Bangladeshi rural secondary school children's attitudes towards mathematics: Do attitudes vary by gender, school type or status of higher maths study?

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It is recognized that an increasing number of students are deciding not to study mathematics beyond minimum secondary school requirements and that many more girls than boys make this decision. A set of variables not only affects the amount of effort one is willing to employ to learn mathematics, but also influence the election of additional mathematics courses beyond the basic requirements. This paper reports the results of the analysis of pilot study data gained from a survey using a Bangla translated version of the Fennema-Sherman Mathematics Attitude Scales (FSMAS). The main purpose of the survey was to check the reliability of using Bangla translated version of FSMAS in the rural Bangladeshi context and analyze the preliminary data to observe the pattern of differences in attitudes to mathematics among different groups.

Key words: attitude towards mathematics (ATM); Bangladesh; FSMAS; gender difference; higher mathematics; rural secondary school

Introduction

During their secondary schooling, children make up their mind about their pathway for study, such as science, humanities or business studies. They also make their choices for optional subjects i.e. advanced mathematics or additional sciences on the basis of their previous achievements, interests and confidence on those subject areas. However, their choices may also be influenced by their teachers, peer learners, parents, other family members, and also by their future career ambitions. It is important to know students' individual differences in the learning of mathematics, the amount of effort they are willing to employ to learn mathematics and the influences on the study of elective mathematics beyond the minimum requirements of secondary education (Fennema & Sherman, 1976). The student attitude survey can explore girls' as well as boys' deeply held beliefs about mathematics and that can determine how students learn, participate and think about mathematics (Fennema, 2000). The belief that mathematics is more appropriate for males than females may have long-term negative impact on female students' achievement in mathematics and that can influence them to pursue non-maths related careers (Leder, 1992). Therefore, the study of attitude seems to have great importance in identifying the factors that may affect children's mathematics achievement, decision making about their higher maths study or targeting of future career.

As an effort to measure students' ATM, Fennema and Sherman (1976) constructed an attitude measurement scales in the early 1970's, which is widely used and known as FSMAS (for more detail, see data collection instrument section). Recently, I have used a Bangla translated version of FSMAS for my pilot study in Bangladesh as part of my PhD research. This paper reports the results of the analysis of my pilot study data gained from a survey across three Bangladeshi rural secondary schools using the FSMAS. The main purpose of the pilot study was to see the

practical implications of administering the survey in a rural Bangladeshi context and to test the reliability of the survey instrument. The other purpose was to test the following three major hypotheses: (1) Female students' ATM is less positive than males, (2) Girls in girls' only schools feel differently about maths than their peers in coeducational settings, and (3) ATM of children studying 'higher maths' course is more positive than their peers who are not studying.

Review of literature

In a Swedish secondary school study, Brandell and Staberg (2008) found a clear tendency to view mathematics as a symbolically male dominated subject where the positive aspects are associated with boys and negative aspects are perceived as more female type. Older students hold more strongly gendered views than the younger and boys in the natural science program have strongest beliefs of mathematics as a male domain. In a longitudinal study on attitudes towards computer base mathematics in Mexico, Ursini and Sanchez (2008) found significant gender differences favouring boys in grades 7, 8 and 9 who were using computer technology. Girls of grade 8 who were using computer technology got higher scores in mathematics than the girls who were not using. The interview data revealed that the Mexican local culture in which girls and boys construct their perceptions of themselves in relation to mathematics have a deep influence on their attitude towards the subject. The girls who did not use the computer showed negative attitudes towards computer-based mathematics. However, in Israel, attitudes towards mathematics are found more different than it was expected. Israel's TIMSS national mathematics testing data of 2006 and 2009 show the better performance of Jewish students than the Arab. But, Birenbaum and Nasser (2006) reported that the Arab students displayed more positive attitudes to mathematics than the Jewish and the Arab girls exhibited an even more achievement-enhancing pattern than the Arab boys.

Thornton, Sultan, Huda and Munsura (2005) reported that Bangladeshi rural girls' most popular subject is Bangla and the most problematic subjects are Maths and English. In another study Raynor (2004a) reports that, in terms of classroom interaction there is generally a strong male bias with male teachers, whereas women teachers are more likely to have balanced interaction patterns, or slightly in favour of girls. In a World Bank (2003) study Abadzi reports that Bangladeshi rural parents are likely to register their daughters with the madrasahs (Islamic schools) as they are seen to be safer places, and perhaps closer to home, thus reducing the risks girls face in going to and from school. Notably, many of those madrasahs do not offer science (Raynor, 2004c), and focus on subjects that have no direct links with employment opportunities relevant to present market needs. According to Gaff (1991, p.183), "unless teachers know their students reasonably well, it is impossible for them to know whether or how any given idea will be understood, integrated into their mind, or used by the student". Therefore, in order to give all children an equal opportunity in today's global workplace, efforts must be made to determine how attitudes, beliefs and perceptions are used for achieving success in mathematics (Bramlett, 2007).

Methods

School settings and participants

Three rural secondary schools were chosen purposively to meet the criteria of co-educational and girls' only schools. All participants were students in the age group of

15-16 years. Some of them were studying 'higher maths' optional courses but some were not. Due to the shortage of time and other resources, data were not collected from a boys' only school. Table -1 shows the details about the number and types of schools and participants.

Table -1: Description of participants

	Study higher maths		Don't study higher maths	
School type	Boys	Girls	Boys	Girls
A (Co-ed)	13	8	27	36
B (Girls' only)	-	15	-	74
C (Co-ed)	3	1	1	11
Total	16	24	28	121
Grand total: 189 (Boys:44, Girls:145)				

A total of 28 children's data were discarded due to incomplete data. Therefore, the valid data were collected from 161 children.

Data collection instrument

The complete version of the FSMAS was translated into Bangla and back translated to check the quality of the translation. FSMAS consists of nine sub-scales, each with 12 items (6 of them are positively worded and 6 of them are negatively worded items) on a 5-point Likert scale. Therefore, the full scale has 108 items in total. The FSMAS measures important attitudes of both boys and girls related to their learning of mathematics. The names of the nine sub-scales are: Confidence in Learning Mathematics Scale (C), Mathematics Anxiety Scale (A), Father Scale (F), Mother Scale (M), Mathematics Usefulness Scale (U), Mathematics as a Male Domain Scale (MD), Success in Mathematics Scale (S), Teacher Scale (T) and Effectance Motivation Scale (EM). Children were asked to put a tick in the corresponding box of their choice from the options A=Strongly agree, B=Agree, C=Neutral, D=Disagree and E=Strongly disagree. Each of the positively worded items received the score based on points, A=5, B=4, C=3, D=2 and E=1. The scoring of each negatively worded items were reversed as A=1, B=2, C=3, D=4 and E=5 points. Therefore, a participant's highest possible score for each sub-scale was 60 points.

Procedures

All children sat down in their classroom after maths lesson. Their teachers were not present at that time. Following the ethical requirements, survey instruments were distributed to the children who were willing to take part in the research. They were assured that their responses would be used for research purposes only and no one other than the researcher would see their responses. Prior to this, necessary instructions were given on how to complete the survey. The scale items that the children asked for clarifications were noted down for further review.

Data analysis

All data were entered into SPSS and relevant analyses, such as descriptive statistics, means and standard deviations of attitude scores, Alpha reliability coefficients, and *t*-test of difference in means produced through SPSS.

Results and discussion

Reliabilities

Cronbach's alpha reliability coefficients were calculated for each of the nine sub-scales of FSMAS on the sample data (see Table -2). Two of them are close to 0.70 (S and EM), one of them (MD) is equals to 0.53 and rest of them above 0.70. The reliability of all 108 items was also calculated and this had an alpha coefficient of 0.95. Having the alpha reliability coefficients below 0.70 means the sub-scale items are not hanging together very well and probably I do not have a unidimensional scale. This requires checking with factor analysis.

Table-2: Cronbach's alpha coefficient for each of the nine sub-scales of FSMAS

Scales	C	A	F	M	U	MD	S	T	EM	All items
Cronbach's alpha	0.76	0.81	0.74	0.74	0.71	0.53	0.69	0.73	0.68	0.95

Normally, the decision should be to delete the relevant questions in the subscales in order to increase the Cronbach's alpha above 0.70, but, according to De Vaus (2002), the smaller the number of items, the greater the likelihood of the reliability analysis (using Cronbach's alpha) to be inaccurate. Moreover, FSMAS is a well-established scale that has already been used for a large number of studies with Cronbach's alpha above 0.70 for each of the sub-scales. Therefore, for the use of my final study, I intend to consider reviewing the translation of the relevant question items again to make the language clearer keeping the original meaning same.

Differences between female and male students' ATM

Firstly to test the first hypotheses: female students' ATM is less positive than males', the overall mean attitude scores of girls and boys were calculated and a *t*-test has been run to find the significance of the differences in their mean (see Table -3). The result shows that the *p*-value (0.196) against the calculated *t*-score is greater than the significance level (0.05). Therefore, the null hypothesis, H_0: there is no difference between female and male students' ATM is accepted and the assumption that the female students' ATM is less positive than males has no statistical significance although the observed mean attitude score of girls is higher than boys (contrary to the assumption). The observed difference may be due to sampling error and may not actually reflect the characteristics of the whole population.

Table -3 : Mean difference of overall attitude scores of girls and boys

Gender	N	Mean	Std. Deviation	Diff. of Mean	*t*-test score (df) (*p*-value)
Girl	122	444.12	48.35	11.76	1.298 (159)
Boy	39	432.36	52.13		(.196)

Note: Degrees of freedom and *p*-value are given in parentheses.

Table -4 shows the result of observed differences in mean attitude scores of nine sub-scales of FSMAS. Only two sub-scales have statistically significant differences: confidence in mathematics and mathematics as a male-domain. Boys' confidence was seen as better than the girls' and more girls than boys were found with the belief that mathematics is a male-dominated subject. In all other seven sub-scales the observed differences have no statistical significance to suggest that they reflect the characteristics of the actual population.

Table -4: Differences of boys' and girls' attitude scores on nine sub-scales

Attitude sub-scales	Girls' Mean (SD)	Boys' Mean (SD)	Mean difference	*t*-Test of difference in means
Confidence	45.21 (7.65)	47.81 (6.78)	-2.6	*
Anxiety	44.66 (9.16)	45.51 (8.15)	-0.85	**
Father	50.71 (7.14)	48.79 (7.35)	1.92	**
Mother	50.54 (7.02)	49.79 (7.60)	0.75	**
Usefulness	52.64 (6.19)	51.75 (6.43)	0.89	**
Male-Domain	46.83 (5.71)	42.75 (6.02)	4.08	*
Success	52.01 (6.06)	50.90 (6.67)	1.11	**
Teacher	49.46 (6.73)	47.48 (7.08)	1.98	**
Effectance Motivation	43.72 (6.47)	44.07 (7.31)	-0.35	**

Note: Standard deviations (SD) are given in parentheses. The differences of mean are from girls' to boys'. "*" indicates that the mean difference between groups is statistically significant at 5% level. "**" indicates that the difference is not significant.

ATM of girls in girls' only school and their peers in coeducational settings

According to the result presented in Table -5 there is no significant difference between the attitude of girls in girls' only school and girls in co-education school in rural Bangladesh. Therefore, the second hypothesis is not proved with the pilot study data. However, in rural Bangladesh other associated issues i.e. shortage of good maths teachers in girls' only schools may have direct effect on girls' study of maths or their choice to study or not to study 'higher maths' optional subject. A larger sample size may provide more accuracy in explaining the difference.

Table -5 : Mean difference of overall attitude scores of girls in girls' only school and girls in co-ed school

School type	N	Mean	Std. Deviation	Diff. of Mean	*t*-test score (df) (*p*-value)
Girl' only	89	444.48	45.80	1.33	-0.135 (120)
Co-ed	33	443.15	55.39		(.893)

Note: Degrees of freedom and *p*-value are given in parentheses.

ATM of children who study 'higher math' compare to their peers who do not study

The result presented in Table -6 shows that the ATM of Bangladeshi rural secondary school children who are studying 'higher maths' course is significantly more positive than their peers who are not studying. Therefore, this result suggests that children's positive ATM may help them decide to study higher maths or the children who are already in higher maths study contain more positive ATM than who do not study.

Table -6 : Mean difference of overall attitude scores of children who study and do not study higher mathematics

Status of HM study	N	Mean	Std. Deviation	Diff. of Mean	*t*-test score (df) (*p*-value)
Study HM	36	468.67	41.63	35.29	-3.945 (159)
Don't study HM	125	433.38	48.75		(.000)

Note: Degrees of freedom and *p*-value are given in parentheses.

Conclusion

From various literature reviews it is found that measuring student's ATM is important as ATM is linked with their achievement in mathematics and the choice to study further mathematics. The use of a Bangla translated version of FSMAS is found to be reliable in rural Bangladesh although a few sub-scales have alpha reliability

coefficients less than 0.70. This can be considered as sampling error or may be it is an issue of translation. From the analysis of preliminary data it is found that there is no significant difference in ATM between boys and girls, and also between girls of girls' only school and girls of co-education school. However, ATM is found to be significantly different between children (regardless of gender) who study higher maths and those who do not study. Significant differences are also found in the confidence sub-scale favouring boys and in the male domain sub-scale more girls than boys are found with the view that mathematics is a male dominated subject. However, I do expect that more significant results will be found in the final study by improving the quality of translation of the FSMAS and selecting a large number of samples to ensure a more representative response.

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