



MEMBER OF



Deb Kumar Halder

State Aided College Teacher,
Dhruba Chand Halder College,
South 24 Paraganas, West Bengal

halder.d.k.92@gmail.com

<https://orcid.org/0000-0002-6866-7106>

Dr. Marisha Chakrabarti

Assistant Professor,
Sammilani Mahavidyalaya,
Kolkata, West Bengal

marishachakrabarti@gmail.com

<https://orcid.org/0000-0002-1174-3542>

Dr. Prabir Ghosh

Assistant Professor,
Dhruba Chand Halder College,
South 24 Paraganas, West Bengal

ghoshiac@gmail.com

<https://orcid.org/0000-0001-6641-1521>

**GENDER DIFFERENCES IN MATHEMATICS PERCEPTION
AMONG STUDENTS OF KOLKATA**

ABSTRACT

Mathematics is deemed to be an essential part of education. It is a compulsory part of school learning. Unfortunately, mathematics is not always looked back at with fond memories of school. Rather, it is about unwilling schedules of homework and practice, to be got over at the earliest opportunity. The way students perceive mathematics is bound to affect their achievement in the subject. Moreover, mathematics is often fallaciously conceived of as a subject more suited to male predilections. This investigation, therefore, assesses the perceptions of students in secondary and higher secondary schools in Kolkata and makes a gender-wise comparison of the same. The sample consisted of 660 students. The tools of the study consisted of three opinionnaires to assess students' experiences of mathematics, their image of the subject and their manifestation of the relationship with the subject. The results of the study showed that while the experience of mathematics and the manifestation of the relation with it were high average, the image of mathematics was less so. Gender-wise, the t-test showed that boys reminisced significantly better experience with mathematics and manifestation of their relation with it than girls, the image of mathematics did not show a significant difference.

Keywords: Gender Difference, Mathematics Perception, Experience, Image, Manifestation.

Introduction

Education is one of the basic rights of children. It initiates students into the human culture that has been built up over the ages. In the modern world, a life without adequate basic education is a life without the essential tools of living. In particular, digitization and logical induction and deduction have taken over much of our existence. For this, mathematics is deemed to be an essential part of education. Hence, it is a compulsory part of school learning.

Mathematics is not always looked back at with fond memories of school. Rather, it is about unwilling schedules of homework and practice, to be got over at the earliest opportunity. Debates rage over school boards about mathematics being a compulsory part of the curriculum at the Secondary stage (The Telegraph, 20.06.17)

On the other hand, mathematics is known to become a way of life for many students who go on to pursue mathematical vocations like engineering, or mathematics itself. After all, computer programming experts are the most sought-after profession in today's world. Thus, mathematics is perceived in several

different ways by people who have different inclinations and abilities, and indeed, different types of intelligence (Gardner, 1983). However, it is the responsibility of schools and teachers, as well as parents, to ensure that the citizens of tomorrow acquire the necessary mathematical skills as well as the mindsets for living in the future society. Mathematics has to be seen as a friend in need, and even as an amusing past time.

Generally, mathematics is perceived as a boys' subject rather than a past time suited for girls. This attitude has been cultivated over generations and is endemic among societies (Lloyd, Walsh & Yailagh, 2005). Boys are expected to aspire to vocations or the study of engineering and the sciences, whereas girls in many homes are expected to end up as home makers who do not require mathematical expertise. Obviously, this results in girls and boys perceiving mathematics through difference lenses (Nematullah, Yousaf & Gulshan, 2015). While this state of affairs requires to be altered, it may be necessary to investigate the actual differences in our society.

Several investigations have been carried out to this effect in other societies. Ciftci (2015) in Turkey investigated the effect of the perception of the quality of mathematics education among 638 secondary school students. The findings indicated that perception of the quality of mathematics education positively affects mathematics achievement and negatively affects mathematics anxiety. Skaalvick and Skaalvick (2011) made two longitudinal studies on mathematics self-perception, i.e., self-concept and self-efficacy of 246 middle school students and 484 high school students. Over a span of two years, they found that self-concept and self-efficacy is an important mediator of academic achievement. Academic achievement in this case, was measured by the last two evaluation scores of students in the schools. Billington et al. (2007) in their study 415 students of physical science and humanities found gender differences on 'Empathy Quotient' and 'Systemizing Quotient'. They found that while the former is more prevalent among females, the latter was more prevalent among males. They concluded that having more Systemizing Quotient better enabled males to enter science.

Halpern et al. (2007) in their paper on sex differences in Science and Mathematics have dwelt on several issues. While doing Science and Mathematics requires several types of cognitive abilities, women are more proficient in verbal abilities and men are better at visuospatial abilities. Besides, the authors relate gender differences to cultural practices, early experiences, biology and other sociocultural influences. These tend to affect the difference in numbers of men and women in Science and Mathematics related vocations. Brandell et al. (2003) conducted a project (Ge Ma - Project) on student attitudes towards mathematics in Sweden. They constructed a questionnaire which consisted of questions about 'others and mathematics' and about themselves as individuals and mathematics. Their finding shows that mathematics is 'gender stereotyped' from the ninth year of school and many older students perceive mathematics as a 'male domain'. A comparison of the Swedish students was made by applying the questionnaire to Australian students. It showed that Swedish students tended to view mathematics as a male domain more than Australian student. In fact, some Australian students' related mathematics positively and strongly with women.

These and several other findings indicate out that gender differences regarding image of mathematics is an issue that requires attention.

Mathematics is thus considered to be one of the most important core subjects in the school curriculum.

The investigators therefore examined the perceptions regarding mathematics of secondary and higher secondary students and compared them on a gender-wise basis. The perceptions of mathematics were examined with respect to:

- a) Experience of mathematics
- b) Image of mathematics and
- c) Manifestation of the relationship with mathematics

Objectives of the Study

The following are the objectives of the proposed study:

1. To ascertain the perception of mathematics of students in secondary and higher secondary schools with respect to
 - a) Experience of mathematics
 - b) Image of mathematics
 - c) Manifestation of the relation with mathematics
2. To compare the perception of mathematics of students in secondary and higher secondary schools on a gender wise basis.

Variables of the Study

The variables of the study are:

Perception of mathematics: This is about the way mathematics is perceived (Allen, 2011). This consists of the following dimensions:

- **Experience with mathematics (EM):** Students' experience with the subject.
- **Image of mathematics (IM):** Students' mental representation of mathematics.
- **Manifestation of the relationship with mathematics (MM):** The actual behaviour of students when they are faced with mathematics as a subject of study or in a mathematical situation.

Gender: This is a categorical variable indicating the sex of the participants.

Gender 1: Girls; Gender 2: Boys

Population and Sample

The population for the study consisted of secondary and higher secondary students of Kolkata. In particular, children from Class VII to XII were the target population.

The sample was incidental and selected as follows:

Table-1

Girls (1)	Boys (2)	Total
350	310	660

Tools of the Study

Opinionnaire: Three opinionnaires from Jahan (2001) were adapted for this study.

The descriptions of the three opinionnaires are:

1. Experience with mathematics (EM)

This opinionnaires sought to assess the student’s experiences with regard to mathematics in connection with:

- i. Teachers of Mathematics
- ii. Participation in mathematics class
- iii. Peers and friends
- iv. Study habit
- v. Daily life
- vi. Parents

2. Image of mathematics (IM)

This opinionnaire sought to find out the image of mathematics formed by the respondent with regard to:

- i. Gender specific image
- i. Utilitarian image
- ii. Discipline oriented image

3. Manifestation of relationship with mathematics (MM)

This opinionnaire sought to find out the relationship of the respondent with mathematics by focusing on its manifestation with respect to:

- i. Classroom situation
- ii. Examination situation
- iii. Self-study situation
- iv. Discipline oriented situation

Scoring Procedure

All the three opinionnaires had statements that were to be responded through Likert Type responses. The scoring principle is:

Table-2

Response	Positive statement	Negative statement
Strongly Agree	5	1
Agree	4	2
Indifferent	3	3
Disagree	2	4
Strongly Disagree	1	5

Validity and Reliability

All three opinionnaires were subjected to content validation by five experts. The three opinionnaires, had a total of 80 items. The reliabilities of the opinionnaires were measured by the test-retest method on a sample of 200 representative students and found to be highly significant.

Table-3

	EM	IM	MM
N Valid	200	200	200
Mean	111.79	36.30	125.50
Std. Deviation	13.524	4.393	18.512
Percentiles 25	102.00	34.00	117.00
50	112.00	37.00	125.00
75	120.00	39.00	133.00

Findings

Objective 1: The scores of the participants for EM, IM and MM were tabulated and subjected to descriptive analysis.

Table 4: Descriptive Analysis of Whole Sample

	EM	IM	MM
N	660	660	660
Mean	103.32	36.60	115.85
Standard Deviation	8.448	3.967	9.846
Skewness	.284	-.069	.103
Standard Error of Skewness	.095	.095	.095
Kurtosis	-.261	-.456	-.267
Standard Error of Kurtosis	.190	.190	.190
Range	42	20	52
Minimum	83	28	91
Maximum	125	48	143

Observation

All the distribution of scores were examined and found to be continuous. The skewness and kurtosis were also found to be within the prescribed limits of normality (Garson, 2012).

EM: The mean score is average as it is within M-SD and M+SD of the standardization sample. The mean score is in the third quartile of the distribution of the standardization sample which makes it high average.

IM: The mean score is average, as it is within M-SD and M+SD of the standardization sample. The mean score is in the 2nd quartile of the distribution of the standardization sample which makes it a low average.

MM: The mean score is average, as it is within M-SD and M+SD of the standardization sample. The mean score is in the third quartile of the distribution of the standardization sample which makes it high average.

Objective 2: The scores for EM, IM and MM were subjected to descriptive analysis on a Gender wise basis.

Table 5: Descriptive analysis of Gender

		Gender	EM	IM	MM
1	N	Valid	350	350	350
		Missing	0	0	0
	Mean		101.75	36.56	113.99
	Std. Deviation		7.213	3.781	8.986
	Skewness		.083	-.198	.143
	Std. Error of Skewness		.130	.130	.130
	Kurtosis		-.519	-.716	-.448
	Std. Error of Kurtosis		.260	.260	.260
	Range		35	18	48
	Minimum		87	28	95
Maximum		122	46	143	
2	N	Valid	310	310	310
		Missing	0	0	0

Mean	105.11	36.64	117.94
Std. Deviation	9.351	4.172	10.356
Skewness	.171	.034	-.069
Std. Error of Skewness	.138	.138	.138
Kurtosis	-.527	-.297	-.135
Std. Error of Kurtosis	.276	.276	.276
Range	42	20	52
Minimum	83	28	91
Maximum	125	48	143

Observation

EM: Mean of Boys is higher than Girls. Standard Deviation of Boys is higher than Girls and this is reflected in the respective ranges and maximum and minimum scores of Boys and Girls.

IM: Mean of Boys and Girls are nearly same. Standard Deviation of Boys is higher than Girls and this is reflected in the respective ranges and maximum and minimum scores of Boys and Girls.

MM: Mean of Boys is higher than Girls. Standard Deviation of Boys is higher than Girls and this is reflected in the respective ranges and maximum and minimum scores of Boys and Girls.

Comparison The gender differences were compared by t-test.

The hypotheses for this are as follows:

H_{0EG}: There is no significant Gender wise difference in mean Experience with mathematics.

H_{0IG}: There is no significant Gender wise difference in mean Image of mathematics.

H_{0MG}: There is no significant Gender wise difference in mean Manifestation of the relation with mathematics.

Table 6: Independent Samples Test

	Levene's Test for Equality of Variance		t-test for Equality of Means			
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
EM	19.218	.000	-5.200	658	.000	-3.361
			-5.121	578.295	.000	-3.361
IM	1.364	.243	-.254	658	.799	-.079
			-.253	627.894	.801	-.079
MM	1.539	.215	-5.243	658	.000	-3.948
			-5.198	615.994	.000	-3.948

Table-6 shows that Gender wise difference between mean Experiences in mathematics is highly significant. H_{0EG} is to be rejected. Mean Experience in mathematics of Boys is higher than that of Girls. H_{0IG} is to be accepted. The difference in mean Image of mathematics between Boys and Girls is not significant. Gender-wise difference between mean Manifestations of the relation with mathematics is highly significant.

H_{0MG} is to be rejected. Mean Manifestation of the relation with mathematics of Boys is higher than that of Girls.

Discussion

The above findings imply important consequences for the teaching and learning of mathematics. They can also be accounted for by looking at learning situations and the influences thereon.

The fact that, on the whole, mean experience with mathematics and Manifestation of the relation with mathematics are high average is promising for the educational scenario. This means that students have good experience in class, and the outward signs of their affinity for mathematics are likewise positive. Yet, the mean Image of mathematics is on the lower side, which shows that the subject still retains, at least partially, the intimidating vision of mathematics. This less than satisfactory Image of mathematics has been created by society which considers the subject to be omnipotent but illusively unattainable.

Much of the above may stem from the popular idea of mathematics as being in the higher echelons of academia. Moreover, its abstract nature, which is further perpetrated by usual classroom practices, further establishes the stark Image of mathematics and retains it as children grow up.

Nervousness about mathematical performance and anxiety about solving problems often make students quail at the thought of mathematics classes, and more so prior to and during examinations. Yet, the findings in this investigation show that the experience students have in mathematics classes is not so bad. Their expression of their feelings about mathematics is also not bad. It is possible that this "change of heart" is a result of better teaching, more attractive and explicative text books, and less pressure on examinations in contemporary school practices. Improvement in teaching practices in mathematics and its beneficial effects on students have been noted in several studies (Mensah, 2013; Cheung, 1998; Yara, 2009; Johan, Linnanmaki & Aunio).

Revelations

The above findings point to certain pertinent aspects of mathematics teaching and learning. It is heartening to know that students retain memories of good experiences in mathematics classes. They also claim to exhibit positive behavior when confronted with mathematical situations. However, the inhibiting

image of mathematics persists and serves to thwart many of them from mathematical pursuits.

Gender differences that emerge from the study show that boys have better experiences of mathematics and exhibit more positive manifestation of it than girls. This is expected, given the popular observations that can be noted in society. This, therefore, attests the need for dispelling the idea of mathematics as a masculine domain. It further shows how imperative it is to interest girls in mathematics and thus prevent them from being deprived of successful careers. In this respect, it is inspiring to know that the IIT's are taking special steps to admit girls (The Times of India, April 16, 2017). However, more necessary than this step is to initially initiate girls into the lofty echelons of mathematics by generating interest in the subject and motivating them in the early years.

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