Stages of Mathematics Anxiety in Primary Pupils of Bangladesh: Investigating Influence of Leading Causative Factors

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ABSTRACT

The presence and impact of mathematics anxiety (MA) among school children cannot be ignored. The preliminary purpose of this study was to assess the level of MA among primary pupils in Bangladesh. Additionally, four causative factors of math anxiety - which have already been identified as dominant in global context- were also investigated in the study to explore what causes MA among this age-group in Bangladesh. The current study involved 120 students from Class 3, 4 and 5 who were randomly selected from two primary schools in Dhaka. The study also purposively involved 15 math teachers of these respondents and also 20 parents - whose children were assessed as math anxious in this study. The findings of the study indicate that a significant number of primary pupils in each of these grades are at moderate stage of math anxiety. In addition to this, students suffering at high level of math anxiety gradually increases in higher grades. Teaching approach is identified as the key factor that causes fear of mathematics which is then followed by students' difficulties in understanding mathematics textbook.

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Introduction

Due to various reasons, some students have fear of manipulation of numbers and also of solving mathematical problems (Tobias, 1993). Dislike and fear of mathematics, in turn, can cause pupils to develop mathematics anxiety (MA) which is an intense negative reaction to this subject (Sherard, 1981). Some students may experience MA as early as third or fourth grade (Jackson & Leffingwell, 1999). Since elementary school children are in critical stage for development of attitudes and emotional reactions towards mathematics (McLeod, 1993), an extent attention in exploring the causative factors of mathematics anxiety at this stage is much needed. In particular, measurement of MA in early school-age children is important as it allows screening of the first symptoms of negative emotions related to mathematics and prevention of development of math anxiety. The current study thus explores and assesses the stage of MA in primary pupils of Bangladesh, in particular, among the students of Class 3, 4 & 5 and further investigates the influence of some research-based causative factors of MA on this particular age-group. Since the primary mathematics curriculum of Bangladesh, in its previous revision, expected children to develop 'eagerness' to learn mathematics (NCTB Primary Curriculum, 2011) the issue of MA needs to be addressed and handled properly in inducing 'eagerness' in all children rather than fear.

Problem Statement

Research into mathematics anxiety has tended to focus on adults and older children and there is a lack of research into the phenomenon in primary school children (Ashcraft & Moore, 2009). Unfortunately, infrequent number of research have taken place in this area in Bangladesh in primary education system which is large, providing education to over 16 million pupils (APSC, 2019). An enduring challenge remains for Bangladesh as among every 100 children who enter into primary education - merely 82 are likely to complete this level in Grade 5 (APSC, 2019). Though school drop-out rate is remarkably high in Bangladesh (Choudhary, 2015) and prevailing in every grade, the rate is higher in Grade 2, 3 and 4 (BANBEIS, 2015). The standard of education at primary level in Bangladesh is furthermore challenged by the poor mathematical performance of the remaining pupils who are present at schools. According to the National Student Assessment 2015, 59% of Grade 3 students did not achieve the grade-relevant competencies in mathematics whereas the corresponding figures for Grade 5 were 90 percent (DPE, 2015). Since poor mathematical performance might be perpetuated by mathematical anxiety (Witt, 2012) the current study may thus provide some insights into this issue by assessing the stage of math anxiety in primary pupils of Bangladesh and exploring the influence of several leading causative factors of math anxiety on these pupils. This study further investigates the mathematical performance of math anxious students in understanding the issue more deeply.

Research Objective and Research Questions

The preliminary objective of this study is to assess the stage of math anxiety in students of Class 3, 4 and 5 of Bangladesh. The objectives also include investigating the influence of leading causative factors of mathematics anxiety and also the relationship between mathematical performance and mathematics anxiety amongst the elementary school age level population in Bangladesh.

To achieve the objectives of this study the following specific questions have been addressed:
1. What is the stage of mathematics anxiety in primary students of Bangladesh?
2. How do the leading causative factors affect in creating mathematics anxiety in primary pupils of Bangladesh?
3. How mathematics anxiety amongst the primary students in Bangladesh is related to mathematical performance?

Literature Review

The paradigm of 'mathematics anxiety' has received significant attention among researchers and mathematics educators in recent years. In this study a number of research articles were reviewed to understand the issue of mathematics anxiety deeply and also to conduct the current study in context of Bangladesh. These articles have helped to shape the concept of the research topic, some of which have been outlined here.

Mathematics Anxiety

Mathematics anxiety/math anxiety is considered as a fear or phobia and refers to feeling of tension or worries (Whyte & Anthony, 2012) which produces a negative response specific to the learning, or doing, of mathematical activities that interferes with performance and also in daily life and school settings (Richardson & Suinn, 1972).

Signs of Math Anxiety

Research (Freiberg, 2005) identifies that math anxiety can affect individuals in varying ways, inducing a cognitive, affective, or physical reaction. A cognitive reaction may involve 'blanking out' and avoidance; an affective reaction may be characterized by distrust of ability, fear of looking stupid and loss of self-esteem; and a physical reaction may be evidenced by perspiring, a boost in one's heart rate, tenseness or nausea.

Math Anxiety and Performance Casualty

Mathematics anxiety has consistently been found to have an inverse relation with mathematical performance, with correlations estimated for children across the middle and high school grades (Hembree, 1990). A higher level of math anxiety is related to lower performance in mathematical tasks (Carey, Hill, Devine, & Szűcs, 2017; Dowker, 2019). Many studies confirm a decrease in mathematical achievement with an increase in math anxiety (Ramirez et al., 2013; Wu et al., 2012; Vukovic et al., 2013). The negative impacts of mathematics anxiety have far reaching consequences compared to their less anxious peers. Mathematically anxious students enjoy mathematics less, have lower perceptions of their mathematical

abilities, and do not see the value of mathematics in everyday life (Ashcraft & Moore, 2009; Hembree, 1990). Mathematically anxious students participate less in mathematics classes in middle school and steer away from mathematical majors (Hembree, 1990.). These patterns are particularly troubling given that mathematical proficiency is becoming increasingly important for full economic opportunity and meaningful participation in society (Moses & Cobb, 2001).

Leading Causative Factors of Math Anxiety
Chiara, Angela & Arthur (2013) have mentioned that "so far, research has focused mainly on the consequences of mathematics anxiety - however, its antecedents remain largely unexplored" (p. 28). While poor mathematical performance might be perpetuated by mathematical anxiety (Witt, 2012), research have identified some other factors that contribute strongly to this anxiety among which the following four leading causative factors are investigated in the current study.

(a) Parents' negative predispositions towards mathematics
Environmental causes for early math anxiety can include negative experiences with parents or teachers who might affect children by their negative attitudes and beliefs towards mathematics (Bekdemir, 2010). Educators (Furner & Duffy, 2002) believe that parents who are afraid of mathematics can pass that math anxiety on to their children by modeling behaviors of their own discomfort with the subject. It was also identified (Mohr-Schroeder et al., 2017) that parents' mathematics attitude significantly predicts students' attitudes towards mathematics. In a study (Eccles & Jacobs, 1986), researchers found that when mothers told their daughters they were not good at math in school, their daughter's achievement declined almost immediately.

(b) Teaching approach of "explain-practice-memorize"
Another major source of math anxiety is the teaching approach of "explain-practice-memorize" (Steele & Alfred, 1998, p: 18). Research has also identified that several common teaching techniques cause MA, such as assigning the same work for everyone, teaching the textbook problem by problem, and insisting on only one correct way to complete a problem (Oberlin, 1982).

(c) Gender-biased math-expectancy
Research indicates that the social stereotype that men are more skilled in mathematics than women is one that is very widely held (Nosek et al. 2009) and suggesting that girls in many countries can fall prey to gender stereotypes about who is skilled in mathematics. It is generally found that females report a higher level of math anxiety than males (Dowker, 2019). Gender biasness towards male when the false idea is promoted that female cannot perform well in mathematics as males is another causative factor of MA (Jackson & Leffingwell, 1999).

(d) Difficulties in understanding mathematics textbook
An extensive study (Khan & Samadder, 2010) explored the reasons of dropout of students from BRAC Primary Schools (BPS) in Bangladesh. Students' disinterest in education and difficulties in understanding textbooks were found as dominating reasons induced to leave BPS.

Some students did not attend school regularly as they found mathematics and English difficult to follow. Moreover, this study revealed that the difficulties in following textbook started particularly when the (dropped out) students were promoted to Grade 3.

Measuring Math Anxiety in Children

The interest in assessing math anxiety in younger children has only emerged recently (Primi et al., 2020). One of the problems which contributes to the difficulty of conducting research into MA in young children relates to the question of how MA should be measured in this age group (Cipora et al., 2019). Among the existing measures of MA, Mathematical Anxiety Rating Scale (MARS) was the first scale developed to exclusively investigate MA (Richardson and Suinn, 1972).

CMAQ-R

The Child Math Anxiety Questionnaire (CMAQ-R; Ramirez et al., 2013) has been developed from the already existing tool, the MARS (Richardson and Suinn, 1972). As scales for early elementary school students must be short, otherwise children get fatigued (Primi et al., 2020), CMAQ-R is the shortest scale with only eight items.and is developed for young children. The questions refer to anxiety elicited by specific math problems, e.g., "How would you feel if you were given this problem? There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?".

"Sliding Smile Scale"

"Sliding Smile Scale" - a pictorial scale with smiley and sad faces is preferably used as a rating scale to measure the level of anxiety elicited by each situation described by the items of the CMAQ-R. This response scale identifies a child's response and suits the target age group instead of using a Likert scale with numbers (Wu et al., 2012). Children have to respond by pointing at the appropriate 'face' from 'not nervous' to 'extreme nervous'. The face on the leftmost side indicates that the child is not nervous at all, whilst the face on the rightmost side indicates that the child feel extreme (very, very) nervous. High scores on the scale indicate high math anxiety.

MSEAQ

Mathematics self-efficacy (MSE) is defined as an individual's beliefs or perceptions with respect to his or her abilities in mathematics (Bandura, 1997). While CMAQ-R is designed for early school-age children, Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) developed by May (2009) is suggested and used by Riboroso et al. (2018) for students in senior grades of elementary school to onwards - rearranging the items of MSEAQ as appropriate. MSEAQ Self-Efficacy Anxiety items ask children how nervous they would feel during various math-related situations. Responses are collected using a 5-point Likert scale ranging from 1 (Never) to 5 (Usually).

Methodology
Nature of the Study

The study is explorative and descriptive in nature. In an explorative study the key emphasis is on gaining ideas and insights whereas in a descriptive research design the major emphasis is on determining the frequency with which something occurs or the extent to which two variables co-vary (Mutodi, P., & Ngirande, H., 2014). The two approaches seem to blend well in the current study as it begins with a precise issue (mathematics anxiety) and sought to illuminate basic facts to form a general picture of learners' experience.

Study Area

The study was basically confined to Dhaka, capital city of Bangladesh. Two different primary schools were selected purposively on the categories of government and non-government sector. According to the quality, both sectors made a balance in this study.

Sample and Sampling

Target population of this study was a group of 120 students from Class 3, 4 and 5. While these three grades had 40 students each, among them 20 were from government and 20 were from non-government primary schools. To identify these respondents of the study, random sampling was used. However, after identifying math anxious students (in medium to very high stage) among this group of 120 students, a group of 30 students were finally selected purposively to collect their responses for the study. Among these thirty math anxious students, 10 were from each of Class 3, 4 and 5. A total of 15 mathematics teachers of Class 3, 4 & 5 from the same primary schools were selected purposively. Among these primary school teachers, at least 2 were from each of these three grades from both govt. & non-govt. primary schools. Finally, 20 parents of the target population were selected as the parents of math anxious students and the selection process was purposive.

Research Instruments

As this study dealt with students from Class 3, an 8-item child math-anxiety questionnaire, CMAQ-R developed by Ramirez et al. (2013) for the early school-age group of students were used with "Sliding Smile Scale" (Appendix A). However, for the senior elementary groups of students from Class 4 and Class 5, two separate Mathematics Self-Efficacy and Anxiety Questionnaire, MSEAQ were prepared with 10 and 15 Self-Efficacy Anxiety items chosen correspondingly (Appendix B and Appendix C, respectively). The items chosen for the current study were based on MSEAQ, developed by May (2009) with originally 29 items wherein 14 statements are on self-efficacy and 15 statements on anxiety. Later, structured interviews with math anxious students, teachers and parents were conducted (Appendix D, E and F, respectively). School assessment report of the math anxious student participants was also used as data collection tools.

Data Analysis Techniques

Qualitative data was collected initially and then classified according to the similarities among the data. Thematic analysis was conducted for the qualitative data. Essential coding and categorizing was done in the process of data analysis. Quantitative data was collected and statistically analyzed. This lead to explore the research questions in multiple ways. Finally, a brief discussion was made by the researchers in illuminating the basic facts in creating a general picture of the addressed issue.

Results and Discussions

Math Anxiety Stage

Stages of math anxiety in students were categorized according to norms presented by Riboroso et al. (2018) as shown in Table 1:

Table 1: *Stages of Math Anxiety with Norms*

Very High /Extremely Severe:	4.21-5.00
High / Severe:	3.41-4.20
Medium /Moderate:	2.61-3.40
Low /Mild:	1.81-2.60
Very low /Normal:	1.00-1.80

6.1.1 Stages of MA in Class 3 Students

The stage of math anxiety in this group of students from govt. and non-govt. primary schools is presented in Table 2(A) and Table 2(B) respectively.

Table 2 (A) & (B)
Math Anxiety Stage of Class 3 Students

Table 2(A): *Govt. Primary School*

	Frequency	Percent
Very Low	3	15.0
Low	4	20.0
Medium	11	55.0
High	2	10.0
Total	20	100.0

Table 2(B): **Non-Govt. Primary School**

	Frequency	Percent
Very Low	4	20.0
Low	3	15.0
Medium	10	50.0
High	3	15.0
Total	20	100.0

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Figure 1:

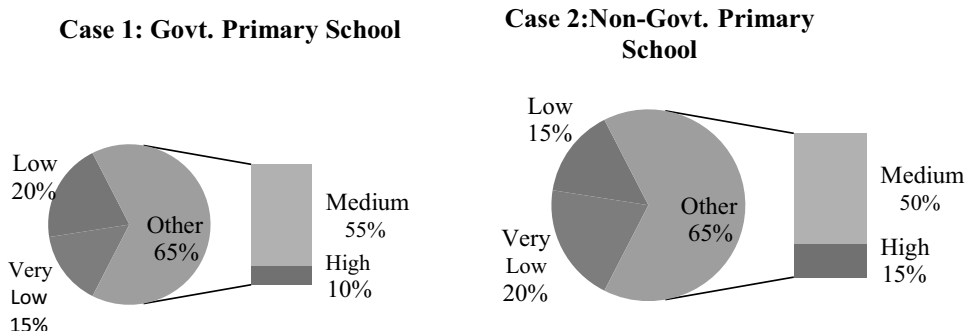*School-wise Math Anxiety Stage in Class 3 Students*

Figure 1 shows that 55% students of Class 3 from the selected govt. primary school are in medium stage of math anxiety whereas 10% of them are in high stage. On the other hand, the figures are 50% and 15% respectively for the non-govt. primary school. In both cases, no student was found in the very high stage of math anxiety by their responses to CMAQ-R. Figure 2 shows the stages of MA in students of Class 3, irrespective of the classification of school (govt. or non-govt.). 65% students of this age group were classified as medium or high math anxious.

Figure 2:

Math Anxiety Stage in Class 3 Students

	Very Low	Low	Medium	High
■ Series1	17.50%	17.50%	52.50%	12.50%
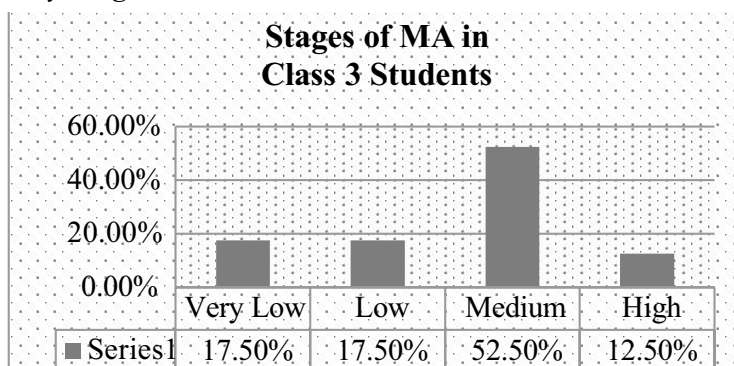
Stages of MA in Grade 4 Students

The stage of math anxiety in students of Class 4 from govt. and non-govt. primary schools is presented in Table 3(A) and Table 3(B) respectively.

Table 3(A) & (B)

Math Anxiety Stage of Class 4 Students

Table 3(A): Govt. Primary School   Table 3(B): Non-Govt. Primary School

	Frequency	Percent		Frequency	Percent
Very Low	2	10.0	Very Low	3	15.0
Low	3	15.0	Low	8	40.0
Medium	9	45.0	Medium	7	35.0
High	5	25.0	High	2	10.0
Very High	1	5.0	Very High	0	0.0
Total	20	100.0	Total	20	100.0

Table 3(A) shows that 45% students of Class 4 from the govt. primary school are at moderate stage of math anxiety while 25% are at severe and 5% are at extremely severe stage. However, in case 2 (for students of non-govt. school), no student was found in the extremely severe stage of MA. In addition, 35% students from this case are in moderate stage of math anxiety and 10% are at severe stage.
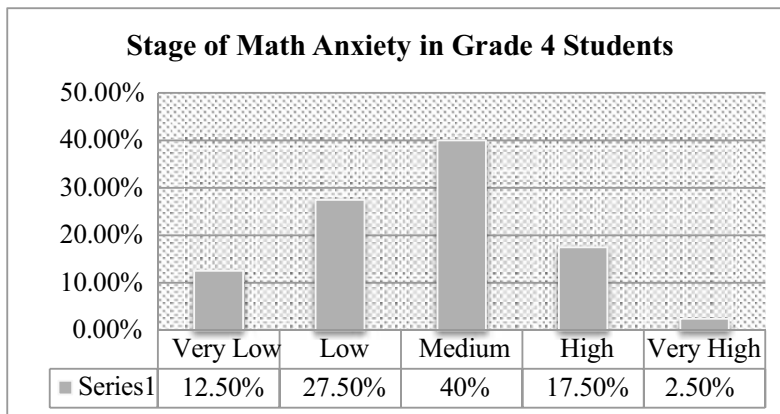
Figure 3:

School-wise Math Anxiety Stage in Class 4 Students
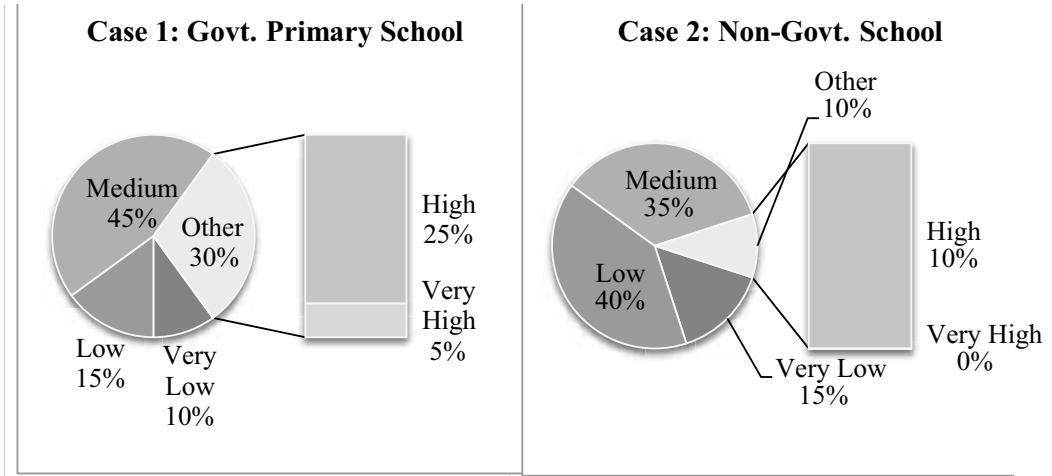
Irrespective of the classification of school (govt. or non-govt.), a significant number of students (60%) of this age group were classified as medium or very high math anxious.

Figure 4:

Math Anxiety Stage in Class 4 Students

Stage of Math Anxiety in Grade 4 Students

	Very Low	Low	Medium	High	Very High
■ Series1	12.50%	27.50%	40%	17.50%	2.50%

Stages of MA in Class 5 Students

The stage of math anxiety in students of Class 5 from govt. and non-govt. primary schools is presented in Table 4(A) and Table 4(B) respectively.

Table 4(A) and Table 4(B)

Math Anxiety Stage of Class 5 Students

Table 4(A): Govt. Primary School

	Frequency	Percent
Very Low	2	10.0
Low	1	5.0
Medium	13	65.0
High	3	15.0
Very High	1	5.0
Total	20	100.0

Table 4(B): Non-Govt. Primary School

	Frequency	Percent
Very Low	2	10.0
Low	2	10.0
Medium	9	45.0
High	6	30.0
Very High	1	5.0
Total	20	100.0

Figure 5:
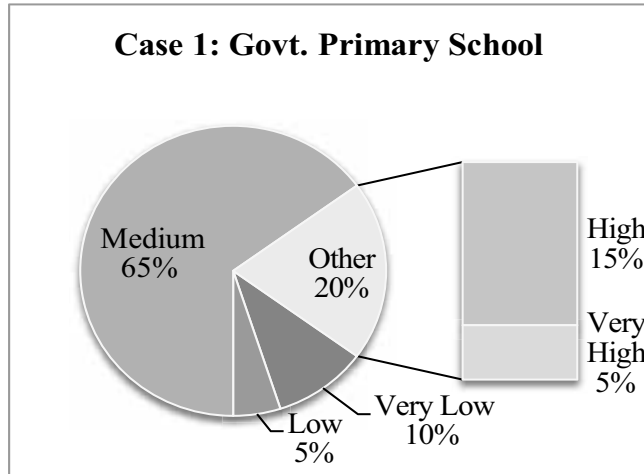*School-wise Math Anxiety Stage in Class 5 Students*

Figure 5 shows that 65% students of Class 5 from the selected govt. primary school are at medium stage of math anxiety whereas 15% of them are at high stage. On the other hand, the figures are reduced to 45% and increased 30% respectively for the non-govt. primary school. In both cases, 5% student are found in very high stage of math anxiety. Figure 6, in particular, shows the stages of MA in students of Class 5, irrespective of the classification of school (govt. or non-govt.). An enormous number of students (82.5%) of this age group are classified as medium to very high math anxious.

Figure 6:
Math Anxiety Stage in Class 5 Students
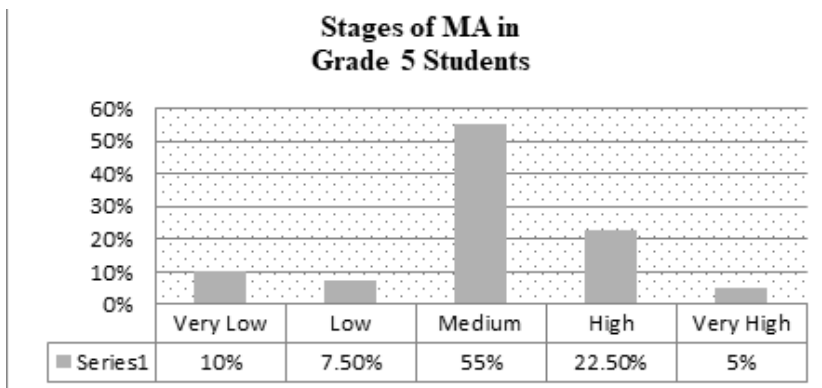
Influence of Leading Causative Factors of Math Anxiety

This section investigates the influence of four leading causative factors of math anxiety on students of Class 3, 4 and 5 which are:

(a) *Parents' negative predispositions towards mathematics*
(b) *Teaching approach*
(c) *Gender-biased math-expectancy*
(d) *Difficulties in understanding mathematics textbook*

Three questionnaires for three different target groups were used attended in the procedure to complete the study for this purpose in this study (Appendix D, E and F). The items as statements in each of these questionnaires were presented in a sequence. The first questionnaire was used for 30 math anxious students from Class 3, 4 and 5 (10 from each Class) with anxiety stage from medium to very high for their responses. The second one was developed for 15 mathematics teachers of this target group of primary students. Finally, the third questionnaire was developed for 20 parents whose child leads to MA at medium, high and very high stage.

A. *Response of Students*

The thirty math anxious students (with anxiety stage from moderate to extremely severe), who were chosen purposively, had given opinions from their own point of view in response to the question 'What do you think is the reason for your low marks/fear in mathematics? The total outcome of the responses is shown in Figure 7 and interpreted afterward.

Figure 7: Students' Response on Causes of their Math Anxiety

Figure 7 represents that a very few (4.17%) students feel that since their parents were not good in mathematics they are also low achiever in math whereas the gender-biased math-expectancy (girls are not good in math) is identified as the reason for fear of mathematics by a significant (8.33%) number of girl students. However, the majority (45.83%) of students identify 'not understanding textbook' as the cause of their fear of mathematics. Almost similar number (41.67%) of students opted for math teachers' teaching approach for their math anxiety.

B. *Response of Teachers*

The fifteen primary math teachers, who were chosen purposively in the current study, had given opinions from their own point of view in responding to the question 'What could be the reason of their (students') Mathematics Anxiety?' The total outcome of the responses is shown in Figure8 and interpreted afterward.

Figure 8:

Teachers' Response on Causes of Students' Math Anxiety
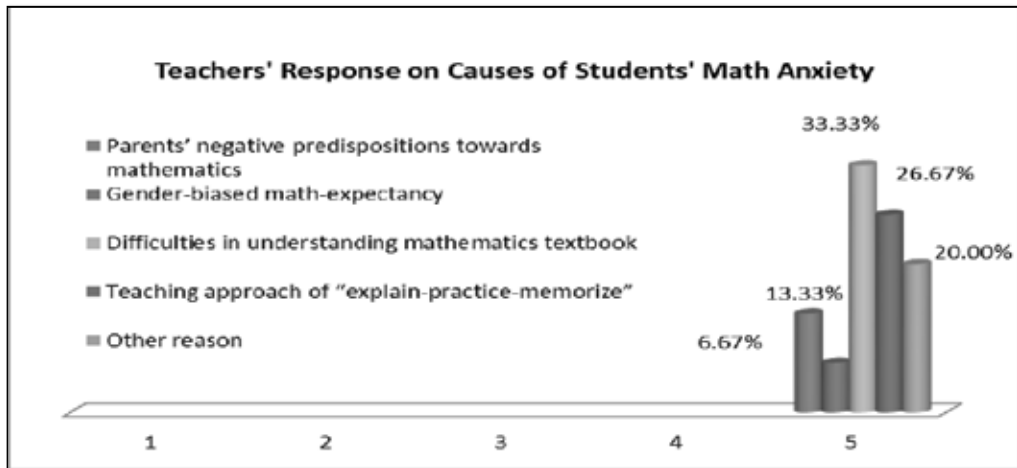
A majority of them (3.33%) view that students usually do not understand their textbook (structure and arrangement of topics, figures, examples and exercises) which contributes to students' MA. 26.67% of math teachers recognize that students cannot understand teaching approach of "explain-practice-memorize" in classroom and that is why fear of math develops in them. Furthermore, few teachers (13.3%) opted for parents negative predisposition towards mathematics as their child's MA. It is significant to note that a very little portion (6.67%) of teachers views that because of students' gender (as a girl) they are afraid of mathematics. However, a significant number (20%) of teachers identify other reasons (rather than these four dominant causative factors) as the cause of MA in their students which includes inattentiveness in math study, preset concept that mathematics is difficult, memorizing mathematical terms/ formula instead of understanding , not practicing more mathematical tasks etc.

Response of Parents

Each of the twenty parents, who were chosen according to the stage of their child's math anxiety level (medium, high or very high), had given their opinions in response to the question 'What do you think is the reason behind your child's fear of mathematics?'. The total outcome of the responses is shown in Figure 9 and interpreted afterward.

Figure 9:

Parents' Response on Causes of their Children's Math Anxiety
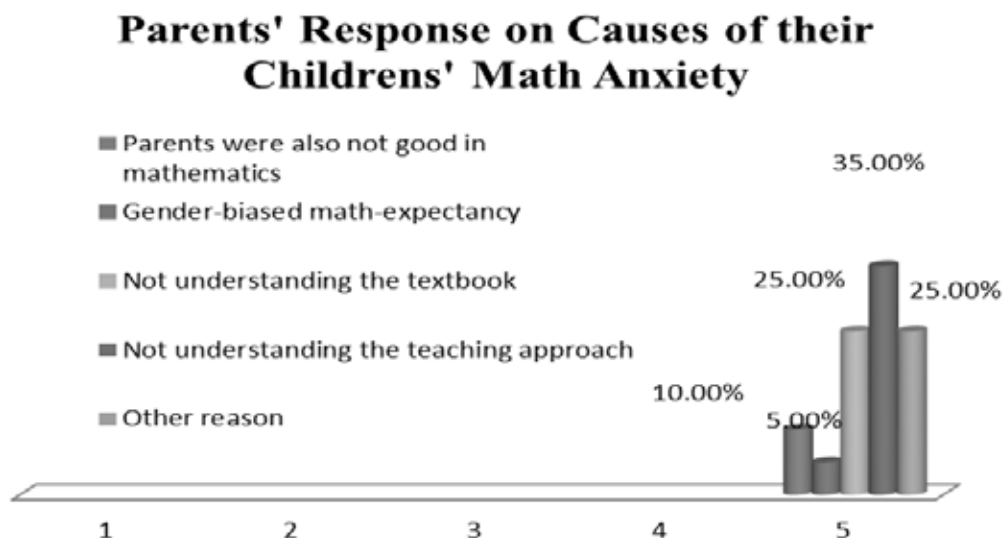

Figure 9 represents that 10% parents view that their child gets fear of math as they were also not good in mathematics. A little portion in parents (5%) thinks that their children grip math anxiety because of being girl. However, 25% of the parents view that their children cannot understand textbook (structure and arrangement of topics, figure, examples and exercises) which causes fear of math. A majority of parents (35%) identified that their children do not understand teaching approach in classroom and that might be the reason for their child's poor performance in mathematics. Additionally, a significant number (25%) of parents identify other reasons (rather than these four dominant causative factors) as the cause of fear of mathematics of their children which includes memorizing mathematical terms/formula instead of understanding, not practicing more mathematical tasks etc.

Mathematical Performance

The mathematical performance of the thirty math anxious students, with anxiety stage from moderate to extremely severe was collected from their score in previous final examination. The scores were categorized in four different categories: Fail (for score below 33), Average (for score within 33 to 60), Good (for score within 60 to 80) and Excellent (for score above

80). The total outcome of the performance of these math anxious students is shown below in Table 5 which shows that the mathematical performance of 66.6% math anxious students is in category of Fail, 27.6% of them are in Average category whereas 6.6% of students performed Good in mathematics. However, it is noteworthy that no math anxious students are in Excellent category according to their math performance.

Table 5:
Mathematical Performance of Math Anxious Students

Mathematical Performance	Frequency	Percent
Fail	20	66.6
Average	8	27.6
Good	2	6.6
Excellent	0	0.0
Total	30	100.0

Conclusion and Recommendation

The findings of the study indicate that a significant number of primary pupils in each of these grades are at medium (or moderate) stage of math anxiety in Bangladesh. Students suffering at high (or severe) level of math anxiety gradually increases in higher grades. The number of students at the stage of very high (or extremely severe) level of math anxiety rises considerably from Class 4 to Class 5. Based on the findings of this study, it is worth noting that majority of teachers, parents as well as students identified teaching approach as the key factor that causes fear of mathematics or poor performance in this subject which is then followed by students' difficulties in understanding mathematics textbook. In addition, parents' negative predisposition towards mathematics and gender-biased math-expectancy also noticeably contributes to math anxiety. Finally, the current study reveals that no math anxious student performed in excellent category in their previous math examination. This study thus suggests that teachers/educators should strive to understand mathematics anxiety and implement teaching-learning strategies and textbook development in a way that can help primary pupils to overcome anxiety at early stage.

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