



ORIGINAL RESEARCH PAPER

Mathematics

IDENTIFICATION OF THE CAUSES OF ANXIETY IN MATHEMATICS AMONG THE STUDENTS OF HIGHER SECONDARY LEVEL

KEY WORDS: Mathematics, Anxiety, Achievement, Higher secondary level students.

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ABSTRACT

Anxiety in mathematics is an important issue in educational system, which impacts to the learners tremendously on their scholastic performance, skills and even the career choice. It has long been associated with our studies. The aim of this paper is to identify the areas of anxiety concern in mathematics of the students of higher secondary level and find out the reasons behind it. To carry out this study, 40 teachers and 1128 students from twelve higher secondary schools of West Bengal (India) were selected by adopting proper method of sampling to identify the causes of anxiety in Mathematics. Data were analyzed by appropriate methods. It was observed from the findings that various types of causes of anxiety were found. Moreover it was found that almost half of the causes were moderately pertinent, more than one fourth of the causes were low pertinent and little less than one fourth causes were highly pertinent. The findings also lead to indicate that anxiety and phobia significantly affect the achievement of students in mathematics. There is a negative as well as significant relationship between anxiety and achievement of students in mathematics.

INTRODUCTION

Our social progress, activities, daily living, life style and all amenities depend on modern scientific and technological development. Mathematics is a fundamental part of human thought and logic, which attempts to understand the world and ourselves. Mathematics (considered as the mother of all sciences) is essential for any branch of science and technology and it is the means for sharpening the individual's reasoning, logical judgement, thinking and developing personality. Mathematical skills are essential to any person's success in technological field as well as non-technical field like Business, Social Science, Behavioral Science, the Humanities and the Arts. Therefore, mathematics teaching-learning process requires a lot of space to make a man mathematically educated and technologically advanced society.

Despite the enormous importance of mathematics education, many students are too much anxious about this subject. The trend in low scholastic achievement, rate of drop outs, failure in the examination, avoidance of mathematics and many other causes are the areas of concern in connection with mathematics education in higher secondary schools. Stuart¹ (2000) observed that the ability to do mathematics ninety percent is mental attitude or confidence building and only ten percent is mathematics skill. Therefore, a pertinent question comes, why the students differ in their performance in spite of similar educational facilities, teaching methodologies and environment ? it is found that high achievers are not necessarily more intelligent than low achievers. There are many causes behind the poor achievements in mathematics, of which anxiety in mathematics plays a vital role behind this and also there are many factors which are interlinked with the anxiety in mathematics.

Anxiety and Phobia in mathematics is very pertinent area in the field of educational research, especially in mathematics. According to the Dictionary of Psychology, anxiety is defined as painful uneasiness of mind concerning impending and anticipated ill. According to Seligman, Walker & Rosenhan² (2001) anxiety is complex combination of the feelings of fear, apprehension and worry often accompanied by physical sensation such as palpitations, chest pain and/or shortness of breath. Kumar & Karimi³ (2010) found that the anxiety in mathematics has negative effect with mathematics performance. Anxiety creates nervousness and inability to concentrate as found by Tobias⁴ (1993). According to Mathison⁵ (1977) anxiety in mathematics is an irrational fear of mathematics that can range from a simple discomfort

associated with numerical operations to a total avoidance of mathematics and mathematics classes. According to Burns⁶ (1998) anxiety in mathematics can results in fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing and loss of ability to concentrate. So the researcher's attempt to identify the causes of anxiety in mathematics among the students of higher secondary level.

Objectives of The Study

The following objectives were laid down for the study :

1. To find out the causes of anxiety and in mathematics among students of higher secondary schools.
2. To find out the intensity of identified causes of anxiety and phobia in mathematics among students of higher secondary schools.
3. To find out the significant relation between the anxiety and the achievement of students.

Hypothesis

There is no significant relationship between anxiety and achievement of students of H.S level in mathematics.

Population & Sample

All the students, who have opted mathematics as a core subject at the H.S. level consisted of the population of the study. Moreover the teachers of mathematics at the H.S level are also population of study.

As sample 368 students of class XI & XII and 40 mathematics teachers were selected.

Tools of Study

1. A structured proforma: To identify the causes of anxiety in mathematics
 - i. For the students and
 - ii. For the teachers
2. Anxiety in mathematics scale: To estimate the level of anxiety among the students
3. The students achievement test in mathematics (teacher made test) .

Methodology

This study was conducted by adopting analytical survey research. In this connection necessary tools were standardized and administer on the target sample. Not only the students of H.S level, but also the teacher of mathematics was included in the sample specially to identify the causes of anxiety in mathematics among the students of H.S. level and the intensity of identified causes. In addition to that anxiety

scale was administered on the students to estimate the level of anxiety in mathematics. Academic achievements in mathematics were collected from school records. Data were collected and systematized to verify the objectives and hypothesis.

Analysis of Data

1. Analysis of Data pertaining to objective-1

[Obj-1: To find out the cause of anxiety and phobia in mathematics among the students of higher secondary schools]

Mathematics is a vital subject in higher secondary level for the students in respective of science and humanities streams. But it has been found from the results of higher secondary school that a large number of students are unable to achieve qualifying marks in mathematics. Several researches have been conducted to identify the causes behind poor achievement in mathematics. It is presumed that anxiety and phobia in mathematics may be responsible for poor achievement in the subject. With a view to this proposition causes of anxiety and phobia in mathematics were identified in this study. Those causes were identified from the opinion of the teachers and students of higher secondary schools.

1.1. Categorization Of Identified Causes Of Anxiety In Mathematics :

On the basis of the experts' judgement forty causes relevant to anxiety & phobia in mathematics were finally selected and categorized. On the basis of the nature of causes those were categorized into seven areas:

- I. Causes related to nature of students:
 - Low numerical intelligence of the students.
 - Lack of practice of mathematical sums.
 - Student's attitude towards mathematics.
 - Student's low self-efficacy about mathematical ability.
 - Phobic nature of the students.
 - Rote memorization of the theories and concepts in mathematics.
- ii. Causes related to behaviour of parents, family and peer groups:
 - Parent's low efficiency in mathematics.
 - Parent's anxiety in mathematics.
 - Parent's negative attitude towards mathematics.
 - Unhealthy family and social environment.
 - High expectation of parents from their children.
 - Negative comments from peer groups about the ability of the individual.
 - Negative reinforcement as exhibit by the elders.
- iii. Causes related to examination and evaluation:
 - Time bound programme of examination and evaluation.
 - Fear of failure in the examination.
 - Unplanned cumulative assessment programme in mathematics.
 - Marking system of the question and answer in mathematics.
- iv. Causes related to learning gaps:
 - Gap of knowledge in mathematics in one class to next higher class.
 - Knowledge gaps at primary level.
 - Lack of systematization of thought to solve mathematics problem.
- v. Causes related to teacher and classroom instruction:
 - Lack of individual instruction.
 - Absence of teaching aid & modern technology during class room instruction.
 - Negative reinforcement by the teacher.
 - Lack of responsibility of the teacher.
 - Rigidity in using teaching methods.
 - Lack of patience of the teachers.
 - Lack of creating interest by the mathematics teacher.
 - Lack of confidence and ability of the teacher.
 - Teachers' inability to relate mathematics with real life.
 - Un-matching between teaching method and students'

learning style.

- Improper teaching mode.
- Inhibition in the process of memorization.
- Lack of logical thinking ability of the students.
- Lack of matching of curriculum content with students' mental maturity.
- vi. Causes related to general perception:
 - Mathematics requires high intelligence.
 - Mathematics is not an attractive and interesting subject.
 - Mathematics is considered as hard and complicated subject.
- vii. Causes related to the nature of the subject:
 - Abstract nature of the subject.
 - Symbolic operation in mathematics.
 - Lack of understanding of the language of the problem.

2. Analysis of Data Pertaining to Objective-2

[Obj-2: To find out the intensity of different causes of anxiety and phobia in mathematics]

The Identified causes were categorized according to different nature and also to estimate the degree of intensity. In this context five point rating scale was used. Accordingly, intensity of each cause was calculated by the formula:

$$\text{Intensity of the cause (i)} = \frac{[f(A) \times 5 + f(B) \times 4 + f(C) \times 3 + f(D) \times 2 + f(E) \times 1]}{\text{total number of frequency}}$$

Where, → frequency of the candidate chosen the opinion A
 → frequency of the candidate chosen the opinion B
 → frequency of the candidate chosen the opinion C
 → frequency of the candidate chosen the opinion D
 → frequency of the candidate chosen the opinion E.

Rating Score:

Option	Score
Option- A	5
Option- B	4
Option- C	3
Option- D	2
Option- E	1

Hence the range of intensity of the causes lies between 5 & 1. Finally, each cause was categorized based on the intensity.

2.1. Intensity of Causes according to Students' opinion :

Table- 1 Showing the number & percentage of causes in different categories according to students' opinion

Nature of Causes	No. of causes according to nature	Percentage (%) of causes according to nature
Extremely Pertinent	0	0
Highly Pertinent	9	22.5
Moderately Pertinent	19	47.5
Low Pertinent	12	30
Not at all Pertinent	0	0
Total	40	100

Interpretation: Above table indicates that according to students' opinion there was no extremely patient cause of anxiety in mathematics. Most of the causes (47.5%) are moderately pertinent.

2.2. Categorization of causes on the basis of intensity range:

Table- 2 Showing highly pertinent causes – (intensity range: 3.5 to 4.5)

Rank of the cause according to the intensity	Highly pertinent causes
1	Marking system of the question-answer in mathematics
2	Lack of practice of mathematical sums
3	Gap of knowledge in mathematics from one class to next higher class

4	Lack of logical thinking ability of the students
5	Low self-efficacy about mathematical ability
6	Lack of understanding of the language of the problem
7	Time bound programme of examination and evaluation
8	Low numerical intelligence of the students
9	Absence of teaching aid & modern technology

Table- 3 Showing moderately pertinent causes – (intensity range: 2.5 to 3.5)

Rank of the cause according to the intensity	Moderately pertinent causes
10	Rote memorization of the theories and concepts in mathematics
11	Fear of failure in the examination
12	Unplanned cumulative assessment programme in mathematics
13	High expectation of the parents from the children
14	Mathematics is considered as hard and complicated subject
15	Unmatching between teaching method and students' learning style
16	Lack of systematization of thought to solve mathematics problems
17	Improper teaching mode
18	Students' attitude towards mathematics
19	Mathematics is not an attractive and interesting subject
20	Lack of matching of curriculum content with students' mental maturity
21	General perception (mathematics require high intelligence)
22	Lack of creating interest by the mathematics teacher
23	Teachers' inability to relate mathematics with real life
24	Inhibition in the process of memorization
25	Negative reinforcement by the teacher
26	Lack of individual instruction
27	Knowledge gap at primary level
28	Lack of responsibility of the teachers

Table- 4 Showing low pertinent causes – (intensity range: 1.5 to 2.5)

Rank of the cause according to the intensity	Low pertinent causes
29	Lack of confidence and ability of the teachers
30	Phobic nature of the students
31	Due to negative reinforcement as exhibited by the elders
32	Symbolic operation in mathematics
33	Abstract nature of the subject
34	Lack of patience of the teachers
35	Rigidity in using teaching methods
36	Negative comments from peers' group about the ability of the individuals
37	Unhealthy family and social environment
38	Parents' negative attitude towards mathematics
39	Parents' anxiety in mathematics
40	Parents' low efficiency in mathematics

Interpretation: Identified causes were categorized into extremely pertinent, highly pertinent, moderately pertinent and low pertinent on the basis of the intensity of the causes. A brief analysis of high pertinent causes has been made :

- Marking system for the evaluation of the answer script - Due to the lack of partial marking system for partially correct answer in mathematics items like other subjects, many students failed to score a minimum marks. This system leads the anxiety of students in mathematics.
- Lack of practice of mathematical sums - A sufficient practice of mathematical sum is very essential for the development of the confidence; otherwise it may decrease the self-efficacy which again leads the anxiety.
- Gap of knowledge from one class to another - Concepts of mathematics are interlinked from earlier stage to the next higher stage. Every concept is related to another concept based on previous learning. There is a strong chain of hierarchy in mathematics learning. So, any conceptual gap at any stage may create trouble in the latter stage in cumulative way.
- Lack of logical thinking ability of the students - Mathematics requires reasoning and logical thinking of the students. Scope of rote memorization is very limited. If there is any gap of understanding of the mathematical knowledge, it makes trouble to understand the latter concepts for which anxiety-develops.
- Low self-efficacy about mathematical ability - Self-efficacy plays a vital role in every sphere of our life. Students with high confidence always do better in mathematics than the students having low confidence.
- Time bound programme of examination - Rigidity of time limit in the examination also cause anxiety. Students thought that they can do better if there is sufficient time to do the sums. Due to limited time, they make hurry to solve the sums, as a result they make some mistakes and unable to get expected marks. This situation makes them nervous and ultimately creates anxiety in mathematics.
- Poor Intelligence - Poor intelligence is one of the causes of mathematics anxiety and it has some effect in performance. Low intelligent students believe that their poor performance is the cause of low intelligence. Such pre-supposition leads to their anxiety, although Students' poor performance may be one of the causes of low mathematical intelligence according to Gardner theory of multiple intelligence.
- Absence of teaching aid & modern technology- Concrete material become helpful to make the abstract nature of the subject to a meaningful one. Also use of modern technology may motivate the child in the subject. Lack of motivation may result in poor performance that again leads to anxiety.
- Rote memorization of the theories and concepts in mathematics - Scope of rote memorization in the subject and concepts without clear understanding. Knowledge based on rote memorization does not work properly in various situations, that weakens their confidence ultimately leads to anxiety.
- Fear of failure in the examination - It is found to be an important cause. There are some students who can solve a problem rightly in a normal situation but failed to solve the same problem in the exam situation. That means examination situation may trigger students thought process, results poor performances, ultimately raise anxiety.

Analysis of Data pertaining to the Hypothesis (H₀)

[There is no significant relationship between anxiety and the achievement of students in mathematics]

Table- 5 Showing the distribution of anxious and non-anxious students

	Total students	Total anxious students	Total non-anxious students
N	368	180	188

Average anxiety score	56.60	69.45	44.30
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Interpretation: Results indicate a large number of the students of secondary schools are having anxiety and phobia in mathematics. As per scale score below 61% accepted as a score of non-anxious.

Table- 6 Showing the distribution of students based on anxiety category

Score range of anxiety	Category	Number of students	Percentage of students
Above 90	Extremely anxious	0	0
81 – 90	Highly anxious	16	4.35
71 – 80	Moderately anxious	44	11.96
61 – 70	Low anxious	120	32.61
Below 61	Non-anxious	188	51.09

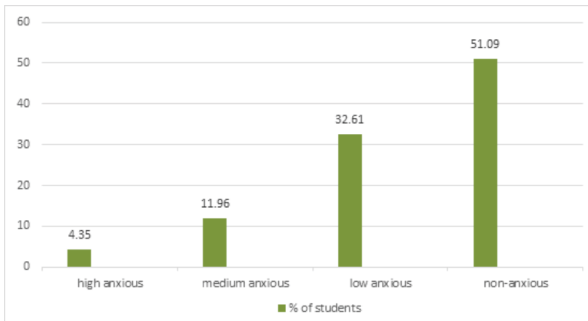


Figure 1: on Table- 6

Interpretation: Table showing the overall distribution of students with reference to their anxiety and phobia in mathematics. Figure 1 also indicates the trends of the distribution on the basis of anxiety and phobia in mathematics of the students.

Table- 7 Showing the coefficient of correlation between anxiety & achievement score of students (Before instruction through strategies in mathematics)

Category	Trait	N	Mean	S.D.	r	t _r	Level of significance
Overall sample	Anxiety	368	56.60	10.41	-0.8	42.85	0.01
	Achievement		51.57	12.85			
Extremely anxious	Anxiety	0	X	x	X	X	X
	Achievement		X	x			
Highly anxious	Anxiety	16	83.42	5.32	-0.7	7.30	0.01
	Achievement		18.75	6.44			
Medium anxious	Anxiety	44	74.50	8.59	-0.6	6.35	0.01
	Achievement		33.70	10.23			
Low anxious	Anxiety	120	66.20	9.77	-0.1	1.87	NS
	Achievement		45.40	10.18			
Non-anxious	Anxiety	188	44.30	10.22	-0.7	7.87	0.01
	Achievement		62.50	11.84			

Interpretation: Values of the Coefficient of Correlation indicate that there is a significant negative relationship between anxiety and achievement of students in mathematics except low anxious category. Hence, anxiety and achievement of students in mathematics are directly related to each other. Therefore, relationship between anxiety and achievement of non-anxious group was also found negative.

FINDINGS AND CONCLUSIONS

A large number of students of higher secondary schools are having anxiety and phobia in mathematics. After analyzing the opinion of the students 40 causes were identified, from which major causes are - lack of partial marking for partially

correct answer, lack of practice of mathematical sums, gap of knowledge from one class to another, lack of logical thinking ability of the students, low self-efficacy about mathematical ability, rigidity of time limit in the examination, poor intelligence, absence of teaching aid & modern technology, limited scope of rote memorization in the subject, fear of failure in the examination, lack of systematization of thought to solve mathematical problems, unmatching between teaching method and student's learning style method, student's attitude towards mathematics.

It has been observed that all the causes were pertinent but the results of weightages indicate that 22.5% of causes were highly pertinent, 47.5% were moderately pertinent for developing anxiety in mathematics whereas 30% causes were low pertinent.

The study was also conducted to estimate the association between anxiety and achievement of students in mathematics. Findings of the study reveals that both the variables were inversely and significantly associated. Results also indicate that due to the increase of anxiety, achievements of students in mathematics have decreased.

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