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Achievement in Mathematics: Effect of Gender and Positive/Negative Attitude of Students

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ABSTRACT: This paper attempts to highlight the affect of gender and positive/negative attitude in regards to achievement in mathematics of the students of class-X in Secondary Schools located in the District of Nagaon under the state 'Assam'. A questionnaire containing 50 questions was prepared with positive and negative implications which was administered to 500 students selected, 25 from each school, and then the students were asked to exercise their responses with five options: (i) strongly agree, (ii) agree, (iii) neutral, (iv) disagree and (v) strongly disagree. The data collected from the questionnaire responses were analysed using statistical tools. The outcome reveals that

a) most of the boys and girls have positive attitude towards mathematics.

b) there exists a slight difference in achievement in mathematics due to gender.

c) there is no difference in achievement in mathematics due to medium of instruction (Assamese and English only).

Keywords: Attitude of students, mathematics achievement, gender, medium of instruction, t-test, Pearson's Correlation

I. INTRODUCTION

The study of mathematics is considered to be very important in each and every country of the world. Students are required to learn mathematics which is considered as a basic education, since the skill of mathematics computation is essential in every walk of life. In India, the Secondary Education Commission appointed in the year 1952 recommended that mathematics should be a compulsory subject in the schools. The Kothari Commission (1964-1966), constituted by the Govt. of India, recommended mathematics as a compulsory subject in school curricula. It stated that '*it is important that deliberate effort is to be made to place India on the world map of mathematics within the next two decades or so*'. The National Policy on Education, 1980 emphasized that '*mathematics should be visualized as the vehicle to train a child to think, reason, analyze and to articulate logically. Apart from being a specific subject, it should be treated as a concomitant to any subject involving analysis and reasoning.*' The NCF-2005 also categorically stressed the importance of mathematics and opined that '*a high quality mathematics programme is essential for all students and provide every student with the opportunity to choose among the full range of future career path*'.

In Assam, the Secondary Education is managed by the Board of Secondary Education, Assam (SEBA). There are schools under CBSE and ICSE also. Every year a huge number of students appear in school-final examination from Assam. Education in the secondary level is also regarded as the preparation of the students for higher studies. Therefore, it is of almost important to study the achievement of the students in secondary education, particularly in the subject of mathematics, which is considered to be a key factor for the development of science and technology as well as for the growth of a nation.

II. REVIEW OF RELATED STUDY

Student achievement is one of the main determining factors in assessing the quality of education in a society. Identifying the factors that affect students' learning and, thus, achievement continues to be an important object of study of educators of different countries. Researchers in mathematics education have expressed concern about the relationship of attitude and achievement in mathematics. Also they are concerned with the tools, methods and approaches that facilitate practice or the study of practice towards enhancing the quality and performance of the students in mathematics. Now mathematics education research has developed into an extensive field of study around the world, with its own concepts, theories, methods and literature.

Research on attitude towards mathematics has a long history. In the field of mathematics education, research on attitude has been motivated by the belief that attitude plays a crucial role in the minds of the teachers and the taught for mathematics. The study of attitude gains renewed popularity with the re-evaluation of the factors affecting the learning of mathematics in the investigations of many researchers. Attitude is considered together with beliefs and emotions that constitute the affective domain of the learners. Attitudes are commonly distinguished from beliefs in the sense that attitudes are moderate in duration, intensity and stability and are linked with an emotional content of the students. Therefore little effort can work suitably in changing the attitude of the students. But beliefs become stable and are not easily removable within a short period and so it requires constant exercise. Attitude towards mathematics denotes interest or feeling of involvement towards studying mathematics. Attitude towards mathematics means mathematical or scientific approach assumed by an individual for solving problems, readiness to respond by associating ideas and making decisions and assessments. Review of relevant literatures [1, 3, 7], provide diverse opinions and assessments on the students' attitude towards mathematics and their performances in the subject

Attitude plays a very important role in the development and progress of human identity and values. Therefore there has been increased interest in the role of affective factors like attitude in learning and teaching mathematics (Leder and Forgasz, 2006) [8]. According to Multicomponent Model of Attitude (Eagly and Chaiken, 1993) [2], attitudes are influenced by three components or parameters. These are -

i) cognitive component (opinion information or strength of belief or disbelief),
ii) affective component (emotional component of like or dislike) and
iii) Action (behavioural component of habit or readiness to respond).

A Study of Gender: Attitude to Mathematics, cognitive style and Achievement in Mathematics conducted by Saha [15] found that all the three components contribute to statistically significant differences in achievement in mathematics.

In the study conducted by Xin Ma and Jianymin (2004) [18] to determine the casual ordering between attitude towards mathematics and achievement in mathematics of secondary school students, the results showed that the achievement demonstrated casual predominance over attitude across the entire secondary school. Gender difference in this casual relationship was not found but elite status in mathematics moderated this casual relationship, [5, 6, 8, 13] Thomas (2006) [17]. conducted a study by using an Integrated Learning System (ILS) to determine the attitude towards mathematics and achievement through combining co-operative learning strategies with instructional delivery. The students were randomly selected and divided in two groups- one for co-operative learning and the other for individual learning. Findings revealed that students using ILS for mathematics instruction under cooperative learning performed better on standardised tests and were more positive towards mathematics than those who worked on the same, but individually.

Also there are some studies conducted to observe the influence of technology in building attitude towards learning mathematics. Although the study of attitude towards mathematics has been developed over a long time, but the study of attitude towards technology aided mathematics learning has a shorter history in mathematics education. To study the attitude towards use of technology for learning mathematics, Galbraith and Haines (1998) [4] defined a construct which they termed as 'computer and mathematics interaction'. They claim that in their context students indicating high computer and mathematics interaction believe that computers enhance mathematical learning and help learning in many ways. Some studies revealed that in countries where there are emergent needs for students in industrial and technological development, there are very favourable attitudes of the students towards science and mathematics. However, in countries where a high level of technological and industrial development had been achieved, the findings showed that attitude towards mathematics were more neutral. Generally, boys held more favourable attitude towards mathematics, the findings concluded [6, 12, 16].

The review of related literature suggests that there is an influential connection between affective mathematical attitudes, beliefs and performances in mathematics (Ai, 2002; Schreiber, 2002) [1, 16], and hence these relationships require investigation for further information and action. Many of the activities and researches to explore this area began with concerns about gender, medium of instruction and mathematical achievement also. Issues of gender have been a rich area, and many studies have been initiated, specially in mathematical education, about the affective factors and learning. It is found that the achievement of girls in mathematics, across a range of different contexts, was lower than that of the boys, and this was attributed to a variety of reasons including affective factors [8, 11]. One of the reasons for gender disparities in mathematics achievement, observed in some studies, is attitude that students nurture towards mathematics in the school days, specially in the early part of the school education.

Many studies have reported that there are gender differences in attitude towards mathematics and girls have more negative attitudes than that of boys. In a meta-analysis of studies on 'gender comparisons of mathematics attitudes and affect' (Hyde, Fennema, Ryan, Frost, and Hopp ,1990) [6]., found that, in general, female students held more negative attitudes to mathematics than male students, and these differences increased gradually with age. In general, many studies reported that, as compared to the boys, the girls lacked confidence, perceived mathematics as a male domain subjects and suffered from anxiety in studying mathematics (Hyde *et al,* 1990) [6].

The causes of the gender differences in mathematics attitude were found to be multifaceted. Many investigators have identified parental and societal attitudes, occupation and economic status of parents and parental expectations [3,11] as influential factors in making the girls feel that they are inferior to the boys in mathematics. Several studies give evidence that compared to boys, girls lack confidence in doing mathematical sums and viewed mathematics as a male domain subject [1,5,6,12,19]. Some studies have compared the effect of single-sex and co-educational classroom environment upon students' attitudes (Forgasz & Leder, 1996) [3]. Students in single sex schools were found to have more positive attitudes than students in the co-educational schools. Within an African context, Lee and Lockheed (1990) [9] conducted a study of more than one thousand students enrolled in single-sex and mixed-sex secondary schools from ten states in Nigeria. The authors found that perceived ability is positively related to higher achievement in mathematics. Another study was conducted by Norton and Rennie (1998) [3,13] on the students of grades 8 to 12 in four secondary schools in Queensland, Australia. The schools selected were - one private single-sex girls' school, one private single-sex boys' school, one co-educational state high school and one co-educational private school. The investigators observed that boys in the single-sex schools had sufficient positive attitudes. On the other hand the attitudes of boys in co-educational schools were similar to the girls in the single-sex school, and the girls in the co-educational schools reported less positive attitude on several scales.

However there are many studies that suggest that there is no significant difference between attitude towards mathematics among male and female students (Mohd *et al,* 2011; Köğce *et al,* 2009; Nicolaidou & Philippou, 2003) [7,11,12]. Still the consequences about the gender differences in subject of mathematics are not conclusive because there are so many other factors which contribute towards achievement (Leder and Taylor, 1995) [3, 8]. Some studies have considered students' classroom experiences and teachers' classroom behaviours as factors associated with students' attitudes (Fisher & Rickards, 1998; Forgasz & Leder, 1996) [3,8,18].. It is found that students' attitudes towards mathematics tended to be more positive in classrooms where the students experience greater importance and friendly behaviours from their mathematics teachers, and more negative in classrooms where students found that their teachers are unfriendly, enforcing strict behaviours and teach in as usual methods [1,3,5,11,13].

On the basis of the observations from different studies it is believed that more investigations concentrating on affective factors, mathematical attitude and achievement are required. While gender differences in mathematics achievement and overall attitudes have been gradually decreasing, but still there exists a gap in higher level in mathematics achievement and advanced mathematics course-taking among females than males choosing professions linked with mathematics, science, and technological fields. Although in recent time female students have completed high schools and attended colleges in increasing numbers, they have expressed less interest in learning mathematics for choosing science careers [3, 5, 6, 19]. The reported gender differences in attitude towards mathematics impelled some researchers to investigate the causes of such gender difference in relation to attitude towards mathematics. However, little consensus has arrived among researchers regarding the influence of affective variables. For example, some studies reported significant effects of the affective variables on learning of mathematics while some others indicated no relationship between attitude and mathematics achievement. Even among those studies that found a significant relationship, there was still uncertainty regarding the educational implications of the outcomes. In this context reference may be made to the study conducted by Ma & Kishor (1997) [10] which indicated that although there exists statistically significant relation among the factors considered to have some or little influence in mathematics achievement but the mean effect size for the relationship was not strong enough to have useful implications for educational practice. On the other hand, some researchers (Hyde *et al,* 1990; Norton and Rennie, 1998) [6, 13] have cautioned against dismissing those effects for learning outcomes. In the meta-analysis on the magnitude of gender difference in mathematics performance Hyde *et al* (1990) [6] noted mathematical problem solving as one of the areas where gender difference still exists and reported that lower classes in the high school education are important to carefully observe the favourable or unfavourable changes which build the attitudes towards mathematics among the

learners. Galbraith and Haines (1998) [4], as referred by Grootenboer [5], marked mathematics confidence as one of the dimensions noticed by students 'who believe they obtain value for their effort, do not worry about learning harder topics, expect to show good results, and feel satisfied about mathematics as a subject'. In a study, Ryan and Pintrich (1997) [14] explained that the students with high confidence in mathematics do not consider the need for help for lack of ability, but are more likely to seek help when they need it. Studies conducted on gender difference in relation to mathematics achievement and self-confidence have mostly reported that girls had lower self-confidence in mathematics than boys. In some cases, boys were more confident than girls even when their mathematics achievement was similar to that of girls. The study conducted by Grootenboer and Hemmings (2007) [5] found that those students who were rated more highly on mathematics performance by their teachers tended to be male. Being either classified as 'above average' or 'below average' in terms of mathematical performance was influenced significantly by gender. That is, males were more prone to be members of the above-average performance group.

Since teaching materials used by teachers, teachers' classroom management, teachers' content knowledge and personality, teaching topics with real life enriched examples influence the students towards a favourable learning and learning outcome (Yilmaz, Altun & Olkun, 2010) [19], so it is expected that proper strategies should be adopted for taking care of all these affective variables which will minimize the gender difference and at the same time will help the students to nurture positive attitude towards mathematics in order to attain higher achievement.

III. RATIONALE OF THE STUDY

In Assam, mathematics is taught as a compulsory subject in the secondary level. Also mathematics is considered to be a dominant factor which plays a vital role in the development of science and technology as well as in almost all fields of study. Since the performance of the students in academic activities reflects the standard of education in a society, so the achievement of the student in the subject mathematics is also very important as well. Therefore in the present study the researcher has considered mathematics achievement as a pertinent field of study. Also from review of different literatures it is noted that attitude of the students towards mathematics, gender and medium of instruction have influences on the academic achievement of the students. So it is very much important to make a study on the present topic in the context of our own society. The objectives of the present study are

a) to investigate the difference of attitude of male and female students towards mathematics
b) to investigate the affect of medium in the achievement of mathematics

IV. DESIGN OF THE STUDY

Descriptive method was thought to be appropriate to analyze the impact of attitude towards mathematics in the context of selected variables, which are gender and medium of instruction. The sample consisted of 500 students selected from 20 schools of Nagaon District. Random sampling method was adopted to select the sample. A questionnaire was constructed by the researcher which was reviewed by a few experts in the concerned field. The questionnaire was administered among the students selected for the study. Against each question there were five options, namely –strongly agree, agree, neutral, disagree and strongly disagree. After the data was collected the responses provided by the sample students were transformed into numerical values. Then the scores were placed for statistical tests of significances using statistical tools for testing the hypothesis for the investigator. The methods of analysis used were SD, t- test and Karl Pearson's Product Moment.

V. HYPOTHESES

a) There is no significant difference in attitude towards mathematics of students of class X in Nagaon District owing to difference in gender.
b) There is no significant difference in attitude towards mathematics of students of class X in Nagaon District owing to difference in medium of instruction

VI. RESULTS AND ANALYSIS

The data from the responses in the questionnaire were transformed into numerical values. The numerical values are 5, 4, 3, 2 and 1 respectively for the options 'strongly agree', 'agree', 'neutral', 'disagree' and 'strongly disagree' were placed against each question of the questionnaire. For the questions with negative implications, reverse marking scheme, i.e., 1, 2, 3, 4 and 5 respectively for 'strongly agree', 'agree', 'neutral', 'disagree' and 'strongly disagree', was adopted. The data analysis was done by the use of statistical tools. The following tables reveal the findings in relation to the investigation.

Inferential statistics. In the tables below SD and SE_m respectively stand for Standard Deviation and Standard Error Mean.

Case I - (for Positive Attitude)

Table1 : Positive attitude of boys in Assamese medium schools.

Mean	SD	SE_m
31.25	6.53	1.306

Table 2 : Positive attitude of girls in Assamese medium schools.

Mean	SD	SE_m
29.54	5.31	1.062

Table 3 : Positive attitude of boys in English medium schools.

Mean	SD	SE_m
32.01	5.91	1.182

Table 4 : Positive attitude of girls in English medium schools.

Mean	SD	SE_m
33.75	6.71	1.342

Case II - (for Negative Attitude)

Table 5. Negative attitude of boys in Assamese medium schools.

Mean	SD	SE_m
26.1	5.32	1.064

Table 6 : Negative attitude of girls in Assamese medium schools.

Mean	SD	SE_m
37.34	6.33	1.266

Table 7 : Negative attitude of boys in English medium schools.

Mean	SD	SE_m
24.31	5.51	1.102

Table 8 : Negative attitude of girls in English medium schools.

Mean	SD	SE_m
32.45	5.73	1.146

Case III : Correlation of positive attitude among Boys and Girls studying in Assamese medium schools:

Pearson's Correlation of
Boys =1 and Girls = 7.34

Correlation of positive attitude among Boys and Girls studying in English medium schools:

Pearson's Correlation of
Boys =1 and Girls = 8.73

Case IV : Correlation of negative attitude among Boys and Girls studying in Assamese medium schools:

Pearson's Correlation of
Boys =1 and Girls = 6.41

Correlation of negative attitude among Boys and Girls studying in English medium schools:

Pearson's Correlation of
Boys =1 and Girls = 7.0

VII. DISCUSSIONS AND REMARKS

From above as listed in Table 1 and Table 2, these are observed that in case of positive attitude of Boys and Girls in Assamese Medium Schools the Mean and the Standard Deviations, enclosed within parentheses, are respectively (31.25, 6.53) and (29.54, 5.31). Again the Mean and the Standard Deviations in case of positive attitude of Boys and Girls studying in English Medium Schools are respectively (32.01, 5.91) and (33.75, 6.71).

Similarly observed that for negative attitude of Boys and Girls in Assamese Medium Schools the Mean and the Standard Deviations, enclosed within parentheses, are respectively (26.1, 5.32) and (37.34, 6.33). Again the Mean and the Standard Deviations for negative attitude of Boys and Girls in English Medium Schools are respectively (24.31, 5.51) and (32.45, 5.73). Further, for gender related study in case of positive attitude towards achievement in mathematics the t-value calculated between boys and girls studying in

i) Assamese medium school is 0.98 and ii) English medium school is 1.03

In case of negative attitude towards achievement in mathematics the t-value calculated between boys and girls studying in

i) Assamese medium school is 1.87 and ii) English medium school is 1.59

Correlation of positive attitude among Boys and Girls studying in Assamese medium schools:

the Pearson's Correlation of Boys and Girls are 1 and 7.34.

Correlation of positive attitude among Boys and Girls studying in English medium schools: the Pearson's Correlation of Boys and Girls are 1 and 8.73

Correlation of negative attitude among Boys and Girls studying in Assamese medium schools: the Pearson's Correlation of Boys and Girls are 1 and 6.41 respectively. Correlation of negative attitude among Boys and Girls studying in English medium schools: the Pearson's Correlation of Boys and Girls are respectively 1 and 7.01.

VIII. CONCLUSION AND SUGGESTIONS

The investigation showed that the students' attitudes towards mathematics were positive and that many of them believed that mathematics is an important subject which can help them in their future career. It is recommended, in the tune of Yilmaz, Altun & Olkun (2010), that the teacher should develop positive relationship with students and stress classroom activities involving active teaching-learning process and students' participation in the classroom. Stakeholders should organize, periodically, seminars and workshops for students, parents and teachers with an intention to promote positive attitudes towards mathematics among all of them.

Though the study did not cover the technology aided learning and cooperative learning the researcher observed from the discussions with the students that these may help the students in attracting them towards the subject. Also popular books on history of mathematics and biography of renowned mathematicians may help the students in removing their mathematical phobia from their minds. The researcher has understood that mathematics education is a very fertile area that has enormous scope to study for a healthy growth of mathematics teaching and learning.

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