Exploring Students' Anxiety Level in relation to Mathematics Learning

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Abstract: ***What is Mathematics?? If it is to be defined, there is no universally accepted definition but when it is seen as a whole, through the use of abstraction and rationality, it is observed that this discipline is developed from numbers, calculations, measurements which includes a well systematic study of the physical objects. This discipline has a multidisciplinary approach and shares its' boundary with several other disciplines like physics, philosophy, science, humanities, etc. It has been reported in several studies that the demand for accuracy, procedural approach, logic, and emphasis on problem-solving makes this subject anxiety-provoking among the learners. Some researchers have also documented the undesirable impact of maths anxiety or phobia on academic performance and achievement. This research dealt with exploring the anxiety level pertaining to mathematics and intended to know the reasons behind the anxiety faced by the students. For this, the researcher conducted a small survey and administered a Maths Anxiety Scale on the sample of 200 students along with the interview schedule to gather the qualitative data. The study revealed that Mathematics anxiety was higher in the students of the secondary stage as compared to students of the upper primary stage. Gender-wise analysis revealed that the female students had high anxiety levels as compared to the male counterparts. The school-wise analysis revealed that the students of government schools had high anxiety levels as compared to the students of private schools. On exploring the reasons behind high anxiety, it was found that rote learning behaviorist approach for teaching maths, difficulty in accommodating different learning styles in Maths teaching, the inability of the teachers in designing positive experiences, undesirable classroom experiences, too much emphasis on justification and explanation without positive and supportive atmosphere, fear due to glorification of maths as a subject, non-conducive learning environment (imposed authority), abstract nature of mathematics, Scoring pressure-High expectation (subject considered to be high scoring), lack of humor in maths, focus more on procedural knowledge rather than on concept development, etc were some of the reasons. The research suggests that to counter this unproductive tension, several relaxation techniques, different teaching methods, and good teacher-taught relations shall be practiced in schools to reduce maths avoidance behavior amongst the students.***

Keywords: ***Maths Anxiety, Maths Phobia, Psychological pressure in Maths, Stress and Mathematics Education.***

1. INTRODUCTION

Mathematics anxiety is intense emotional feelings of anxiety that people have about their ability to understand and deal with numbers. People who suffer from mathematics anxiety feel that they are incapable of doing activities that involve calculations (Ashcraft & Faust, 1994). Some math-anxious people even have a fear of mathematics; it's called 'math phobia'. Mathematics anxiety is considered a psychological rather than an intellectual issue because it interferes with the learning ability of the individual. According to Dreger and Aiken (1957) "Mathematics anxiety is the presence of a syndrome of emotional reactions to arithmetic and mathematics". According to Ashcraft (2002) "Mathematics anxiety is a feeling of tension, apprehension, or fear that interferes with math performance". Brady and Bowd (2005) defined mathematics anxiety as a combination of "debilitating test stress, low self-confidence, fear of failure, and negative attitudes toward mathematics learning".

1.1. Anxiety and its relation with Mathematics:

Anxiety is an overpowering feeling of uneasiness, panic, and distress. It is the situation when one starts getting a feeling of pressure about the future and experiences various physical and psychological changes in the body. Generally, an increased heart rate, rapid breathing, restlessness, sweating, dry mouth, chills or hot flashes, numbness, difficulty in concentrating, and sleepless nights are a few of the anxiety-related signs. The plethora of researches on anxiety revealed that anxiety provokes constructive and sometimes adversative effects among individuals. The positive effect is termed facilitative anxiety whereas the negative effect is termed as debilitating effect. It is said to be positive anxiety or facilitative effect when the anxiety has some motivational consequences or due to anxiety when an individual starts putting in some extra efforts. On the other hand, it is said to be negative anxiety or debilitating anxiety, when the individual expresses negative affective reactions.

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1.2. Mathematics Anxiety: Major Reasons contributing to Developing Anxiety

Although there are many reasons for mathematics anxiety, usually mathematics anxiety stems from unpleasant experiences in mathematics. According to Greenwood (1984), "evidence suggests that mathematics anxiety results in more from the way the subject is presented than from the subject itself". Unfortunately, mathematics anxiety is often due to poor teaching and poor experiences in Mathematics. There are many reasons for the development of mathematics anxiety in a student. On conducting a meta-analysis of the previous researches on anxiety-related Mathematics, it was found that maths anxiety can be related to:

1. Attitudes of parents, teachers, or others towards Mathematics.
2. The Learning environment.
3. Impact of some specific incident in a Student's mathematics history, which was frightening or embarrassing.
4. Teaching techniques that emphasize time limits, the right answer, speed in getting the answer, competition among students, working in isolation, memorization rather than understanding.
5. Personal factors of the learner like attitudes, distrust of ability, negative self-talk, giving up before beginning, depression, and feelings of failure, expectations of divine intervention.
6. Nature of mathematics itself, which requires students to think, cleanly, and often abstractly.
7. Mishandling of any of the mathematics disabilities like difficulty with basic math facts and memory, weakness in doing calculations, inability to apply mathematics concepts, and struggles with the visual and spatial relationship.
8. Existence of learning disability like dyscalculia or poor learning styles.

1.3. Mathematics Anxiety: Related theories

1.3.1. Traditional Arousal Theory

The proponents of the traditional arousal theory stated that there exists an optimal level of arousal around the middle of the arousal dimension. This idea is graphically represented as an inverted U-curve depicting a curvilinear relationship between anxiety and performance. Thus this arousal theory indicates that some anxiety is beneficial to performance, but after a certain point, it undermines performance (Ma, 1999).

1.3.2. Interference model

Based on the work of Liebert and Morris (1967); Mandler & Sarason (1952) and Wine (1971) researchers have described mathematics anxiety as a disturbance of the recall of prior mathematics knowledge and experience. Consequently, a high level of anxiety causes a low level of achievement (Ma, 1999).

1.3.3. Deficit model

The poor performance in mathematics in the past causes high anxiety (Tobias, 1985). According to this model, a student's low level of math achievement is attributed to poor study habits and test-taking skills instead of to mathematics anxiety (Ma, 1999). Within this model math anxiety does not cause poor performance, the reverse is true; an awareness of poor past performance causes mathematics anxiety.

2. REVIEW OF RELATED LITERATURE

Pletzer et.al. (2016) highlighted the complex emotions involved in anxiety-like pressure, uneasiness, high arousal, and physiological reactivity which interferes in manipulation skills and problem-solving in maths. The study discussed the five-factor model, based on two general factors i.e. Mathematics Test Anxiety and Numerical Anxiety. And, a gender-based difference was found in the research. On the other hand, Ihechukwu N.B. and Ugwuegbulam N. C. in 2016 explored Mathematics phobia among students and elaborated on the strategies adopted by the teachers. The use of abusive words and student-teacher relationships were found to be some of the major causes of mathematics phobia among the students. The study emphasized the regular in-service training of Mathematics teachers. In the year 2015, Bieg M, Goetz T, Wolter I and Hall NC investigated whether Gender stereotype endorsement differentially predicts girls' and boys' trait-state discrepancy in math anxiety.

It was revealed that gender stereotype endorsement plays a significant role in describing gender differences in relation to math anxiety beyond academic self-concept. It was also revealed that when controlling for self-concept in mathematics, ladies who acknowledged the gender stereotype of math being a male domain more strongly overestimated their trait math anxiety as compared to their state anxiety whereas this effect was not significant for males. In the study conducted by Newstead (2014) it was found that the traditional approach used to teach mathematics creates stress and anxiety among the students. The experiment revealed that the students who were taught through the traditional approach in mathematics experienced more anxiety as compared to those who were taught through alternative strategies. Hlalele (2012) carried out a study on 403 learners of mathematics. It was researched that all learners occasionally, frequently, or constantly experience mathematics-related anxiety in academic settings. No participants indicated that they never experienced mathematics anxiety in academic settings. Hence, it was found that irrespective of intelligence and interest, mathematics anxiety exists among the learners at one or the other stage of life. Bekdemir (2010) engaged in the study to examine whether negative classroom experiences impact anxiety-related to

Mathematics among pre-service teachers. Mixed –method explanatory approach was employed. The findings revealed that many pre-service teachers had mathematics anxiety and the classroom experiences were directly proportional to mathematics anxiety in pre-service teachers. The study also highlighted the teacher's behavior and teaching approach as the substantial cause of increased anxiety.

The trend observed in Literature reviewed: Mathematics learning and factors affecting mathematics learning including Mathematics Anxiety is a well-analyzed area in India as well as abroad. Many case studies, surveys, experimental studies, longitudinal and cross-sectional studies had been conducted related to mathematics anxiety on a variety of samples, using a variety of methodologies and utilizing various techniques of analysis. Quantitative, qualitative, and triangulation studies were located which had studied mathematics anxiety in relation to variables like mathematics achievement, self-concept, test anxiety, general anxiety, gender, age, mental ability, various teaching methods, etc. Some studies tried to explore the reasons and consequences of mathematics anxiety while some others tried to clarify and define the construct. Besides this, one major thing was noticed that Mathematics Anxiety is a common phenomenon all over the world and must not go unnoticed. The academic anxiety level measurement of the students would help the teachers to provide the interventions at the earliest. Hence, the researcher attempted to explore the current situation of Mathematics learning and related anxiety among the students in the Indian classrooms so that necessary actions could be planned by the teachers to evoke and maintain the interest of the learners in mathematical thinking and application.

3. OBJECTIVE OF THE STUDY

The objective of the study was:-

- To explore the Anxiety level of students in relation to the learning of Mathematics concepts and compare the Anxiety level based on:
  - Gender: Girls v/s Boys
  - Stage: Upper Primary Stage v/s Secondary Stage
  - Type of School: Private School v/s Government School

4. RESEARCH METHODOLOGY

4.1. Sample

The Maths Anxiety scale was administered on a sample of 200 students, 100 students of government schools, and 100 students of private schools of Delhi.

4.2. Tool

Maths Anxiety Scale: The scale developed by Musthafa and Sunitha (2012), was used in the study. The reliability of the scale was established by the test-retest method. The reliability coefficient of the tool was 0.75. The internal consistency of the scale was established by calculating Cronbach's alpha. The obtained Cronbach's alpha of the scale was 0.9 suggesting a very high internal consistency of the scale. The tool included the following components in the tool:- Problem-solving anxiety, Application anxiety, Performance anxiety, Worries about learning Mathematics, Negative affect towards Mathematics, Test/ Evaluation anxiety, Apprehension of Mathematics courses and lessons, Social or public aspects of doing Mathematics, Anxiety due to nature of Mathematics, Self-efficiency for Mathematics and Physical arousal in Mathematics situations. The scoring of the tool is as follows:-

TABLE 1.1

Scoring Range Depicting Anxiety Level

SCORING RANGE	ANXIETY LEVEL
0-11	High Anxiety
12-23	Average Anxiety
24-35	Low Anxiety
36-45	No Anxiety

Interview Schedule: The interview schedule had 12 questions. The tools used in the study were well consulted and validated by the experts. The content validity of the interview schedule was established by 5 experts.

5. ANALYSIS AND FINDINGS OF THE STUDY:

Tool wise analysis is as follows:-

Findings: On analyzing the Maths Anxiety Scale, it was found that 90 students out of 200 had high anxiety with respect to learning mathematics. It came out to be 45% of the sample. 68 students out of 200 had average anxiety levels and it came out to be 34% of the total sample. 28 students had low anxiety levels and represented the 14% of the entire sample. 12 students were found to have no anxiety in maths. This represented only 6% of the whole sample. The same findings have been shown through graphical representation below:-

Interpretation: Figure 1.1 revealed that approximately half of the students experience anxiety when they deal with Mathematics calculations. On the other hand, there were very few students who reported anxiety-related issues in Mathematics. Since, Mathematics is considered as one of the advanced and technology supporting subject, a subject of everyday life, it is a matter of concern and very important for the teachers, parents and all other stakeholders to bring some

revision in the course of instruction, curriculum and teaching strategies to deal with the stress and anxiety. The gender basis comparison of Maths anxiety revealed the following details:-

Boys v/s Girls:- Total sample: 200, Boys: 126 and Girls: 74

Out of 74, 48 girl students showed high anxiety which is 64% of the total girl sample. This showed that more than half of the girl students had anxiety problems in dealing with maths subjects. Out of the total count of boys i.e. 126, 44 boys reported high anxiety, and 23 boys reported average maths anxiety. Based on these statistics, it was concluded that girls had more anxiety as compared to boys.

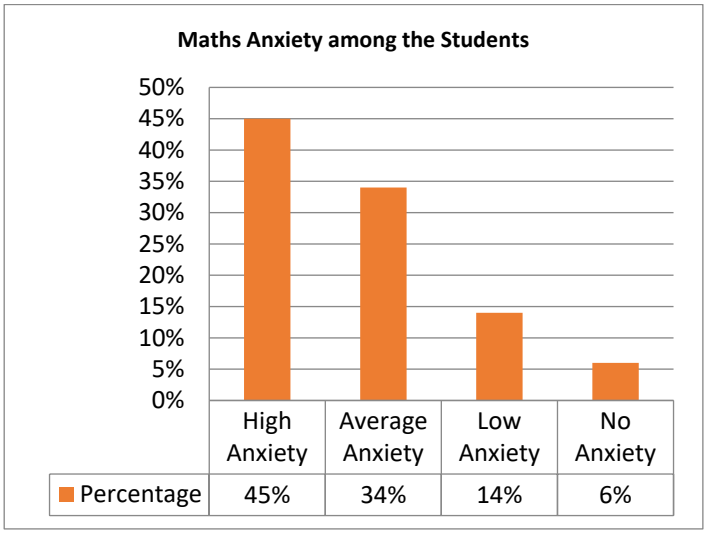

Fig. 1.1: Mathematics Anxiety Level of 200 students on the Anxiety Scale

The academic stage-wise comparison of Maths anxiety revealed the following details:-

Upper Primary Stage v/s Secondary Stage:- Total sample: 200, Upper Primary Stage: 100 students, and Secondary Stage: 100 students

It was found that only 35 students of the upper primary stage reported having high maths anxiety, which is only 35% of the total sample of students of the upper primary stage. However, 43 students of the secondary stage reported having high maths anxiety, which is 43% of the sample of secondary stage students. Hence, it is concluded that students of the secondary stage experience more anxiety with respect to Maths subject as compared to students at the upper primary stage.

When comparison was done based on the type of school where 100 students were selected from private schools of Delhi and 100 students were from Government schools of Delhi, it was found that private school students reported less anxiety as compared to their counterparts. 31% of students of private schools reported anxiety in maths whereas 63% of students of government schools reported maths anxiety. Hence, it was concluded that students of government schools experience more anxiety with respect to Maths subject as compared to students of private schools of Delhi. Figure 1.2 depicts the combined comparison through graphical presentation.

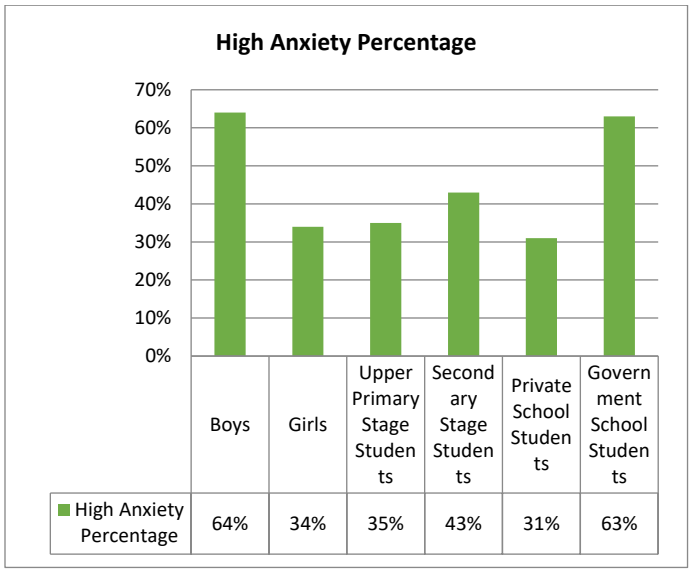

Fig. 1.2
Comparative Analysis: Representing High Anxiety of Students

Analysis of Interview Schedule: 50 students with high Mathematics anxiety were selected for the interview. Content analysis was done on the data collected through interviews. On analyzing, it was found that there were the following reasons behind mathematics anxiety among the students which was presented here in two major categories:-

a) Personal reasons:

- *Rote Learning Behaviouristic Approach*: It was reported by half of the sample that their teachers expect the students to memorize the formulae and rote learn the theorems and concepts of Mathematics.
- *The teacher-Student relationship, Imposed Authority*:- 3/4th of the sample acknowledged that the teacher-student relationship is one of the most important pillars in creating interest and removing fear in the classroom. Most of the students agreed that an environment of imposed authority by the Maths teachers was felt in the classrooms. During the interview, one of the students commented that:-

"Even if I know the answer, I feel afraid when I am called on to blackboard to solve a question in my Maths class and also I feel happy when my Maths teacher is absent on any given day"

- *Abstract nature of the subject*: 1/4th of the sample stated that they find maths abstract and it is difficult for them to understand it. It was revealed during the interaction that most of the teachers still teach through the chalk and talk

method which is considered as a traditional approach and is not as successful as other teaching strategies are in school education.

- *Poor Basic Knowledge*: It was found in the interview that approximately 4/5th of the sample accepted that their basic knowledge of maths is not good due to which they feel afraid in attending the class. It was also accepted by the students that they find difficulty in even simple multiplication and division questions. One of the students of the secondary stage said that:-

  "I become careful and more conscious when someone watches me when I do even simple calculations. Even the easiest calculations, puts me under pressure."

  "I dream about failing in my Mathematics exam, I try to find excuses and feel like taking a leave on my Maths Exam day."

- *Lack of Humour*: 1/5th of the sample indicated the uninteresting aspect of Mathematics and acknowledged that the element of humor is always missing in the teaching of mathematics in class which makes this subject quite serious and boring.
- *Difficulty in accommodating different learning style*s: 1/10th of the sample commented on the style of learning. Few of the students mentioned that they like the visual and auditory style of learning whereas mathematics requires more practice or doing (kinaesthetic).

b) Psycho-social reasons:-

- *Fearful environment*: 4/5th of the students acknowledged that the mathematics teacher appears to be quite strict due to which the opportunity of expressing the doubts and concerns reduces. The fearful classroom environment hinders in concept understanding of the subject.
- *"At times I feel scared of Maths and avoid picking up a Maths book for practice. The thought of completing the home assignment, stresses me a lot and I try to postpone it in the best possible manner."*
- *Undesirable Classroom experiences*: 1/3rd of the sample stated that few undesirable classroom experiences which occurred in their past never let their interest be created in this subject.
- *"I wonder why my Maths teacher gives us Maths surprise test and most of the students of our class get poor marks. When we are to get low marks then why do teachers take the test, they are already aware that we will score badly."*
- *Risk of public harassment (Association of mathematics with high IQ) and Fear due to the excessive glorification of the subject:* It was revealed in the statements of half of the students who were interviewed that most of the times mathematics and science are excessively glorified by the elders which develop an apprehension towards performing good in mathematics. The researcher noticed that this glorification had also created a negative attitude in the minds of the secondary stage students towards the subject.
- *"Because everyone associates Maths subject with high intelligence level, I don't like this subject at all. If I don't perform well in maths, I am considered to be an average or below-average student in the class. Subjects like Maths and Science create discrimination in the class."*
- *"While solving the Maths question, I feel as if I am making many mistakes in solving it and would not reach the final result."*
- *Peer Pressure: 1/3rd of the* students stated that they feel peer pressure in this subject. They also want to perform better in maths like their friends but they are not able to make it up because they feel themselves be under stress due to competition.
- *High Scoring Subject*: It was found in the statements of 3/5th of the students that Maths is considered as a high scoring subject and this notion creates tension among the students. Such a situation built up a kind of pressure among the students.

6. CONCLUSION

Knowledge of Mathematics arouses curiosity, fosters creativity, and prepares the learner for the life beyond school. Day-to-day transactions, real-life situations, and various careers require skills and proficiency in a wide range of basic mathematical applications. Mathematics offers children a powerful way of communication. However, it is concluded in this study that the anxiety with respect to Mathematics among the students is still found to be common and quite high. The study revealed that Mathematics anxiety was higher in the students of the secondary stage as compared to students of the upper primary stage. Gender-wise analysis revealed that the female students had high anxiety levels as compared to the male counterparts. The school-wise analysis revealed that the students of government schools had high anxiety levels as compared to the students of private schools. Therefore, the curricular experiences must be provided in a sequentially arranged, cognitively, and chronologically optimized manner so that the anxiety is managed at the right time.

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