

STUDY OF MATHEMATICS ANXIETY AND MATHEMATICS ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS

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Dr. Md. Mahmood Alam

Assistant Professor

MANUU College of Teacher Education, Asansol -713301(W.B.)-India

(A Constituent College of Maulana Azad National Urdu University, Hyderabad)

Abstract

This study was conducted to examine mathematics anxiety and mathematics achievement among secondary school students of Aligarh (U.P.) The sample of 200 10th class students (100 boys: 50 government school students & 50 private school students; 100 girls: 50 government school students & 50 private school students) were randomly selected from secondary schools of Aligarh district. Mathematics Anxiety Rating Scale- India (MARS-I) by A. Karimi (2008) was used to collect the data. The data were analyzed using descriptive analyses (Mean, Standard Deviations), correlational analyses (Coefficient of Correlation 'r') and differential analyses ('t'- test). The result revealed that there is a significant inverse relationship between mathematics anxiety and mathematics achievement of secondary school students. The study also found that there is a significance difference between boys & girls and government & private secondary school students on the variable mathematics anxiety and mathematics achievement. This study may address the gap in the literature and provides some input which may help the teachers, administrators, and parents to understand the current status of mathematics education and find ways to strengthen learners' self- confidence to reduce the anxiety and improve the performance of students in mathematics

Key Words : Mathematics Anxiety, Mathematics Achievement, Gender, Types of School

1. INTRODUCTION

Mathematics is a dynamic field which produces a competent person to solve day- to- day problems and laid a foundation upon which a range of specialized skills can be built. In today's technologically developing societies, mathematical knowledge is of paramount interest for the success of individuals and progress of nations. Knowledge of mathematics helps in personal development and enhances mental abilities, helps our thought process and

improves the power of imagination to get rid of factors that are irrelevant to situations. Lack of interest in mathematics reduces career options too. Although Mathematics is a core subject in the school curriculum, it has persistently been experiencing poor performances of students. Researchers identified various factors responsible for inconsequential performance by students: e.g. shortage of qualified and competent mathematics teachers, large pupil-to-teacher ratios, family expectations, teacher's personality and teaching style, peer influences etc. On the other hands, excessive familial and societal pressure placed on students to excel in the subject, sometimes, may also produce apprehension about mathematics leading to anxiety syndrome in them.

'Anxiety' was first detected in the late 1950s when Dreger and Aiken (1957) noticed undergraduate college students reacting emotionally to arithmetic and Mathematics. They labeled it 'number anxiety'. Mathematics anxiety is a complex psychological construct that involves cognitive, affective and behavioral responses associated with lack of confidence and occurs in response to a threat to their self- ability and self- esteem. Scarpello (2007) in an article wrote that math anxiety can be caused by past classroom experiences, parental influences, and remembering poor past math performance. 75% of Americans stop studying math before they have completed the educational requirements for their career or job according to the National Research Council. He wrote that "research shows that students who have high levels of math anxiety have lower levels of math achievement and may be less likely to pursue math courses or math related careers" (p. 34). The findings of Marsh and Tapia (2002) indicate that students with low levels of math anxiety feel more excited, more confident and highly motivated to learn mathematics when compared to students who have high anxiety levels. Tocci & Engelhard (1991) found that students with a higher level of mathematics anxiety perform at a lower level of mathematics achievement. Also a negative correlation between mathematics anxiety and mathematics achievement was reported by Cates & Rhymer (2003) and Miller & Bichsel, (2004). The main purpose of the study was to ascertain the level of mathematics anxiety among high school students and to find out (i) the correlation between mathematics anxiety & mathematics achievement and (ii) the differences between boys and girls on the measures anxiety level and math achievement.

2. CONCEPTUAL FRAMEWORK

Mathematics Anxiety: Concept and Definitions

Math anxiety is the feeling of discomfort and uneasiness resulting from uncomfortable past experiences facing number/ numeral problems. This type of continuous feelings further affects student's ability to learn mathematics and they have difficulty believing in their abilities in the future. Professor Mark Ashcraft, one of the main researchers in the area, has described it as "Feelings of tension, apprehension, or even dread that interferes with the ordinary manipulation of number and the solving of mathematical problems" (Ashcraft & Faust, 1994). Yang (2014) defines it as 'People who feel tension, apprehension and fear of situations involving math are said to have math anxiety' (p. 28). Operationally mathematics anxiety is defined as the student's emotional state having the debilitating effect on the manipulation of numbers.

3. REVIEW OF RELATED LITERATURE

Francesca et al., (2016) reported that (i) girls exhibited higher mathematics anxiety than boys at both educational level and (ii) there was a reliable negative correlation between mathematics anxiety and secondary students' arithmetic performance. Ali Taheri et al., (2016) observed that overall math anxiety score dimensions have a negative significant relation with math academic achievement. Amanda and Jennifer (2015) conducted an observational study using pre-existing data from the *Freshman Orientation Survey*, on students at a university in the south eastern United States. The results suggest that standardized test scores and math anxiety had a moderate, negative relationship. The levels of mathematics anxiety did not differ by sex or language background. Mohd et al., (2014) reported that mathematics anxiety was negatively correlated with mathematics achievements and the relationship was significant. Karjanto and Yong (2013) studied the level of test anxiety in mathematics subjects among early undergraduate students at the University of Nottingham Malaysia Campus. The result shows that the students who had a lower score expectation were more anxious than those who had a higher score expectation. Xinbing Luo, Fengkui Wang and Zengru Luo (2009) found that mathematics performance is statistically significant negatively correlated to mathematics anxiety; there exists statistically significant difference between male students and female students in mathematics anxiety, and female students' anxiety level is higher than male students.

Ronato and Ballado (2014) found that there was a significant difference in the math anxiety levels of male and female students with females having higher level of mathematics anxiety. There was no significant difference in the math achievement of the two groups. A significant negative relationship was found between anxiety level and mathematics achievement. Other studies by Primi, et al. (2014) and Ferguson et al. (2015) have also noted higher mathematics anxiety in girls than boys. Birgin et al., (2010) and Kyttälä & Björn, (2014) have reported no gender differences in mathematics anxiety. Maria et al. (2016) in a study titled, "The Gender Gap in Mathematics Achievement: Evidence from Italian Data" noted that girls tend to underperform with respect to boys in mathematics achievement. Fatima (2013) in a study on mathematics achievements among high school students in Afghanistan, observed significant difference between boys and girls mean score in math favouring boys. Ruchi et al., (2016) in a study of mathematics anxiety among secondary school students in relation to personal and school related factors noted that students of private school have lowest mathematics anxiety scores than the other three groups namely; private, government, semi government and minority managed secondary school students. Baraneeswari and Pitchaimani (2017) studied academic achievement in mathematics subject among secondary school students in Madurai, Tamil Nadu. They found that students studying in private school outperform their government school counterparts in mathematics performance. Agnes, et al. (2009) found out that private school students perform better than their government counterpart in mathematics examination. The inconsistencies and varied nature of the results of literature review on the variable under study compel the researcher to carry this investigation to

ascertain the relationships and differences between the variables in hand. The present investigation is expected to fill the void of knowledge.

4. OBJECTIVES

- [1] To investigate the relationship between mathematics anxiety and mathematics achievement of secondary school students.
- [2] To study the difference between secondary school boys and girls ; government and private secondary school students on the measure of mathematics anxiety and mathematics achievement.

5. HYPOTHESES

Based on the review of literatures and aforementioned objectives the present study formulated the following hypotheses:

- H₁:** There is no significant relationship between mathematics anxiety and mathematics achievement of secondary school students.
- H₂:** There is no significant difference between boys and girls of secondary school students in respect of their mathematics anxiety.
- H₃:** There is no significant difference between boys and girls of secondary school students in respect of their mathematics achievement.
- H₄:** There is no significant difference between students of government and private secondary schools in respect of their mathematics anxiety.
- H₅:** There is no significant difference between students of government and private secondary schools in respect of their mathematics achievement.

6. DELIMITATIONS OF THE STUDY

- [1] The study is delimited to secondary school students studying in 10th class of Aligarh district of U.P.
- [2] The study is delimited to schools affiliated to U.P. Board and C.B.S.E. only.
- [3] The study is delimited to certain demographic variables viz., Gender (boys and girls) and type of schools (private and government) only.
- [4] The study is delimited to mathematics anxiety as dependent variable.
- [5] The study is delimited to the following tool to gather the data:
 - Mathematics Anxiety Rating Scale- India (MARS-I) by A. Karimi (2008)

7. METHODOLOGY

This study utilized survey techniques due to its descriptive nature. This section is comprised of sample, research tools and procedure of the data collection.

- [1] **Sample:** The present study was conducted on a representative sample of 200 10th class students (100 boys: 50 government school students & 50 private school students; 100 girls: 50 government school students & 50 private school students) were randomly selected from secondary schools of Aligarh district. The ages of the students ranged from 15 to 16 years.

[2] **Tool Used:** The researcher used the following tool for collecting the data to study the research in hand.

- i. Mathematics Anxiety Rating Scale-India (MARS-I) by A. Karimi (2008)**
 Mathematics Anxiety Rating Scale-India (MARS-I) has been constructed and standardized by A. Karimi (2008). It is a 30 items self administering scale divided across two subscales- – Math test Anxiety with 15 items and Numerical tasks with 16 items. Each item of this scale was rated on a five point continuum ranging from very much anxious – 5 to not at all anxious-1 (5-very much anxious, 4-anxious, 3- slightly anxious, 2- not anxious, 1- not at all anxious). The possible score ranges between 25 - 125. Two weeks test- retest reliability of this scale for high school students was reported as 0.85 and internal consistency alpha coefficient for the 31 -item MARS –I was computed to be 0.88.
- ii. Mathematics Achievement**
 Marks secured by students in the mathematics paper of annual examination of class 10th were taken as the mathematics achievement of the students. These marks were collected from the office records of the concerned schools and used in the analyses of the data.
- iii. Procedure of Data Collection**
 The data was collected with the prior permission of the selected schools and concerned teachers. The administration of the tool viz., Mathematics Anxiety Rating Scale-India (MARS-I) by A. Karimi (2008) was completed following the instructions given by the author of the tool.

8. ANALYSIS OF THE DATA

The data was analyzed using descriptive analyses (Mean, Standard Deviations), correlational analyses (Coefficient of Correlation ‘r’) and differential analyses (‘t’- test). The hypotheses were tested at varying level of significance.

9. RESULTS AND DISCUSSION

[1] Correlation of mathematics anxiety and mathematics achievement of secondary school students.

The correlation was calculated using Pearson’s Product Moment Coefficient of Correlation between above mentioned variables. Results of the correlation coefficients between mathematics anxiety and mathematics achievement of the secondary school students are presented in Table No. 1

H₁: There is no significant relationship between mathematics anxiety and mathematics achievement of secondary school students.

Table 1: Correlation Matrix of Mathematics Anxiety and Mathematics Achievement

Variables	Mathematics Anxiety	Mathematics Achievement
Mathematics Anxiety	*	-.391 (.01)
Mathematics Achievement	-.391 (.01)	*

Perusal of table-1 establishes that there is significantly inverse relationship between mathematics anxiety and mathematics achievement. This means that lesser mathematics anxiety will result into better mathematics achievement and vice-versa. The reason for the greater mathematics anxiety resulting into poor mathematics achievement may be due to their inability to control their negative thoughts and attention distraction from the given tasks which in turn affects their performance. Similar result is also reported by Francesca et al., (2016) and Ali Taheri et al., (2016). Thus the null hypothesis H_1 is rejected and it is reframed as **there is significant relationship between mathematics anxiety and mathematics achievement of secondary school students.**

[2] Comparison between boys and girls of Secondary School on the selected variables

The comparison between the samples on the selected variables was done by testing the significance of difference between their means by using t-tests. The results are presented in the following tables.

H_2 : *There is no significant difference between boys and girls of secondary school students in respect of their mathematics anxiety.*

H_3 : *There is no significant difference between boys and girls of secondary school students in respect of their mathematics achievement.*

Table 2: Comparison between boys and girls of Secondary School on the selected variables

Variables	Gender				t - value
	Boys (100)		Girls (100)		
	M_1	σ_1	M_2	σ_2	
Mathematics Anxiety	70.09	4.45	74.79	5.47	6.68 (.01)
Mathematics Achievement	65.69	9.87	61.21	10.18	3.16 (.01)

Table-2 presents mean scores of boys and girls of secondary school students for mathematics anxiety and mathematics achievement. Means and S.Ds of boys and girls on the measure of mathematics anxiety are 70.09 & 4.45 and 74.79 & 5.47 respectively. When the t-test was applied to compare the mean scores of mathematics anxiety of both the groups, t-value is found to be significant at .01 level of significance. This significant difference favouring girls are indicative of the fact that girls are more anxiety prone in comparison to boys on the measure of mathematics anxiety. The reason why girls experience higher mathematics anxiety may be due to the way they are socialized and conditioned in the society to believe that mathematics is a male domain and females are mathematically incompetent resulting in avoidance of mathematics and mathematical activities. They also tend to experience a more negative emotional pattern in mathematics. These tendencies make them more vulnerable to psychological pressures resulting in the forms of anxiety in mathematics. This result is in

consonance with the results of Ferguson et al. (2015) and Ronato and Ballado (2014). Thus the null hypothesis H_2 is rejected and it is reframed as **there is significant difference between boys and girls of secondary school students in respect of their mathematics anxiety**. On the other hands, mathematics achievement favouring boys may be due to their superior spatial skills, better self- confidence. This gives them an edge in mathematics learning and achievement. As Watt stated “girls are less interested and have less liking for mathematics than boys” (2007, p.38). This result is in line with the results of Maria et al. (2016) and Fatima (2013). Thus the null hypothesis H_3 is rejected and it is reframed as **there is significant difference between boys and girls of secondary school students in respect of their mathematics achievement**.

[3] Comparison between government and private secondary school students on the selected variables

The comparison between the samples on the selected variables was done by testing the significance of difference between their means by using t-tests. The results are presented in the following tables.

H₄: There is no significant difference between students of government and private secondary schools in respect of their mathematics anxiety.

H₅: There is no significant difference between students of government and private secondary schools in respect of their mathematics achievement.

Table 3: Comparison between Government and Private Secondary School Students on the selected variables

Variables	Types of School				t - value
	Government (100)		Private (100)		
	M ₁	σ ₁	M ₂	σ ₂	
Mathematics Anxiety	68.19	4.69	63.23	4.77	7.031 (.01)
Mathematics Achievement	63.69	5.12	66.11	5.25	3.30 (.01)

Table-3 presents the mean scores of government and private secondary school students for mathematics anxiety and mathematics achievement. Means and S.Ds of government and private secondary school students for mathematics anxiety are 68.19 & 4.69 and 63.23 & 4.77 respectively. The computation of t- value reveals that the t-value is significant at .01 level of significance, suggesting that types of school play an important role in producing anxiety in general and mathematics anxiety in particular among the students. It may be due to the reason that government schools in India may have insufficient necessary infrastructures, desired academic support, ineffective mechanism to check the working of the school system

and high expectations from parents to excel in the academics to grab the better careers opportunities. All these factors along with peer competitions may contribute to academic anxiety in general and mathematics anxiety in particular to the students admitted into these institutions. Similar result is also reported by Ruchi et al., (2016). Thus the null hypothesis H_4 is rejected and it is reframed as **there is significant difference between students of government and private secondary schools in respect of their mathematics anxiety.**

The comparison of government and private secondary school students for mathematics achievement goes in favour of the later. The reason why private secondary school students outperform their government school counterpart may be due to their interests which are specifically aligned to their studies, are exposed to more diverse and competitive curriculum and good study habits and are motivated to study with conducive learning environment. This result agrees with the results reported by Baraneeswari and Pitchaimani (2017), Agnes, et al. (2009). Thus the null hypothesis H_5 is rejected and it is reframed as **there is significant difference between students of government and private secondary schools in respect of their mathematics achievement.**

9. FINDINGS

- [1] There is significant inverse relationship between mathematics anxiety and mathematics achievement of secondary school students.
- [2] There is significant difference between boys and girls of secondary school students in respect of their mathematics anxiety.
- [3] There is significant difference between boys and girls of secondary school students in respect of their mathematics achievement.
- [4] There is significant difference between students of government and private secondary schools in respect of their mathematics anxiety.
- [5] There is significant difference between students of government and private secondary schools in respect of their mathematics achievement.

10. CONCLUSION

The result of the study shows that there is a significant inverse relationship between mathematics anxiety and mathematics achievement among secondary school students. This implies that the students who have lesser mathematics anxiety perform better in mathematics and vice-versa. The results of the study also suggest that mathematics anxiety significantly differs in case of boys & girls and government & private secondary school students. The various factors associated with varied performances in mathematics between boys & girls and government & private secondary school students have implications for the kind of instructional procedures that are to be adopted for setting up an appropriate teaching and learning environment for mathematics instruction that is suitable for all. This will help in achieving the millennium declaration of September 2000 (United Nations, 2000) in promoting gender equity, the empowerment of women and the elimination of gender inequality in basic and secondary education.

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