Current Situation and Strategy of Mathematics Anxiety among Mathematics Majors

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Abstract

Mathematics anxiety will not only affect the healthy development of individuals, but also affect the cognitive development of mathematics. Therefore the study of mathematics anxiety has important practical significance. In order to understand the situation of mathematics anxiety among sophomores in Shandong University and explore the correlation between mathematics anxiety and major of mathematics, this paper adopts the method of questionnaire survey and data analysis. It is found that students' mathematics anxiety exists in four dimensions of "Mathematics Class", "Mathematics Test", "Mathematics Problem Solving" and "Overall Feeling of Mathematics", and there are differences among different majors. Accordingly, some suggestions are put forward to lower mathematics anxiety levels.

Keywords

Mathematics Anxiety, Undergraduate, Different Mathematics Majors, Differences in Levels of Anxiety, Solution Proposal

1. Introduction

With the advancement of mathematics curriculum reform, mathematics teaching has paid more and more attention to students' emotional experience and psychological tendencies. Meanwhile the research of mathematics teaching has also focused on how to guide students to learn more actively and more effectively from a psychological perspective. Mathematics anxiety is an unexplained negative emotion that students produce in the process of mathematical learning. It manifests itself in nervousness, uneasiness, anxiety and annoyance. When students have mathematics anxiety, it is manifested as their low interest in mathematical learning, which is easy to produce boredom and resistance. So it is difficult to form a good classroom teaching atmosphere. The vicious circle will lead to students' aversion to mathematics. Especially with the strengthening of the

university mathematics major, under the pressure of the mathematical discipline, students can easily give up the idea of mathematical learning and choose to change majors or give up the opportunity to continue further education. In order to train high-quality mathematics teachers, financial workers or mathematics researchers for the society, it is necessary to understand the current situation of mathematics students' mathematics anxiety.

This paper is based on a survey of sophomore students who are major in Mathematics of a university in Shandong. The main problems of this paper are as follows:

1) What is the current situation of mathematics anxiety among students?

2) Is there a correlation between mathematics anxiety level and the gender or major?

3) How to lower students' mathematics anxiety level?

2. Literature Review

The relationship between mathematics anxiety and gender has attracted many education researchers' attention, but the research objects mostly focus on middle schools. The conclusions can be roughly divided into the following three aspects: 1) The degree of math anxiety of boys is higher. For example, Ling Jeanne Lan ED.D found that male students' math anxiety was more serious through a survey of freshmen majoring in mathematics. 2) The anxiety degree of girls is higher than that of boys. Hembree's research shows that girls have higher math anxiety level. In his research of master's thesis, Jianhua Xiong pointed out that the degree of math anxiety of middle school girls was generally higher than that of boys (Jianhua Xiong, 2008). 3) There is no significant correlation between boys' and girls' math anxiety. Coates James found that no significant correlation between math anxiety and gender in his survey of freshmen. 4) Girls are more willing to admit that they have math anxiety than boys, and girls can self-eliminate it. It can be seen that there are many kinds of researches on math anxiety, but the conclusions are not uniform. The research objects are mostly middle school students, while there are few researches on college students' math anxiety in China.

As for the relationship between math anxiety and majors, in 1978, Brush proposed that students majoring in physics had lower level of math anxiety, while students majoring in humanities and social sciences had a relatively high level of math anxiety through a survey of college students. Shenglan Liu pointed out that liberal arts students tend to have higher degree of math anxiety after entering college (Shenglan Liu, Qihua Zhou, Yun Xia, & Qi Li, 2014).

3. Theoretical Basis

3.1. Mathematics Anxiety

The term "Mathematics Anxiety" was first used by Dreger and Aiken in 1950s. Then Western researchers began to explain the concept of mathematics anxiety

from multiple perspectives, such as: Fennema and Sherman, from a physiological perspective, who proposed that the mathematics anxiety is the perception of symptoms such as panic in the process of completing a given mathematical task (Fennema & Sherman, 1976). Other researchers have proposed that mathematics anxiety is a disease, a cognitive fear of math.

There was little domestic research on mathematics anxiety before the 21st century. Therefore the concept of mathematics anxiety is often cited by Yinghe Chen and Liuna Geng, "Mathematics anxiety refers to anxiety states such as tension and fear generated by individuals when dealing with numbers, using mathematical concepts, learning mathematical knowledge or taking mathematics exams" (Yinghe Chen & Liuna Geng, 2002). Fengkui Wang and Zengru Luo defined it as a special discipline anxiety disorder, a series of abnormal physiological changes, including behavioral performance and psychological experience caused by excessive anxiety about mathematics, (Fengkui Wang & Zengru Luo, 2002) after summarizing the concepts of western studies.

3.2. Measurement of Mathematics Anxiety

How to make quantitative analysis of mathematical anxiety has always been a problem that researchers are constantly seeking. At present, the main research methods used in these studies are questionnaire survey, interview and case study. The measuring tool is survey scale. The scale of mathematical anxiety has been constantly updated to accommodate different research subjects. The scale for the assessment of mathematics anxiety of college students was originally adapted by Dreger and Aiken, adding three mathematical items into the TMAS scale. MAS developed by Betz shows good reliability in assessing the degree of mathematics anxiety of college students, and has been widely verified and used internationally. Because the scale adopts the grammatical structure of double negation, it requires high understanding ability of students. Therefore some foreign researchers believe that the stability of this scale is general.

4. Methods

4.1. Research Object

This survey selected 248 full-time sophomore undergraduates from a Shandong university, which has a comprehensive classification of undergraduate mathematics majors. In order to comprehensively investigate the current situation of math anxiety among students of all majors and ensure the representativeness of the survey samples, a random sampling method was adopted to randomly select a class from different classes of each major. Finally, 221 questionnaires were collected. After the analysis and screening of the questionnaires, all of them were valid questionnaires. They includes 54 students majoring in "Applied Mathematics", 30 students majoring in "Integrated Mathematics", 52 students majoring in "Mathematics Teacher Training", 58 students majoring in "Statistics" and 38 students majoring in "information Statistics".

4.2. Research Tools

The scale used in this paper is slightly adapted from the Chinese version of the Mathematics Anxiety Scale (MAS) developed by Betz. The reason for choosing this scale is that it does not involve the differences between eastern and Western mathematical cultures, nor does it involve the question and answer of specific mathematics major subjects. So it can well adapt to the test of Chinese students. This questionnaire designs questions from two aspects of positive impact and negative impact, and each aspect has 5 questions, which involve the investigation of anxiety degree from four dimensions of "Mathematics Class", "Mathematics Test", "Mathematics Problem Solving" and "Overall Feeling of Mathematics". The answers were designed on a five-point scale from "Strongly disagree" to "Completely Agree".

4.2.1. Reliability of the Questionnaire

Fan Zhang and Zhenbing Zhu translated and tested this scale in China. It showed that the Cronbach's α of this scale was 0.89 with high reliability (Fan Zhang & Zhenbing Zhu, 2011). The overall consistency was also adopted in this study to test the reliability. In the prediction conducted before the formal investigation showed the Cronbach's α calculated by SPSS software was 0.635. Therefore, this study has good reliability.

4.2.2. Validity of Questionnaire

Fan Zhang and Zhenbing Zhu also tested that MAS had good predictive validity through the self-efficacy scale, and the exploratory factor analysis showed that the scale had good structural validity. Confirmatory factor analysis shows that the two-factor structure model data of this scale has a better fitting index (Fan Zhang & Zhenbing Zhu, 2011). In this study, the KMO value calculated by SPSS was 0.875, and the value of Bartlett's test was 1525.808. Therefore, it is considered that the questionnaire used in this study has good validity.

4.2.3. Distribution and Recovery of Questionnaires

The questionnaire will be sent to the participants using the auto-generated link of the questionnaire star, which will facilitate the participants to answer the questionnaire. During the distribution of questionnaires, we explain the purpose of the questionnaire, and hope that they will answers seriously. The questionnaire was divided into two parts. Firstly, questionnaires were distributed to the students of Class 2 for prediction, and 50 valid questionnaires were recovered. The reliability and validity tests were carried out by these questionnaires. After ensuring that the questionnaire had good reliability and validity, it was randomly distributed to each class for formal testing, by which 221 valid papers were recovered.

4.3. Data Collection and Processing

The collected questionnaires were analyzed and screened according to the com-

pletion rate. Moreover invalid questionnaires were removed, after, using the way of classification statistics to sort out the answers of the same dimension. On this basis, analyze the proportion of students in each dimension of mathematics anxiety. Then correlation analysis and path analysis were used to analyze the relationship between mathematics anxiety and gender or major. Finally, the method of cross analysis is used to sort out and analyze the data again.

5. Research Results

5.1. Current Situation

According to the statistics of the positive and reverse score of the questionnaire, the average score of the students is 32.83, with the score range ranging from 10 to 50 points. It can be seen that the subjects of the study generally have a certain degree of mathematics anxiety. The data were sorted and analyzed according to the four dimensions of "Mathematics Class", "Mathematics Test", "Mathematics Problem Solving" and "Overall Feeling of Mathematics", by which the correlation between mathematics anxiety and gender or major was explored.

1) The degree of students' anxiety in math class. In the face of the situation of having more math classes, 37.1% of the students will be upset about having more math classes, and 48.4% of the students do not feel relaxed in math classes.

It can be seen that more students have mathematics anxiety because of math class, but it is not a common phenomenon. (Table 1)

2) The degree of anxiety of students facing math exams. When thinking about the math exam, 67.4% of the students would be agitated because of the math exam and 71.4% of the students would be nervous because of the math exam headache.

Thus it can be seen that most students have obvious mathematics anxiety for math exams. (Table 2)

3) Students' anxiety in solving math problems. 65.2% of the students feel helpless when they think of struggling to solve math problems.

Table 1. Mathematics class.

Items	Options	Frequency (%)
I don't bother at all about math classes.	Strongly disagree	27 (12.2)
	Disagree	55 (24.9)
	Neutral	89 (40.3)
	Agree	29 (13.1)
	Completely Agree	21 (9.5)
I usually feel relaxed in math class.	Strongly disagree	31 (14.0)
	Disagree	76 (34.4)
	Neutral	87 (39.4)
	Agree	18 (8.1)
	Completely Agree	9 (4.1)

Table 2. Mathematics test.

Items	Options	Frequency (%)
The math exam was a piece of cake for me.	Strongly disagree	41 (18.6)
	Disagree	69 (31.2)
	Neutral	87 (39.4)
	Agree	18 (8.1)
	Completely Agree	6 (2.7)
I almost never get upset about math exams.	Strongly disagree	60 (27.1)
	Disagree	89 (40.3)
	Neutral	47 (21.3)
	Agree	15 (6.8)
	Completely Agree	10 (4.5)
The math test made me very nervous.	Strongly disagree	14 (6.3)
	Disagree	49 (22.2)
	Neutral	71 (32.1)
	Agree	50 (22.6)
	Completely Agree	37 (16.7)

It can be seen that students will have mathematics anxiety because of math problems, and the more difficult the problem, the higher the anxiety degree. (See Table 3)

4) Students' anxiety about the Overall Feeling of mathematics. 47% of the students feel nervous and uncomfortable about math, 48% of the students will feel uneasy and confused because of math.

It can be seen that nearly half of the students have a certain degree of mathematics anxiety at this stage. (Table 4)

5.2. Correlation Discussion

5.2.1. Gender

Through correlation analysis, this study found that there was no significant correlation between gender and mathematics anxiety for sophomores in this school of mathematics, and gender had no influence on mathematics anxiety. (Table 5)

5.2.2. Professional

Through the specific analysis of the four dimensions of the questionnaire, this study found some data worthy of attention and discussion. First of all, in the dimension of "take more math classes", compared with students of other majors, the number of students who show high degree of mathematics anxiety are from Statistics. The number of students, from Statistics, who would be upset about taking more math classes accounted for 51.71%. Meanwhile the number of students from other majors did not exceed 40%, among which the proportion of Applied Mathematics was the lowest at 27.78%.

Table 3. Mathematics problem solving.

Items	Options	Frequency (%)
I feel helpless at the thought of struggling to solve math problems.	Strongly disagree	17 (7.7)
	Disagree	60 (27.1)
	Neutral	74 (33.5)
	Agree	47 (21.3)
	Completely Agree	23 (10.4)
When I make math problems, my mind goes blank and I can hardly think straight.	Strongly disagree	33 (14.9)
	Disagree	92 (41.6)
	Neutral	64 (29.0)
	Agree	17 (7.7)
	Completely Agree	15 (6.8)

Table 4. Overall feeling of mathematics.

Items	Options	Frequency (%)
Math makes me nervous and sick.	Strongly disagree	33 (14.9)
	Disagree	84 (38.0)
	Neutral	65 (29.4)
	Agree	25 (11.3)
	Completely Agree	14 (6.3)
Math makes me feel uneasy and confused.	Strongly disagree	37 (16.7)
	Disagree	78 (35.3)
	Neutral	68 (30.8)
	Agree	23 (10.4)
	Completely Agree	15 (6.8)

Table 5. Correlation test.

		Sex	Sum
Sex	Pearson	1	.115
	Sig.		.087
	N	221	221
Sum	Pearson	.115	1
	Sig.	.087	
	N	221	221

Secondly, 63.79% of the students from "Statistics" who felt comfortable in math class held a negative attitude to the topic, while 57.89% of the students who are from "Information Statistics" also think so. The number of students who majored in other majors did not exceed 50%. Thus it can be seen that most of the students of Statistics will have anxiety because of more math classes. Therefore there is a certain degree of rejection of math classes. (Table 6)

For "Mathematics Test", students of all majors show a high degree of anxiety, but the proportion of students of "Statistics" and "Information statistics" who choose "Strongly disagree" and "Disagree" is higher than the proportion of students of other majors. In the negative impact reverse scoring question, the proportion of students who choose "Neutral", "Agree" and "Completely Agree" is still high. Therefore, it can be analyzed that students who are from statistics have a relatively high degree of anxiety because of the examination. (Table 7)

As for the questions of "Mathematics Problem Solving", 48.28% of students from "Statistics" chose "Strongly disagree" and "Disagree" for the questions of positive influence. Meanwhile, there are 60.53% students from "Information Statistics". In the questions with negative impact, the proportion of students from "Statistics" who choose "Neutral", "Agree" and "Completely Agree" is 58.63%. At the same time the proportion of students who are from "Information Statistics" is 44.74%, which is obviously higher than the proportion of students from other majors. It can be seen that the students of "Statistics" are more anxious about solving math problems. (Table 8)

Table 6. Mathematics Anxiety levels in different majors NO. 1.

Items	Options	Mathematics Teacher Training	Applied Mathematics	Statistics	information Statistics	Integrated Mathematics
I don't bother at all about math classes.	Strongly disagree	5 (9.62)	4 (7.41)	12 (20.69)	5 (13.16)	1 (5.26)
	Disagree	11 (21.15)	11 (20.37)	18 (31.03)	10 (26.32)	5 (26.32)
	sum	30.77	27.78	51.72	39.48	31.58
I usually feel relaxed in math class.	Strongly disagree	7 (13.46)	4 (7.41)	12 (20.69)	7 (18.42)	1 (5.26)
	Disagree	16 (30.77)	16 (29.63)	25 (43.10)	15 (39.47)	4 (21.05)
	sum	44.23	37.04	63.79	57.89	26.31

Table 7. Mathematics Anxiety levels in different majors NO. 2.

Items	Options	Mathematics Teacher Training	Applied Mathematics	Statistics	information Statistics	Integrated Mathematics
The math exam was a piece of cake for me.	Strongly disagree	8 (15.38)	7 (12.96)	14 (23.73)	10 (25.64)	3 (15.79)
	Disagree	15 (28.85)	20 (37.04)	17 (28.81)	11 (28.21)	6 (31.58)
	sum	44.23	50	52.54	53.85	47.37
I almost never get upset about math exams.	Strongly disagree	13 (25.00)	8 (14.81)	23 (38.98)	14 (35.90)	3 (15.79)
	Disagree	18 (34.62)	29 (53.70)	21 (35.59)	15 (38.46)	6 (31.58)
	sum	59.62	68.51	74.57	74.36	47.37
The math test made me very nervous.	Neutral	25 (48.08)	15 (27.78)	19 (32.20)	7 (17.95)	5 (26.32)
	Agree	11 (21.15)	13 (24.07)	14 (23.73)	8 (20.51)	4 (21.05)
	Completely Agree	7 (13.46)	5 (9.26)	10 (16.95)	9 (23.08)	7 (36.84)
	sum	82.69	61.11	72.88	61.54	89.7

Table 8. Mathematics Anxiety levels in different majors NO. 3.

Items	Options	Mathematics Teacher Training	Applied Mathematics	Statistics	information Statistics	Integrated Mathematics
I don't usually doubt my ability to solve math problems.	Strongly disagree	5 (9.62)	5 (9.26)	11 (18.97)	6 (15.79)	3 (15.79)
	Disagree	12 (23.08)	16 (29.63)	17 (29.31)	17 (44.74)	6 (31.58)
sum		32.7	38.89	48.28	60.53	47.37
When I make math problems, my mind goes blank and I can hardly think straight.	Neutral	14 (26.92)	15 (27.78)	23 (39.66)	8 (21.05)	4 (21.05)
	Agree	0 (0.00)	4 (7.41)	7 (12.07)	4 (10.53)	2 (10.53)
	Completely Agree	3 (5.77)	1 (1.85)	4 (6.90)	5 (13.16)	2 (10.53)
sum		32.69	37.04	58.63	44.74	42.11

Table 9. Mathematics Anxiety levels in different majors NO. 4.

Items	Options	Mathematics Teacher Training	Applied Mathematics	Statistics	information Statistics	Integrated Mathematics
Math makes me nervous and sick.	Neutral	15 (28.85)	18 (33.33)	18 (31.03)	7 (18.42)	7 (36.84)
	Agree	4 (7.69)	7 (12.96)	6 (10.34)	5 (13.16)	3 (15.79)
	Completely Agree	2 (3.85)	1 (1.85)	6 (10.34)	3 (7.89)	2 (10.53)
sum		40.12	48.14	51.71	39.47	63.16
Math makes me feel uneasy and confused.	Neutral	16 (30.77)	18 (33.33)	20 (34.48)	9 (23.68)	5 (26.32)
	Agree	3 (5.77)	6 (11.11)	8 (13.79)	3 (7.89)	3 (15.79)
	Completely Agree	2 (3.85)	3 (5.56)	5 (8.62)	3 (7.89)	2 (10.53)
sum		40.39	50	56.89	39.46	52.64

Among the two questions that had negative impact on the "Overall Feeling of Mathematics", 51.71% of the statistics students chose "Neutral", "Agree" and "Completely Agree" among the questions that "mathematics makes me nervous and sick". Meanwhile, 63.16% of the "Integrated Mathematics" students chose "Neutral", "Agree" and "Completely Agree". In addition, in the question "Math makes me feel uneasy and confused", 58.89% of the students from "Statistics" chose "Neutral", "Agree" and "Completely Agree". At the same time, 52.64% of the students who are from "Integrated Mathematics".

Thus, it can be concluded that the situation of mathematics anxiety among students from "Statistics" and "Integrated Mathematics" is terrible. Interestingly, students with high mathematics anxiety in the previous analysis had the lowest percentage of anxiety about the overall feeling of the lesson. (Table 9)

6. Conclusions and Suggestions

6.1. Conclusions

1) Sophomores of Mathematics have some degree of math anxiety, but it is not serious. The score range of the questionnaire is 10 - 50 and the average score of the overall survey is 28.6. Therefore, on the whole, the degree of mathematics

anxiety of the survey subjects is at the average level.

2) Mathematics anxiety exists in students from the four aspects of "Mathematics Class", "Mathematics Test", "Mathematics Problem Solving" and "Overall Feeling of Mathematics", among which the mathematics anxiety caused by "Mathematics Test" is the most obvious.

3) There is no significant correlation between gender and mathematics anxiety. This result may be affected by the proportion of girls and boys respondents, which is worth further exploration.

4) In the classification statistics of the major, compared with other majors, students majoring in "Statistics" have a higher proportion of mathematics anxiety in the four dimensions, followed by students majoring in "information Statistic". But students majoring in "information Statistic" show a small range of mathematics anxiety for the overall feeling of mathematics.

6.2. Suggestions

6.2.1. Students

1) Correct attitude and set up a correct view of learning. The research shows that students' mathematics anxiety is the most common and obvious phenomenon caused by "Mathematics Test". After passing the college entrance examination, college students tend to be passive and idle in their studies. They think that the examination questions in college are simple and the requirements of teachers are low, resulting in the study view and examination view of not studying at ordinary times and cramming for exams. "Math learning motivation, concept and attitude are significantly correlated with math scores" (Jianhua Xiong, 2008). When students establish appropriate learning motivation, concept and attitude, they will often achieve good scores in math exams, which is conducive to improving mathematics anxiety to a certain extent.

2) To establish efficient self-concept and self-efficacy. Unable to master the professional knowledge of mathematics, the experience of failure in learning, and the negative experience of others will lead to students' anxiety in "Mathematics Class", "Mathematics Test", "Mathematics Problem Solving", and even have resistance to mathematics. "Mathematical self-efficacy and mathematical anxiety play a chain mediating role in the relationship between mathematical self-concept and mathematical achievement" (Xiaofeng Du, Da Zhou, & Lu Yuan, Jian Liu, 2020). Students themselves can improve the situation of mathematics anxiety, improve the enthusiasm of individual mathematics learning and obtain good emotional experience by establishing efficient mathematics self-concept and self-efficacy.

3) Develop the spirit of assiduous study. According to the research survey, students present a common and high degree of math anxiety in the dimension of "Mathematics Test", and also present an obvious mathematics anxiety in the dimension of "Mathematics Problem Solving". Compared with elementary mathematics, higher mathematics has more content and higher difficulty. At the same time, it requires higher logical proof ability of students. In this situation,

students should carry forward the spirit of hard struggle, in order to study hard in the face of difficult problems and do not give up easily.

6.2.2. Teachers

1) Change the teaching strategy. The results showed that 31.7% of students would be bothered by taking more math classes, especially majoring in "Statistic". In view of this problem, teachers can change the teaching strategy according to the situation. It is a good idea to adopt more heuristic teaching, such as: abstract concrete, mathematical history, mathematical stories and so on, to stimulate students' interest in mathematics learning and gradually cultivate students' mathematical abstract ability and the ability to put forward problems and solve problems.

2) Improve the multiple evaluation system. The difficulty of the test paper should be moderate, considering the situation of students of different levels. It can reduce the degree of mathematics anxiety of students. We should break the evaluation method that only depends on grades and awards. On the contrary, teachers should change the evaluation method that only takes examination papers as final grades. We should pay attention to process evaluation and objectively evaluate students through self-evaluation, mutual evaluation and group evaluation.

3) Pay attention to the psychological state of students. Counselors and teachers should pay attention to students' daily learning status and help students to make clear their goals through offering courses such as career planning. At the same time, we should pay attention to the students with serious mathematics anxiety. It is necessary to open the psychological counseling channel and analyze the causes of mathematics anxiety according to the individual situation.

7. Discussion

There are some shortcomings in this study. Firstly, the number of questionnaires for students majoring in Integrated Mathematics isn't enough. Although the samples are random, there is still occasional influence on the results of the study, which makes the analysis of mathematical anxiety of students from Integrated Mathematics not accurate. Secondly, the correlation between gender and mathematics anxiety may be due to the fact that most of the subjects are girls and the number of boys is small. Finally, due to my limited energy and funds, I only chose a highly representative university, which resulted in a low extension validity of the research results. So it is worth further research and discussion. However this study can reflect the current situation of mathematics anxiety of sophomores and show differences in different dimensions and majors to some extent.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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