MATHEMATICS ANXIETY AND MATHEMATICAL PROBLEM SOLVING ABILITY OF SECONDARY SCHOOL STUDENTS.

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Abstract: Mathematical Problem Solving Ability is a fundamental skill to be acquired by an individual to enable him to face daily-life situations efficiently. Anxiety is found to be influencing many cognitive outcomes of mathematics education. The paper aims to finding the extent of Mathematical Problem Solving Ability and Mathematics Anxiety as well as finding the type of relationship between them. In this study survey method was adopted. Test of Problem Solving Ability and Mathematical Anxiety Scales were used for collecting relevant data. The data was collected from 400 ninth standard students of five revenue district of Kerala. There exists a significant negative correlation between Mathematical Anxiety and Mathematical Problem Solving Ability. Also 2.69 percent of variation in Mathematical Problem Solving Ability can be explained by variance in Mathematics Anxiety. Problem Solving Ability of high and low Mathematics Anxiety students differ significantly favoring the low anxiety group. There is no gender difference in Mathematical Problem Solving Ability and Mathematics Anxiety among secondary school students. The study reveals that, the students with Mathematics Anxiety perform poorly in test on Mathematical Problem Solving Ability, and hence those factors contributing to Mathematical Anxiety to be minimized.

Index Terms: *Mathematical Problem Solving Ability, Mathematics Anxiety, Secondary School Students.*

INTRODUCTION

Mathematics assumes a prominent position in modern education throughout the world. Degree of excellence of mathematics education points out the scientific and technological rapport on development of nation. It becomes necessary to groom a child to elicit strong mathematical ideas and skills to face challenges of globalization. A major aim of mathematics education up to secondary level is making a person capable of applying mathematical knowledge in his daily life situations which ensure capability of problem solving and decision making. According to Bhat (2014) problem solving is the keystone and best provider of achievement in mathematics.

Without getting proper mathematical knowledge and associated skills, one cannot function effectively or pursue a better future in science and technology. Board examination results of school students show poor performance of students in mathematics and science which call urgent attention from the part of practitioners. Many studies in the area of mathematics achievement and its correlates highlight the negative impact anxiety plays on achievement (Jackson & Leffingwell, 1999; Steele & Arth, 1998; Sherman & Wither, 2003; Şahin, 2008; Karimi & Venkatesan, 2009; Khatoon & Mahmood, 2010, Bala & Shaafiu,2016). Tobias (1995) defined Mathematics Anxiety as a feeling of tension and anxiety that appears when someone is engaged in the manipulation of figures to solve mathematical problems in both academic and daily-life situations. Marsh and Tapia (2002) in their study found that Mathematical Problem Solving Ability is high in students with low level of Mathematical Anxiety when compared to students who have high Mathematical Anxiety levels. You Kai Kow (2005), In a study on 621 students of 10 secondary schools in Singapore identified a marginal linear negative relationship between Mathematics Anxiety and Problem Solving Ability. Low level negative relationship between Mathematics Anxiety and Mathematical Problem Solving Ability was found among primary school students of Turkey by Karasel, Ayda and Tezer (2010).

Kerala education system is a model for the other states of India, but still the performance of school children is not to the expected level. Anxiety is found to be a common disorder among adolescents (Tabrizi, Talib & Yaacob, 2011) and when it comes to the experiences based on Mathematics, it becomes more focused. The ability of students to solve problems is also a significant element to be highlighted in mathematics education.

OBJECTIVES

The objectives of the study are,

1. To find out the extent of Mathematical Problem Solving Ability among secondary school students.
2. To find out the extent of Mathematics Anxiety among secondary school students.
3. To find out whether there is gender difference in Mathematical Problem Solving Ability and Mathematics Anxiety among secondary school students.
4. To find out whether low- and high- Mathematics Anxiety groups differ in their Mathematical Problem Solving Ability.
5. To find out whether there exist any relationship between Mathematical Problem Solving Ability and Mathematics Anxiety of secondary school students.

METHOD

Present study is an attempt to find out the influence of Mathematics Anxiety on Problem Solving Ability among secondary schools students of Kerala. Survey method was adopted for the study.

Instruments

The variable Mathematical Problem Solving Ability was measured using Test of Problem Solving Ability in Mathematics developed by Sumangala and Rinsa (2008). The test contains 30 items in the form of multiple choice questions. The respondent has to mark his response from given choices. As all the items are of objective type the scoring scheme is to give one score for each correct answer and a zero score for an incorrect one. The internal consistency of the test was calculated using Cronbech Alpha Coefficient (0.94). Concurrent validity of the test was estimated by correlating the score of the test with that marks obtained by 30 students in another test of Problem Solving Ability in Mathematics developed by Sumangala and Vijayakumari (2000). The correlation coefficient obtained is 0.59 indicating that the test is valid to measure Problem Solving Ability in Mathematics.

The variable Mathematics Anxiety was measured using Scale of Mathematics Anxiety developed by Sumangala and Malini (1993). This scale is in the form of a five point Likert type scale and is intended to measure the extent of fear or the feeling of apprehension in working with Mathematics. The maximum score obtainable is 145 and the minimum is 29. The test retest reliability coefficient is .86 and the Cronbach's Alpha reliability coefficient is 0.796. The authors have claimed that the scale is valid to measure Mathematics Anxiety after establishing the criterion related validity by taking the score of Kerala examination anxiety scale and achievement scores in mathematics as the external criteria.

Participants

The study was conducted on a sample of 400 ninth standard students of five revenue districts in Kerala. Stratified random sampling method was used for this study.

Results and Discussion

To know the extent of the variables Mathematical Anxiety and Mathematical Problem Solving Ability among Secondary School Students, Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis, Standard error and Critical ratio were computed and is presented in table 1.

Table1: Descriptive statistics of the variable mathematical anxiety and mathematical problem solving ability

Variable	Mean	Median	Mode	SD	Skew-ness	S.E	z-value	Kurto-sis	S.E	z-value
Mathematics Anxiety	89.47	92	99	15.34	-0.787	0.122	-6.45	0.482	0.243	1.98
Problem Solving Ability	11.36	11	11	4.18	0.06	0.122	0.49	-0.821	0.243	-3.37

Table 1 shows that mean, median and mode of Mathematics Anxiety are 89.47, 92 and 99 respectively. Value of Mean, Median and Mode are almost equal. The standard deviation of Mathematical Anxiety is found to be 15.34, which shows that the scores are slightly deviated from the mean score. The skewness of Mathematics Anxiety is found to be - 0.787 with standard error 0.122. The Z-value calculated by dividing skewness with its standard error is -6.45. As this value is greater than 2.58 and the sign of the value of skewness is negative, the distribution of scores on Mathematics Anxiety among secondary school students is negatively skewed showing that more students cumulate towards the higher values on the scale. The value of kurtosis is 0.482 with standard error is 0.243. The Z-value calculated by dividing kurtosis with its standard error is 1.98. as the critical ratio for kurtosis is greater than 1.96 and as the value of kurtosis is greater than zero, the distribution is lepto kurtic, meaning the values are cumulating at a part, the tails being thin.

The mean score of 89.47 is greater than 87 the middle score on the scale and hence the students are having debilitating anxiety but is very much lower than 145 the maximum score on the scale. Hence it can be considered as students are not having high level of debilitating anxiety in Mathematics. Further to establish significance of difference between mean score and middle score on the scale one sample t-test was used and obtained t-value is 3.22, which shows there exist a significant difference between the obtained mean score and middle score on the scale at 0.01 level of significance. These results indicate that secondary school students are having debilitating anxiety, but not at a high level.

From table 1, it can be seen that Mean, Median and Mode of Mathematical Problem Solving Ability are 11.36, 11 and 11 respectively which are almost equal. The standard deviation of the scores of Mathematical Problem Solving Ability is 4.18 which show that the scores are slightly deviating from the mean score. Skewness and kurtosis of the distribution of Mathematical Problem Solving Ability are found to be 0.06 and -0.821. The Z-value calculated by dividing skewness with its standard error is 0.49. The value of kurtosis is -0.821 with standard error is 0.243. The Z-value calculated by dividing kurtosis with its standard error is -3.37. The critical ratio for skewness is less than 1.96 and hence the distribution can be considered as symmetric. Also the mean, median and mode obtained for the Mathematical Problem Solving Ability are almost equal (11) which support the symmetric nature of the distribution. But the critical ratio for kurtosis is greater than 2.58 and the value of kurtosis is negative. Hence the distribution is platy kurtic. That is, though the distribution is symmetric, more values are there in the extreme. That is the number of students who have very low score on the test is almost equal to those who have high scores. The mean score suggests an average level of performance in Mathematics Problem Solving ability, but kurtosis suggests that there are students who have very low Problem Solving Ability where as almost equal number have high ability in problem solving.

The maximum score obtained in the test is 30 and the mean score obtained is 11.36 indicating that secondary school students are not having a satisfactory level of Problem Solving Ability in Mathematics. The mean score of 11.36 is less than 15 the middle score on the scale. Further to establish significance of difference between mean score and middle score on the scale one sample t-test was used and obtained t-value is 5.42, which shows there exist a significant difference between the obtained mean score and middle score on the scale at 0.01 level of significance. These results indicate that secondary school students are having low Mathematical Problem Solving Ability.

To find whether gender difference exist in Problem Solving Ability and Mathematics Anxiety among secondary school students , t-test for large independent sample was executed the details of which are given in table 2.

Table 2: Gender wise comparison of mathematical problem solving ability and mathematics anxiety.

Sample	Sub Sample	N	Mean	SD	't' Value
Problem Solving Ability	Boys	199	10.98	4.36	-1.803
	Girls	201	11.74	3.97	
Mathematics Anxiety	Boys	199	90.78	14.32	1.703
	Girls	201	88.17	16.21	

From table 2 it is clear that there is no significant difference in the mean Problem Solving Ability score for boys(M=10.98, SD=4.36) and girls(M=11.74, SD=3.97. That means there is no significant gender difference in Mathematical Problem Solving Ability of secondary school students. Also there is no significant difference in the mean Mathematics Anxiety score for boys (M=90.78, SD=14.32) and girls (M=88.17, SD=16.21. That is, boys and girls do not differ in the mean score on Mathematics Anxiety.

In order to find whether Mathematical Problem Solving Ability is influenced by Mathematics Anxiety, test of significance of Mean difference for independent groups was used. For this the total group was divided into two based on the score on Mathematics Anxiety. The Median value of Mathematics Anxiety (92) was taken as the cut off value for High and Low Mathematics Anxiety group. A score less than 92 was taken as low anxiety and greater than 92 was taken as high anxiety. In the total sample, it was found that 201 students are in low Mathematics Anxiety group and 199 are in the High Mathematics Anxiety group. The significance of difference in Mathematical Problem Solving Ability between the Low Mathematics Anxiety group and High Mathematics Anxiety group was tested and the result is presented as table 3.

Table 3: Mathematics anxiety group wise comparison of mathematical problem solving ability.

Variable	Mathematical Anxiety	N	Mean	Std. Deviation	't' Value
Mathematical Problem solving Ability	High Group	199	10.79	3.95	2.73
	Low Group	201	11.93	4.32	

Table 3 shows that the obtained 't' value for Mathematical Problem Solving Ability for Low anxiety group and High anxiety group is 2.73. Since the calculated t value is greater than 2.58, there is a significant difference in the mean Mathematical Problem Solving Ability scores of Low anxiety group and High anxiety group ($p \leq 0.01$). Mean value shows that Low anxiety group have high Problem Solving Ability than high anxiety group. That is Problem Solving Ability of high and low Mathematics Anxiety students differ significantly favoring the low anxiety group. Mean scores on Mathematical Problem Solving Ability of Low Anxiety group and High Anxiety group is depicted diagrammatically as figure 1 to get a clear picture of the difference between the groups.

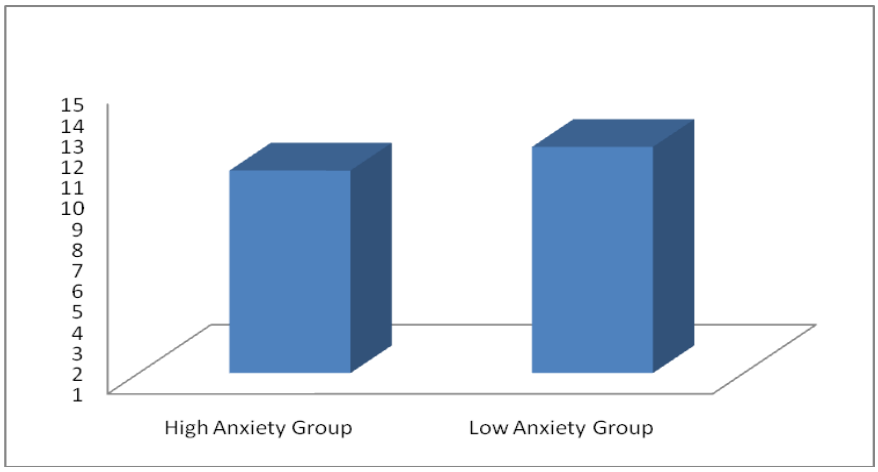

Figure 1: bar diagram showing mean mathematical problem solving ability score of high and low anxiety group.

To know whether Mathematics anxiety is related to Mathematical Problem Solving Ability and its nature, Pearson's product moment coefficient of correlation was calculated. To know the linearity of the relationship scatter diagrams were drawn for each case and is presented as figure 2.

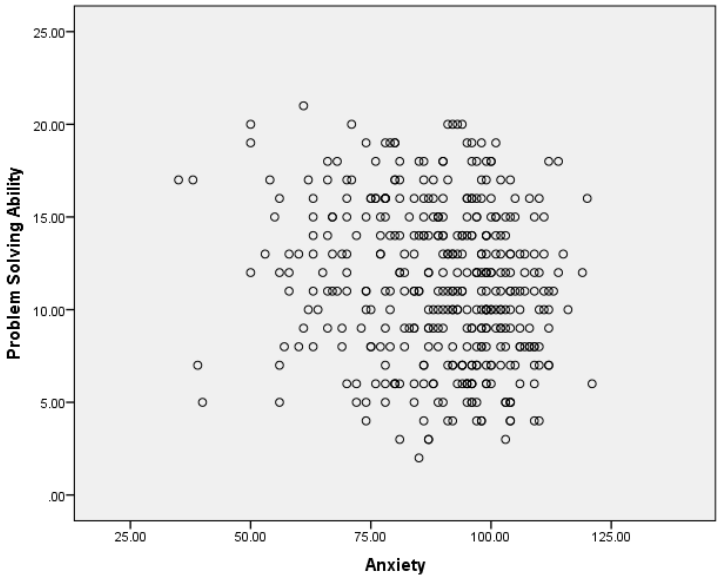

Figure2: Scatter diagram for mathematical problem solving ability with mathematics anxiety.

The scatter plot shows that the relationship between the variables is linear as the points tend to cluster around a straight line, but the extent of relationship is low.

Correlation coefficient obtained for Mathematics Anxiety and Mathematical Problem Solving Ability is greater than the value needed for significance at 0.01 level for N=400. Hence there is significant relationship between the variables. A low negative relationship is found for the variable Mathematics Anxiety with Mathematical Problem Solving Ability. That is Mathematics Anxiety is significantly negatively related with Mathematical Problem Solving Ability, but the extent of relationship is low. That is for an increase in Mathematics Anxiety there will be a small decrease in Mathematical Problem Solving Ability. When shared variance is calculated ($r^2 \times 100$) the value obtained is 2.69. Hence only 2.69 percent of variation in Mathematical Problem Solving Ability can be explained by variance in Mathematics Anxiety.

CONCLUSION

Problem Solving Ability is an important element of mathematics education. The present study indicates that Mathematics Anxiety is one of the factors that hinder Mathematical Problem Solving Ability. Mathematics Anxiety is found to be influencing Mathematical Problem Solving Ability. So it is essential to reduce the Mathematical Anxiety for developing Mathematical Problem Solving Ability. Many of the researches in this area suggested, techniques and ideas to eliminate relation between above two. For instance, effective instruction for struggling mathematics learners includes instructional explicitness, a strong conceptual basis, cumulative review and practice, and motivators to help maintain student interest

and engagement (Fuchs et al., 2008; Gersten et al., 2009). Also Das, Halder, Bairagya (2014) suggested that teachers should follow and use such methodology in teaching mathematics that will help the students to interest in doing mathematics.

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