high expectations from parents and teachers or internal pressures students place on themselves, could lead to math anxiety (Yu, 2018; Lau et al., 2022; Smith, 2004).

In summary, this research provides evidence that math anxiety is not limited to students with poor academic performance; students with strong math skills can also feel anxious. Moreover, poor academic achievement is not solely caused by math anxiety. Other factors, such as teaching methods, may also play a role. Reducing students' anxiety about mathematics is important to address the issue of poor math achievement, but additional approaches—such as improving teaching methods—should also be considered.

This study has several limitations. First, the questionnaire focused primarily on students' grades and math performance without exploring other potential sources of math anxiety, such as parental expectations or societal influences (Yu, 2018; Lau et al., 2022; Smith, 2004). Second, the sample size was small and limited to a specific group, which reduced the generalizability of the findings to a broader population, such as all students in China.

Future research could avoid these limitations by increasing the sample size and improving the questionnaire to include various dimensions of factors causing math anxiety and poor math achievement. Moreover, further research could conduct longitudinal studies to look at how math anxiety and performance affect each other over time. These studies could help to understand whether

ongoing anxiety causes poor performance or if repeated failures make anxiety worse.

6 CONCLUSION

In conclusion, there is a negative correlation between math anxiety and average mathematics scores, but this correlation is not strong. The finding shows that math anxiety could affect academic achievement, but it is not the only factor. Many students reported high anxiety levels related to exams and the fear of disappointing teachers, which aligns with previous research indicating the influence of external pressures on math anxiety. The results also revealed that math anxiety was not limited to students with low grades; high-performing students may also feel anxious due to external and internal pressures.

However, there are also some limitations in this research. Firstly, this research focuses on a small sample focusing on one region, which reduces the generalisability of this restricted research. It could expand the sample size, include additional factors causing math anxiety, and conduct longitudinal studies to better understand the interplay between anxiety and performance over time. Therefore, further research could focus on improving teaching methods, minimising external pressures on students to help students feel more confident and perform better in math.

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