

Difference in Achievement between Boys and Girls in Mathematics at Secondary School Level

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Abstract: *The present study intends to investigate the disparity of achievement between boys and girls in mathematics in class vi, viii and x. by Achievement cum Diagnostic Test in Mathematics conducted by Centre for Pedagogical Studies in Mathematics from of 380 boys 380 girls (N=760) from 50 centres of South 24 Parganas based upon Six null hypotheses. The mode of analysis was dispersion, significance of difference of means and percentages of grades achieved by the students. Result reveals the fact that mean scores of boys are remarkably higher than the girls., boys are comparatively higher achievers than the girls in the higher grades i. e, in A+, A and B grades. But in case of girls it is reverse. Girls achieved Higher in the lower grades than boys in class vi and viii. The disparity ins not very prominent in class x. The difference is significant in the achievement of boys and girls in mathematics in case of class vi and viii. But this difference is not significant in case of knowledge and skill and total score (sum of the scores of bknowledge and skill, understanding and application), algebra and geometry. There is significant difference in the scores of boys and girls in algebra and geometry. So, there is disparity prevalent in between the scores of boys and girls in mathematics in class vi, viii and x.*

Keywords: achievement, Mathematics, Boys, Girls, Disparity, significant difference.

1. Introduction

The underachievement of women in mathematics is a problem (Sabahat Anjum, 2015). Women in position of power and in decision making role through their individual merit is rare. Women have gone less for technical studies and science course (Bulbul Ghosh 1985). As Mathematics has been witnessed a stereotyped male domain (G. Kaiser, 2022). Males shown higher academic achievement in Mathematics than females (Kaiser & Zhu, 2022). Erdem & Ramazan, (2025) examined the role of psychosocial factors in shaping the mathematics performance and future occupational expectations revealed significant sex differences that how psychosocial factors predicted mathematics. Women are less involved than men in higher-level mathematics classes and careers related to mathematics. Both positive and negative gender stereotypes can affect peoples' beliefs, values, attitudes and academic achievement. (Biswas & Paul, 2018). Academic achievement is the most significant factor in achieving educational goals and Panapana March (2022) demonstrated There is a notable variation in the mathematics performance of tenth-grade students in secondary schools, influenced by gender, school location, and the type of school management. Students attending rural schools have shown lower performance compared to their counterparts in urban schools. Additionally, students in government schools have demonstrated lower achievement levels than those in private schools. (Venkatarao & Rao, 2022). Achieving success in mathematics during secondary education, particularly in class ten, is crucial for academic excellence at advanced levels. Excelling in mathematics is a key component of academic success and serves as a foundational tool for success in various modern professions and careers. Understanding the connection between attitudes and achievement can assist educators, policymakers, and stakeholders in developing strategies and interventions to promote positive attitudes and improve students' performance in mathematics (Sakya & Mahajan, 2023). In the areas of self-confidence, perceived value, enjoyment,

motivation, anxiety, and their relationship with mathematics achievement, the results demonstrate a significant correlation between each attitude domain towards mathematics and mathematical achievement. Students need to cultivate effective attitudes to enhance their mathematics achievement (Aladil, 2024). The study is based on a literature review that investigates the underlying factors contributing to these disparities and evaluates effective interventions to bridge the achievement gap between genders. The research was grounded in social cognitive career theory and gender role socialization theories. The findings suggest that although girls often show higher self-efficacy in mathematics, systematic biases and stereotype threats significantly impede their performance. The study indicates that a combination of individual, familial, and educational factors greatly influences gender disparities in high school mathematics achievement. It recommends implementing comprehensive educational policies and programs that address the cognitive, emotional, and social dimensions of mathematics learning. It highlights unexplored constructs such as stereotype threat and gender-specific affective experiences, expanding the scope of academic investigation. The study provides a systematic methodology for literature reviews while also examining context-sensitive interventions through content analysis for pattern recognition. Moreover, it informs educational policy and practice, laying a foundation for future empirical research and promoting equitable mathematics achievement across diverse educational contexts (Chiphambo, 2025).

2. Review of Related Literature

The study by Pandey (2017) focuses on the Mathematical Achievement of class X students in secondary schools in the Bageswar District. A random selection of 200 class X students from secondary schools in the Bageswar district was made. The research tool developed and standardized by Dr. Ali Imam and the t-test by Dr. Tahira Khatoon was administered to the students. Mean, S.D., and t-test were used for data analysis. The results reveal a significant

difference in the mathematical achievement of class X students in secondary schools based on sex and belongingness. The study showed that rural male and urban male students had almost similar mathematical achievement scores.

In their 2025 study, Mohammad, Frimpong, and Kofi examined gender disparities in mathematics performance among 118 secondary high school students from the Suniyani and Techman municipalities. The sample consisted of 64 male and 54 female students ($N=118$), who were randomly selected from four senior high schools across the two municipalities.

The explanatory sequential mixed method approach was employed using an achievement test and semi structured interview guide to collect both quantitative and qualitative data from the participants. The data was analyzed using independent sampled t-test to compare performance disparities by gender. The findings of the study revealed the significant difference in the mathematical achievement of students by gender. The male participants with a mean score of 75, out performed their female counterparts with a mean score of 57. The study recommended the removal of barriers to the teaching and learning of mathematics among females. Also the feminists' examples must be adopted to make female students feel inclusive in the lessons.

The main objective of the study of Khadka (2017) was to compare the mathematical achievement of boys and girls of class X in Kailali district. The main instrument of study were an achievement test paper and interview. The researcher has developed 20 MCQ items based on text book and proactive book. The population of the study involved 1500 students in Kailali districts which selected 6 secondary sample schools from which total 350 students were taken as samples for achievement test paper in class x. In an interview conducted by the researcher, 36 students who scored either high or low on a mathematics achievement test were selected. The data gathered was examined using mean, standard deviation, variance, and a one-tailed t-test at a significance level of 0.05. The findings indicated that there was no significant difference in mathematical achievement between boys and girls in class X in the Kailali district. The primary factors influencing both high and low achievement in mathematics included the school environment, economic conditions, attitudes towards mathematics, parental involvement, and the teaching-learning process. There is increasing evidence highlighting the ongoing documentation of disadvantaged females in mathematics (Fryer and Levitt, 2010; Bharadwaj et al., 2012; Bharadwaj et al., 2016; Lipman and Senik, 2018) and its various potential channels- such as social factors (Buser et al., 2014; Sinetacova, 2015), cultural norms (Noltenberger et al., 2016), parental attitudes (Crowley et al., 2019), and teacher bias (Carlana, 2019), among others. However, in this context, evidence from developing countries, particularly India, is limited. Gender differences in mathematics learning are notably present and persistent across different times, age groups, and regions.

The study of Breda, Jonini and Napp (2023) analyzed PISA data of 2012 on 251, 120 15yearold students in 61 countries to analyse the educational intentions of boys and girls along

the ability distribution on mathematics assessment tests. They analyzed the percentage of boys and girls intended to pursue maths related studies or careers as a function of mathematics performance. The result reveals the following facts:

Initially, both male and female students exhibited a positive and linear correlation between their likelihood of pursuing mathematics and their performance in the subject. However, this positive correlation was more pronounced among boys than girls. The gender disparity in students' intentions to engage in math-related studies or careers is nearly nonexistent among those with the lowest math performance but grows progressively with improved math performance. Consequently, the gender gap in math performance, which disadvantages girls, is more significant among students planning to pursue math than in the general student body. Giofre et al. (2020) noted that the gender gap varies across countries. The INVALSI dataset, comprising over 13 million observations from a single educational system (the Italian system) in grades 2, 5, and 8 from 2010 to 2018, revealed that males outperformed females in mathematics (and the reverse in reading), with the gap widening from the 2nd to the 8th grade. The gender gap in mathematics was more pronounced in the wealthier northern Italian regions compared to the southern areas. Kadonsi's (2025) study explored how gender disparities manifest in mathematics achievement and examined the socio-cultural factors influencing female performance. Data from 500 students (250 males and 250 females) in grades 8 to 12 were collected through standardized mathematics assessments and surveys. The results showed significant differences between male and female students, with males outperforming females, $t(498) = 5.63$, $p < 0.001$; Cohen's $d = 0.52$. Regression analysis identified parental education ($\beta = 0.41$, $p < 0.001$) and household responsibilities ($\beta = 0.28$, $p = 0.002$) as significant predictors of female students' performance, explaining 29% of the variance. Qualitative findings highlighted five key themes: societal stereotypes, disparities in parental and teacher support, limitations in resources and role models, domestic responsibilities, and psychological barriers, including math anxiety. These findings extend the Expectancy-Value Theory by contextualizing competence beliefs and task value in resource-constrained rural settings. This study, among the first to explore such disparities in rural Zambia, offers new insights into socio-cultural influences on mathematics education. Recommendations include teacher training to address implicit biases, equitable resource allocation, mentorship programs featuring female role models, and community engagement to reduce domestic burdens. Although specific to rural Zambia, the findings may inform gender equity strategies in similar contexts, aligning with Sustainable Development Goals 4 (Quality Education) and 5 (Gender Equality) on how gender norms shape various domains, including mathematics.

The study of Ozge Nurlu (2025) aimed to synthesize empirical research systematically, published between 1999 and 2024, focussed on broader STEM stereotypes, non-English publications, records without full text access, and papers outside the specified time window were excluded. Limitations include the observe of protocol pre registration –

although inclusion / exclusion criteria and the analysis plan were specified in writing prior to the search and PRISMA 2020 guidelines were followed – and the unavoidable subjectivity in interpretation and categorization despite established intercoder reliability. Analyses indicate that most studies are situated in psychology, frequently employ, experimental assigns and primarily sample university students. Surveys dominate data collection and parametric inferential statistics are commonly used. Geographically, the literature is concentrated in western countries – particularly in United states and Germany with limited contributions from the Global South. Publication counts fluctuate over time with notable peaks in 2012 and 2022. The literature converges on two principle axes (I) belief domain-ownership formulation centred on male superiority and (II) process based formulations centered on ST. Less frequently examined yet theoretically informative extensions include endorsement, internalization, counter stereo typic role model and stereotype lift. Across qualitative, descriptive, correlational, mediation, meta analytic and experimental evidence, findings consistently cluster around these axes, with stereotype endorsement and MGS occupying central positions. The results underscore the used for future research that is more interdisciplinary, cross cultural and methodologically diverse to more comprehensively address MGS.

Gender norms influence various areas, including mathematics, which has long been perceived as a male-dominated discipline. This perception has led to widespread mathematical gender stereotypes (MGS) that impact individuals' involvement and success. Lindberg, Hyde, Petersen, and Linn (2010) conducted a meta-analysis to examine gender differences in recent mathematics performance studies. Initially, they analyzed data from 242 studies published between 1990 and 2007, encompassing tests on 1,286,350 individuals. The result, $d = .05$, suggested no gender difference, while $VR=1.08$ indicated nearly equal variances between males and females. Subsequently, data from large-scale studies based on probability sampling of U.S. adolescents over the past two decades, including the NLSY, NELS88, LSAY, and NAEP, were examined. The effect sizes for gender differences ranged from -0.15 to -0.22 , with variance ratios between 0.88 and 1.34 . Collectively, these results support the notion that males and females perform similarly in mathematics. Nematullah, Yousaf, Gulshan, and Dad (2015) conducted a study analyzing gender differences in academic achievement in mathematics at the secondary level in Muzaffar Garh district (Punjab, Pakistan). They used a self-designed multiple-choice test with 40 items to gather data from 400 respondents. The findings indicated that male students outperformed urban female students, showing a significant difference in achievement between genders. Bashir, Akram, and Basir (2023) investigated gender differences in students' attitudes towards mathematics and their academic performance at the secondary level. Data were collected through questionnaires from students at secondary schools in Rawalakot (three schools) and Muzaffarabad (two schools), with 100 boys and 100 girls ($N=200$) randomly selected from the chosen schools. The research instruments included an attitude scale towards mathematics (39 items) and an academic achievement scale (65 items). The data analysis

revealed no significant gender difference in terms of enjoyment and motivation in mathematics, but a significant gender difference in overall academic achievement in mathematics.

Ahmed, Kasim and Banerjee (2023) investigated the rural urban disparity of academic achievement in mathematics of senior secondary schools in Bodoland Territorial Region of Assam state, India. 4028 students of class ten and 2633 students of class twelfth grade students were selected as samples. Of BTR. To determine the nature of achievement, descriptive analysis and t test were applied. The result shows that the large amount of difference was seen in the mean in achievement between boys and girls of rural and urban schools. And there is significant difference in achievement in mathematics between boys and girls in rural and urban secondary and higher secondary school.

3. Objective of the study

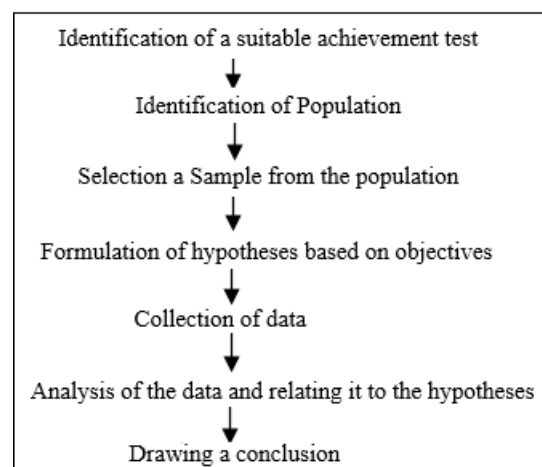
Following the preceding discussion, the investigator proceeds on the investigation following the objectives in mind:

- 1) To investigate disparity, if any, in mathematical achievement of scores boys and girls in secondary school.
- 2) To investigate disparity, if any, in mathematical achievement between boys and girls as regards Knowledge and Skills, Understanding, Applications and Total Score (Sum of the scores of Knowledge and Skill, Understanding and Application).
- 3) To investigate, disparity, if any, in mathematical achievement between boys and girls as regards Arithmetic, Algebra, Geometry and Total Score (Sum of the scores of Arithmetic, Algebra and Geometry).

4. Procedure

Design of the study

The procedure of the investigation is shown below in the form of a flow chart:



The investigation is therefore mainly considers the analysis and interpretation of a survey of the mathematical achievement of Boys and Girls of Class VI, VIII and X.

Mathematics is the subject in school that helps children to develop his or her logical reasoning and problem solving skill and to have justice through unbiased opinion so that he can face his future confidently particularly at this age of science and technology. For this reason, mathematics was taken as a subject of study for this investigation.

5. Objective

Objective of the study is to investigate the disparity, if any, in the mathematical achievement between boys and girls in class VI, VII and X.

Selection of the ADTM TEST.

For the purpose of this investigation the ADTM Test, The Achievement Cum Diagnostic Test in Mathematics has been chosen for the following criteria.

- 1) It is a criterion based test.
- 2) This test has been used for the purpose of diagnosis and assessment of different branches of mathematics (i.e., Arithmetic, Algebra, Geometry etc.) in the different cognitive categories or domains i.e., Knowledge and Skill, understanding and application (Bloom's Taxonomy).
- 3) The test is designed to administer on the students of the standards of IVth to XIIth grade and so it caters to the students at different stages of secondary school.
- 4) The test is conducted under the auspices of CPSM, Centre For Pedagogical Studies in Mathematics, Kolkata which is mainly an organisation of teachers. This test has been conducted in West Bengal and some other states of India from 1989-90.

The test consists of hundred of questions for each class. Fifty questions are from the previous class and fifty questions are for the present class. The questions are of multiple choice items with four or five distracters or response options. The details about the ADTM test is as follows:-

Description of the ADTM Test

The aims of the ADTM test are as follows:-

- 1) The students background knowledge is necessary for understanding the present knowledge due to correlatedness of the subject mathematics. For this reason, students' knowledge of the previous class is measured along with the knowledge of the present class in mathematics.
- 2) To measure the students' level of achievement in mathematics and diagnose their areas of errors.
- 3) To assist the students in mastery learning after preparing the list of errors.

The test consists of hundred questions.

Evaluation of the ADTM Test

The items of the test covers different branches of mathematics, such as, Arithmetic, Algebra, Geometry etc., based on the common syllabus of all the boards of secondary education (ICSE, CBSE and WBBSE), as well as, in different categories of the cognitive domain, viz, knowledge and skill, understanding, Application. Four distracters are given for each test item, so that guessing may not influence

the result Negative marking are given while scoring, i.e., one mark is deducted for every three wrong answers.

The scores obtained in each branch of mathematics and in each category are posted on the diagnosis card. This displays each students' areas of success as well as their areas of difficulty in each of the branches of mathematics and in the different cognitive categories.

Though the ADTM test is not a standardised test, the grading are made on the basis of the cut off point fixed up for each year, so that two percent (2%) of the students got A++, three percent (3%) of the students got A+, ten percent of the students got A and 10% of the students got B grade. It has been observed from the evaluation of the answer scripts that though the test is prepared afresh every year, the cut-off-points of each grade slightly vary every year slightly. This proves that though the test is not a standardised test, more or less it fulfils some criteria of a standardised test.

Scoring Principle of ADTM Test.

The following principles are followed at the time of scoring ADTM Test.

- 1) The total attempts in each group was calculated.
- 2) The number of correct answers.
- 3) One mark has been deducted for each wrong answers.
- 4) The final numerical value is calculated.
- 5) Numerical value was converted to grade value (as per 3D)
- 6) The total grade points were calculated.

Projected Use of ADTM Test

The ADTM test was required for outlining the differences in mathematical achievement between boys and girls in secondary schools. Therefore the investigator has identified the ADTM test in mathematics at secondary school level and analysed the results of the examinees at different stages of secondary school. So the intention of the study is to –

- 1) Formulate hypotheses based on objectives (article no. 2.1) as mentioned earlier.
- 2) Identify a population consisting of participants in the above mentioned test and select a sample from the population among the subjects taking the test.
- 3) Collection of the data, was through the detailed scores of the chosen sample.
- 4) Analysed the data and related it to the hypotheses mentioned above.
- 5) Drawn conclusions and endeavour to find causalities for them and provide avenues for future progress.

Sampling

The Achievement Cum Diagnostic Test in Mathematics (ADTM Test) was administered on a large number of students of West Bengal and few students of outside West Bengal every year. For the purpose of the study, the students (Boys and Girls) of Class Vi, VIII and X of South 24 Parganas was being considered as the population of the study.

First Stage

It was decided to take the test results of the districts of South 24 Parganas as the population of the study because, South 24

Parganas in a mixed type of district consisting of urban, semi urban and rural areas as well as industrialized and agricultural areas. Therefore, it was deemed to be a representative cross section of the population of West Bengal.

It was decided to examine and analyzing the results of Class VI, VIII and X. Class Vi is the entry point in the secondary school, whereas, Class X is the stage, when the students were preparing for their first public school leaving certificate examination and many students were expected to leave formal education at that very point. Class VIII was considered because it is the middle point of the secondary school stage and the continuum of scores from Class VI, VIII and X will provide a suitable picture of the progression of the students achievement throughout the secondary stage.

Second Stage

The South 24 Parganas had approximately twenty centres. The distribution is being shown as following table :

Table – 1.1

Table – 1.1 shows the distribution of the ADTM Test

Class	No of Coed Centres	No. of Single – Ex Centres	
		Boys only Centres	Girls only Centres
VI	18	0	0
VIII	17	2	0
X	15	2	0

The single sex centres were eliminated from the sample because it was felt that male – female comparison would be biased due to the absence of “only girls centres”.

However, the proportion of boys against girls was disproportionately large. Therefore, all the girls from each centre were selected for the sample. Therefore, the final sample, consisting of equal number of boys and girls according to the centre is shown in the table below:

Table – 1.2

Table 1.2: The final sample of boys and girls is as follows:

Class	No. of Boys	No. of Girls	Total
VI	186	186	372
VIII	151	151	302
X	43	43	86
Total	380	380	760

Hypotheses

In the light of the above mentioned discussions, the following hypotheses were formulated to assist in attaining the objectives mentioned before.

H₀ 1.0 There is no significant difference in mathematical achievement between boys and girls in secondary school.

H₀ 1.1 There is no significant difference in Mathematical Achievement between boys and girls in class VI as regards. Knowledge and Skill, Understanding, Application and Total Score.

H₀ 1.2 There is no significant difference in Mathematical Achievement between boys and girls in class VI as regards. Arithmetic, Algebra, Geometry and Total Score.

H₀ 1.3 There is no significant difference in Mathematical Achievement between boys and girls, in class VIII, as regards knowledge and skill understanding, Application and Total Score.

H₀ 1.4 There is no significant difference in Mathematical Achievement between boys and girls in class VIII, as regards Arithmetic, Algebra, Geometry and Total Score.

H₀ 1.5 There is no significant difference in Mathematical Achievement between boys and girls in class X, as regards knowledge and skill, understanding, Application and Total Score.

H₀ 1.6 There is no significant difference in Mathematical Achievement between boys and girls in class x, as regards Arithmetic, Algebra, Geometry and Total Score.

6. Method and Procedure

Analysis

The method of dispersion by Mean and Standard Deviation applied to study the disparity of mathematical achievement of boys and girls at secondary level

- By applying significance of difference of means.
- By applying the percentages of different grades of students

Variables

In this study the three classes of the secondary level of education, i.e., class VI, VIII and X were considered as independent variable and mathematical achievement was considered as dependent variable.

Sampling

Secondary data of boys and girls were collected as samples from Class VI, VIII and X is shown in the table 1.2 below:

Table 1.2: The Sample of the study

Class	No. of boys	No. of girls	Total
VI	186	186	372
VIII	151	151	302
X	43	43	86
Total	380	380	760

Tool

The Achievement Cum Diagnostic Test in Mathematics (ADTM) under the auspices of centre for Pedagogical Studies in Mathematics was used as the tool for collection of data.

Scoring

Co-ordinators of CPSM are to note the following in connection with evaluation of answer scripts.

- 1) Answer-Scripts of A++ holders of all classes are to be sent to secretary, 35/2 B.C. Road, Calcutta-700019.
- 2) All proformas are to be duly filled and sent to the authority. Time-Schedule to be followed strictly.
- 3) Final grade is to be determined in the following way :
Add the grade points of two class grades and award Final Grade as follows:

10	A++, 9	A+, 7-8	A, 6	B+, 5	B
3-4	C, 1-2	D, 0	E		

The earlier decision of writing two class grades in Final Grade Position is cancelled.

- 4) Any other decision taken in Co-ordinators meeting is to followed by Co-ordinators.

Norm

ANALYSIS & relate it to the hypotheses.

- 1) The mode of analysis was dispersion and have been employed to compare the achievement of boys and girls.
- 2) One and Two Tailed test of significance at .05 level and at .01 level of significance by P-values, confidence intervals and critical values such as Z or t scores which determine the boundary of rejection area.
- 3) Mean and other statistics.

The data was analysed and interpreted to assist in assessing the hypotheses

Means and Standard Deviation

It can be interpreted that in each and every category of Mathematics Test, viz. Knowledge and skill, Understanding, Application, Total Score (Sum of the scores of knowledge and skill, understanding and Application) and every branch of Mathematics, viz., Arithmetic, Algebra, Geometry and Total Score (Sum of the scores of Arithmetic Algebra, Geometry) of all the three classes of Class VI, VIII and X.

Class VI

Boys have achieved appreciably more than girls in all the categories of Mathematics, i.e., Knowledge and Skill, Understanding and Application, and all the three branches of Mathematics, i.e., Arithmetic, Algebra and Geometry.

Class VIII

In class VIII, boys have achieved better than that of the girls in all the three categories of Mathematics, i.e, knowledge and skill, understanding and Application and all the three branches of Mathematics, i.e., Arithmetic, Algebra and Geometry.

Class X

In class X the achievement of boys is higher than that of the girls in all the three categories of Mathematics, i.e., knowledge and skills, understanding application. On the other hand boys are over achievers than that of the girls in this class in case of different branches of Mathematics, viz., Arithmetic, Algebra and Geometry.

Standard Deviation

Class VI

In class VI, boys and girls scores have equally spreaded over and Geometry. The boy's scores in Application and Geometry is distributed over a much wider range than that of the girls. This is possibly because some boys have not fared well in case of the questions related to Application at the same time others have done very well. In contrast, the girls ability in Application and Geometry is possibly not so varied and their application scores are clustered at the lower end.

Class VIII

In class VIII too, the scores of boys are distributed over a, much wider range than that of the girls' so far as the scores

of Application is concerned. This may be possibly assumed that some boys have done fairly well in case of the questions related to application, whereas, the girls' ability in case of application in this case is not so varied.

Class X

In case of class X, the scores of boys are slightly widely distributed than that of the girls in case of Geometry.

Significance of difference of means.

Table –2 shows the difference of means are all significant in class VI and VIII, whereas, this is not the same in case of class X.

The result

- 1) In class VI and VIII of the test of significance indicated that there is a definite difference in the mathematical achievement between boys and girls and the difference of means are not just due to chance factor brought about by sampling error.
- 2) But in Class X, the difference of means are not significant in all the cases. The result is exclusively not significant in case of Application and Geometry. In case of Knowledge and skill and Algebra the result is not significant to a large extent. In case of Arithmetic the test result is not significant to some extent. The result is significant exclusively in case of understanding only.
- 3) By applying one and two tailed test of significance at .05 level and at .01 level it can be interpreted that –

Proportional Representation

Table –2 indicated that the proportion of boys achieved higher grades, i.e., at A+, A, B, C, is comparatively very high as compared to that of the girls in class VI and VIII. At the same time the proportion of girls achieved lower grades, i.e, grades D and E is considerably higher than that of the boys in class VI and VIII.

But the same trend was followed in case of class X too in case of the proportion of boys and girls achieving different grades. But, the number girls achieved higher grades are more as compared to that of the girls of class VI & VIII and no of girls achieved lower grades is comparatively less than the number of girls achieved lower grades in class VI and VIII. Neither any boys or nor any girls achieved the lowest grade E in class X.

Frequency Polygon may be interpreted following the graph of Python if possible.

7. Findings

The data obtained from the results of the Achievement – cum – Diagnostic Test in Mathematics in 1993 on class VI, VIII and X in the district of South 24 Parganas. Their interpretations indicated several factors that characterised the difference between boys and girls as far as their mathematical ability is concerned.

The Achievement Cum Diagnostic Test in Mathematics (The ADTM Test) has a wide usage in diagnostic purposes inside West Bengal and the district of South 24 Parganas had been selected as a representative district of West Bengal.

The above result characterised differences in mathematical ability between boys and girls in West Bengal. Infact, this result may be extended to include all students of secondary schools of West Bengal, as the classes VI, VIII and X covers the crucial years of adolescence as well as the different stages of secondary school.

Findings of the Study

The boys appear to have higher mean score than the girls in class VI, VIII and X in all categories of the test viz., knowledge and skill, understanding, Application and all the branches of Mathematics viz. Arithmetic, Algebra and Geometry as far as the ADTM Test is concerned in the district of South 24 Parganas.

Table I: The Means and the Standard Deviation

Class		Knowledge Skills			Understanding		
		Boys	Girls	Diff.	Boys	Girls	Diff.
VI	Mean	3.176	2.371	0.805	5.845	3.683	2.162
	SD	2.443	2.44	0	4.575	3.532	1.043
VIII	Mean	3.735	2.314	1.421	4.226	2.559	1.667
	SD	2.445	2.331	0.114	3.661	3.23	0.431
X	Mean	4.395	3.721	0.674	7.116	4.581	2.535
	SD	1.686	1.908	0.222	3.99	3.112	0.878

Application			Total Score		
Boys	Girls	Diff.	Boys	Girls	Diff.
3.546	1.972	1.574	12.56	8.027	4.533
4.079	2.213	1.866	9.792	6.514	3.278
4.672	2.641	2.031	12.63	7.515	5.115
4.264	2.91	1.354	9.038	7.436	1.602
7.186	5.883	1.303	18.698	14.18	4.518
4.042	3.545	0.497	8.465	7.527	0.939

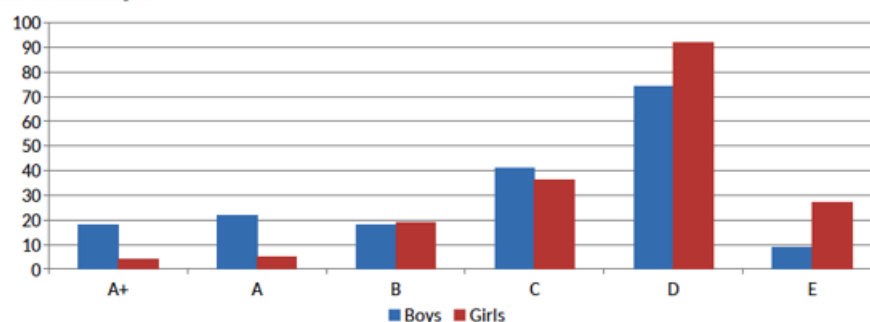
Class		Arithmetic			Algebra		
		Boys	Girls	Diff.	Boys	Girls	Diff.
VI	Mean	4.856	2.803	2.053	4.651	2.978	1.673
	SD	4.491	3.14	1.351	4.21	2.932	1.278
VIII	Mean	5.264	3.283	1.981	2.194	1.283	0.911
	SD	4.223	3.869	0.354	1.837	1.492	0.345
X	Mean	7.791	6	1.791	6.14	4.837	1.303
	SD	3.915	3.524	0.391	3.825	3.117	0.708

Geometry			Total Score		
Boys	Girls	Diff.	Boys	Girls	Diff.
3.06	2.344	0.716	12.56	8.125	4.435
2.158	1.854	0.304	9.489	6.491	2.998
4.786	2.792	1.994	12.24	7.358	4.882
4.284	3.625	0.659	8.724	7.505	1.219
4.558	3.558	1	18.488	14.395	4.093
3.817	2.975	0.842	8.345	7.3804	0.965

This implies that in all possibilities boys are better achiever than girls in Mathematics in West Bengal. Specially in class VI, VIII and X of the secondary level.

3. Descriptive Analysis — Class VI

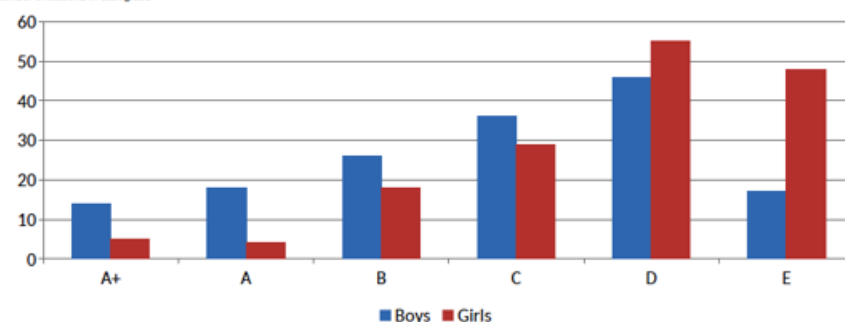
Number of students in each grade



Conclusion: Grade D is dominant for both groups; girls have higher D and E counts, while boys have higher A+ and A counts.

3. Descriptive Analysis — Class VIII

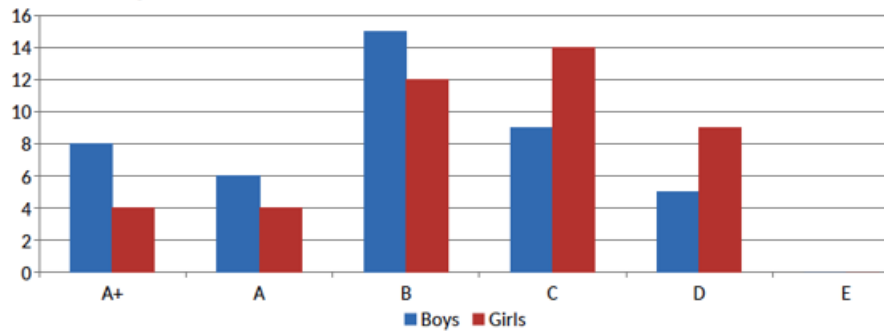
Number of students in each grade



Conclusion: Grade D remains dominant; the girls' Grade E count is notably higher than the boys' count.

3. Descriptive Analysis — Class X

Number of students in each grade



Conclusion: The Class X sample is small; boys are more concentrated in A+-B, while girls are more concentrated in C-D.

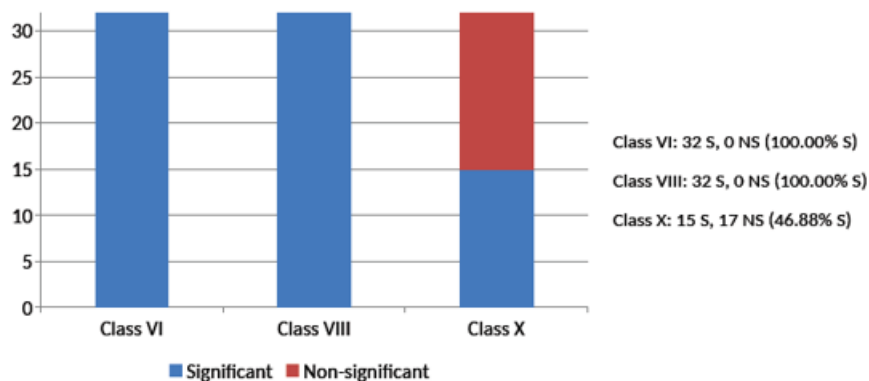
Table-II: The Significance of Difference of Means of Two Tailed and One Tailed Test of Significance

Class	Knowledge & Skills				Understanding			
	Two Tailed		One Tailed		Two Tailed		One Tailed	
	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level
VI	S	S	S	S	S	S	S	S
VIII	S	S	S	S	S	S	S	S
X	NS	NS	S	NS	S	S	S	S

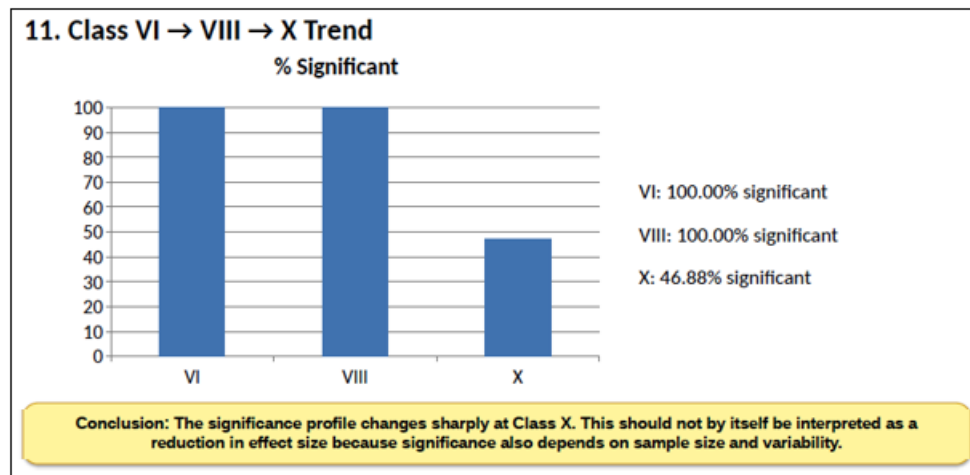
Application				Total Scores			
Two Tailed		One Tailed		Two Tailed		One Tailed	
.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level
S	S	S	S	S	S	S	S
S	S	S	S	S	S	S	S
NS	NS	NS	NS	S	S	S	S

Class	Arithmetic				Algebra			
	Two Tailed		One Tailed		Two Tailed		One Tailed	
	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level
VI	S	S	S	S	S	S	S	S
VIII	S	S	S	S	S	S	S	S
X	S	NS	S	NS	NS	NS	S	NS

Geometry				Total Score			
Two Tailed		One Tailed		Two Tailed		One Tailed	
.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level	.05 Level	.01 Level
S	S	S	S	S	S	S	S
S	S	S	S	S	S	S	S
NS	NS	NS	NS	S	NS	S	S

4. Overall Significance Profile

Conclusion: Classes VI and VIII are 100% significant across the 32 decisions; Class X has 15 significant and 17 non-significant decisions (46.88%).



Infact, Table-II shows that the difference of mean scores between boys and girls is significant in all aspects of the ADTM test for class VI and Class VIII. This shows that, as far as Class VI and VIII are concerned, the difference in scores are not just due to vagaries of sampling and therefore, in these two classes boys are smarter than girls:

However, in case of class X, the significant difference between boys' score and girls' scores is not all significant. This prevents the investigator from saying definitely that boys are better in Maths than girls particularly in class X. Yet, if one looks deeper into this situation, one can notice some factors that has influenced the result. The number of girls who took the ADTM test is much less than the number of boys who actually took the test. Then the question comes that which of the girls have participated. Possibly, only better girls have participated in the investigation. Also, the high dropout rate among the girls is also predominant. The remaining girls in the schools in class X are usually the last few determined students. Therefore, the girls participating in the ADTM test in class X are usually academically better than the ordinary type of girls students of secondary schools.

Though the difference between the scores of boys and girls, does not appear to be significant if the gamet of the girls' students in class X had appeared for the test, the difference in the scores of boys and girls would perhaps had been more significant.

Though, girls have participated in smaller number than boys, their representation in grades D and E is despropotionately higher as compared to that of the boys, particularly in class VI and VIII.

Tenability of Hypotheses

From the above discussion, it implies that the hypothesis H_01 is rejected as far as class VI and Class VIII are concerned. For class X, the tenability of the hypothesis is marginal, if at all. It may be concluded that H_01 may be rejected with reservation in the case of class X on the basis of date and interpretations arrived at by the investigator. It may be asserted that subject to reservations of class X, there is significant difference in mathematical achievement between boys and girls in secondary schools.

Table-III A

Table III A shows total number of boys and girls and their grades in percentages in class VI

	Total	A+	A	B	C	D	E
Boys	183	18	22	18	41	74	9
Girls	183	4	5	19	36	92	27
Boys	100%	9.83%	12.02%	9.83%	22.40%	40.43%	4.91%
Girls	100%	2.18%	2.73%	10.38%	19.67%	50.27%	14.75%

Table-III B

Table III B shows total number of boys and girls and their grades in percentages in class VIII

	Total	A+	A	B	C	D	E
Boys	159	14	18	26	36	46	17
Girls	159	5	4	18	29	55	48
Boys	100%	8.80%	11.32%	16.35%	22.64%	28.93%	10.69%
Girls	100%	3.14%	2.15%	11.32%	18.23%	34.59%	30.18%

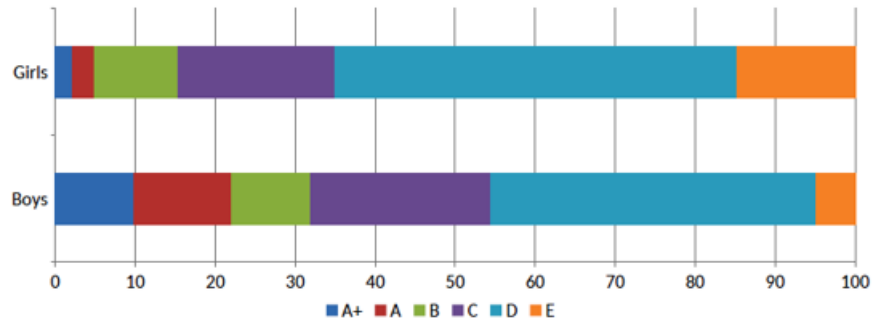
Table-III C

Table III C shows total number of boys and girls and their grades in percentages in class X

	Total	A+	A	B	C	D	E
Boys	43	8	6	15	9	5	0
Girls	43	4	4	12	14	9	0
Boys	100%	18.60%	13.95%	34.88%	20.93%	11.62%	0
Girls	100%	9.30%	9.30%	27.90%	32.55%	20.93%	0

6. Percentage Distribution — Class VI

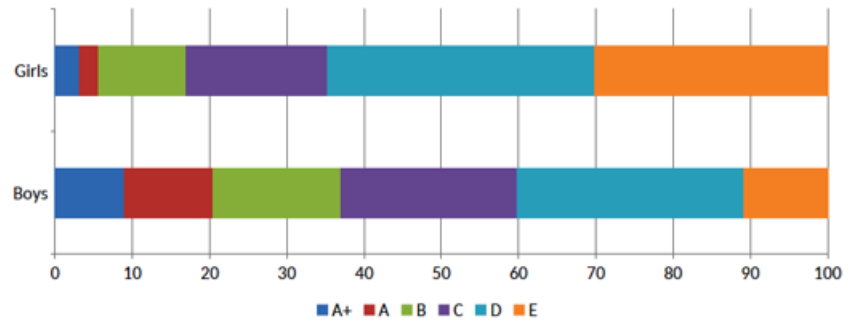
100% stacked comparison of grade composition



Conclusion: Girls have higher D and E percentages; boys have higher A+ and A percentages.

6. Percentage Distribution — Class VIII

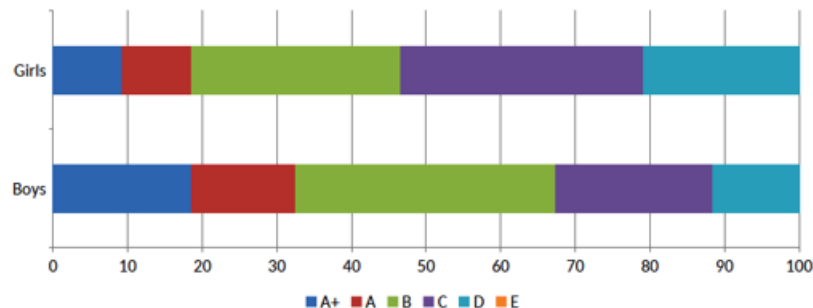
100% stacked comparison of grade composition



Conclusion: The strongest visual separation occurs in Grade E, where the girls' share is much larger.

6. Percentage Distribution — Class X

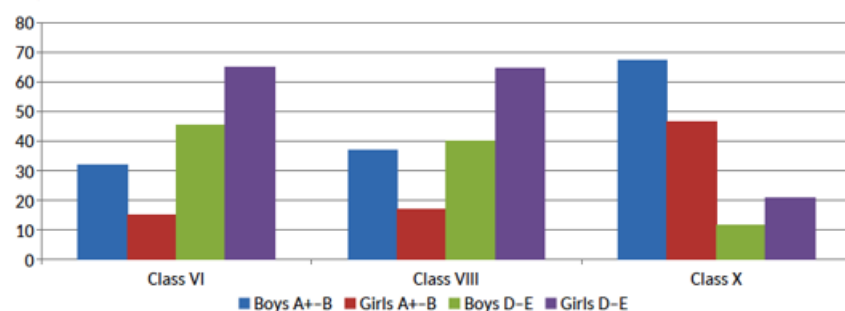
100% stacked comparison of grade composition



Conclusion: The small Class X sample produces larger percentage swings; girls have higher C and D shares.

10. Higher- vs Lower-Performance Analysis

A+–B = higher performance; D–E = lower performance



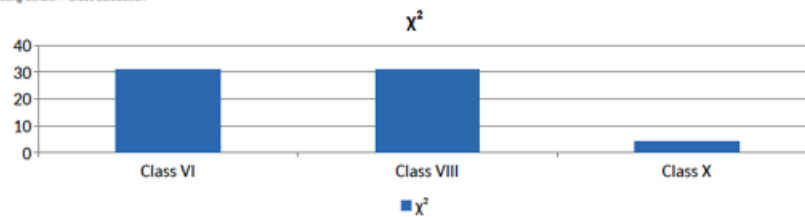
Conclusion: Boys have the larger A+–B share in every class, while girls have the larger D–E share in every class.

11. Percentage-Point Difference Analysis

Boys' percentage minus girls' percentage



Conclusion: The largest gender gaps occur at the upper and lower ends of the grade distribution, especially Grade E in Class VIII.

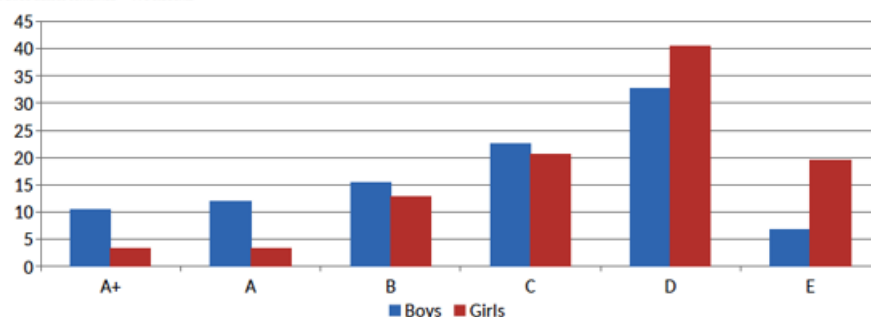
12. Chi-square Test of IndependenceTesting Gender $\times$ Grade associationClass VI: $\chi^2=30.914$, $df=5$, $p=9.742e-06 \rightarrow$ significant.Class VIII: $\chi^2=30.956$, $df=5$, $p=9.557e-06 \rightarrow$ significant.Class X: $\chi^2=4.296$, $df=4$, $p=0.3674 \rightarrow$ not significant.

Class X Grade E has zero counts for both genders and is excluded from that test.

Conclusion: Gender and Grade are significantly associated in Classes VI and VIII, but not in Class X at the 5% level.

14. Overall Combined Analysis

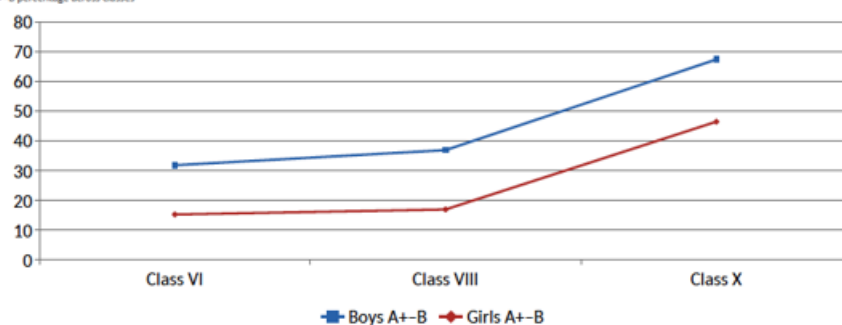
All three classes combined — 770 students



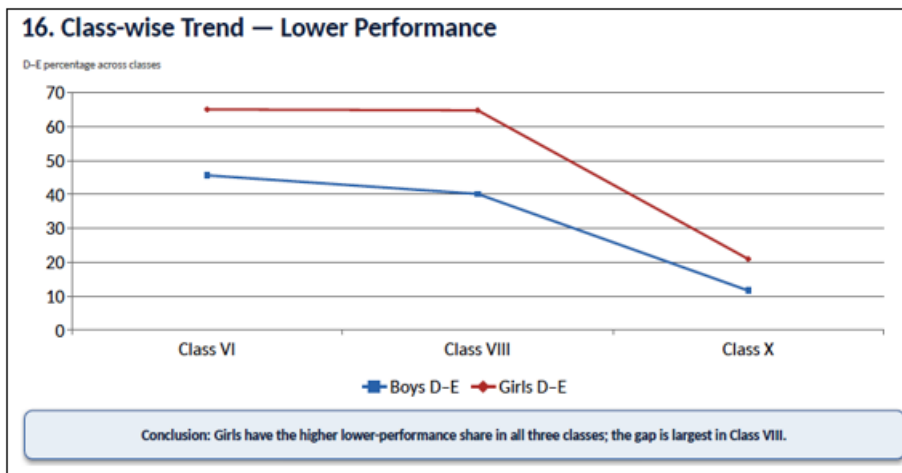
Conclusion: Overall Gender $\times$ Grade association is significant: $\chi^2=60.617$, $df=5$, $p=9.06e-12$; Cramer's $V=0.281$.

15. Class-wise Trend — Higher Performance

A+–B percentage across classes



Conclusion: Higher-performance shares increase from VI to X for both genders, but Class X is based on a much smaller sample.



H₀1.1 There is no significant difference in Mathematics Achievement between boys and girls in Mathematics in class VI as regards knowledge and skill, understanding, Application and Total Score.

This hypothesis is not tenable. That is why, this is rejected.

So, there is significant differences in Mathematical Achievement between boys and girls in class VI as regards knowledge and skill, Understanding Application and Total Score.

H₀1.2. There is no significant, difference in achievement between boys and girls in Mathematics in class VI as regards, Arithmetics, Algebra, Geometry and Total Score. This hypothesis is not tenable and this is rejected. Table – 1.

So, there is significant diff in achievement between boys and girls in Mathematics as regards, Artithematic Algebra, Geometry and Total Score.

H₀1.3. There is no significant difference in mathematical achievement between boys and girls in Mathematics in class VIII, as regards knowledge and skill, understanding, application and total score : This hypothesis is not tenable and thus it is rejected. Table-2.

So, there is significant, difference in achievement between boys and girls in Mathematics in Class VIII as regards knowledge and skill, Understanding, Application and Total Score.

H₀1.4. There is no significant difference in achievement between boys and girls in Mathematics in class VIII, as regards, arithmetic, algebra, geometry and Total score. This hypothesis is not tenable and thus it is rejected. Table-2.

So, there is significant, difference in achievement between boys and girls in Mathematics in class VIII as regards arithmetics, algebra, geometry and total score.

H₀1.5. There is no significant difference in mathematical achievement between boys and girls in Mathematics in class X, as regards, knowledge and skill understanding, Application and total score. This hypothesis is not tenable in case of understanding only and in this context the hypothesis is rejected. But in case of Application the hypothesis is

tenable and this is why the hypothesis is kept. In case of knowledge and skill, the hypothesis is tenable to some extent and thus it is not rejected fully.

So, there is significant, difference in achievement between boys and girls in Mathematics in class X in case of understanding and total score and in this case it is not escaped only in case of Understanding and Total score only and it it escaped in case of knowledge and skill and application. So H₀ is escaped to extent.

H₀1.6. There is no significant difference in mathematical achievement between boys and girls in Mathematics in class X, as regards, Arithmetic Algebra, Geometry and total score. This hypothesis is tenable in case of Geometry. That is why this hypothesis is tenable and thus it is not rejected and it is kept in case of Geometry. Table-2

In case of Arithmetic and Algebra this hypothesis is to some extent not tenable. That is why it is partially tenable and that is why it is partially rejected and on the other hand it is not completely accepted Table-2

Though the achievement of boys has developed from class Vi to VIII to X gradually, this trend is pretty consistent that the disparity remains throughout the secondary school stage. Therefore, it can be stated that there is a tendency in the difference in achievement between boys and girls in Mathematics as they proceed through their secondary academic school years.

In class X, in case of knowledge and skill there is no significant difference in achievement between boys and girls in Mathematics in case of two tailed test of significance at .05 level and at .01 level of significance and at .01 level of significance of one tailed test of significant. It is significance only at .05 level of significance of one tailed test only. Therefore the hypothesis is kept.

In case of class X, in case of understanding, these is significant difference in mathematical achievement between boys and girls at .05 and at .01 level of significance of both the cases of one and two tailed test of significance.

In case of X, in Application, there is no significant difference in achievement between boys and girls in

Mathematics at .05 level and at .01 level of significance in both the tests of one and two tailed test of significance.

S – for both two I one tailed hypothesis at 0.05

NS – for both two I one tailed hypotheses at 0.01.

Hypotheses seems to partially tenable as per the results.

In case of class X, in Arithmetics, there is no significant difference between the mean scores of boys and girls at .01 level of both the tests of one and two tailed test of significance, but there is significant difference between the mean scores at .05 level of significance of both the tests – one and two tailed test of significance.

H6 is moderately significant. (Mukherjee) (Algebra)

In class X, in Algebra, there is no significant difference between the mean scores of boys and girls at .05 level and at .01 level of significance in one and two tailed test of significance except at .05 level of one tailed test.

In class X, Geometry, there is no significant difference in mathematical achievement between the mean scores of boys and girls at .05 level and at .01 level of significance in one and two tailed test of significance.

In the light of the above analysis it is predicted that

Though the achievement of boys has been increased from class VI to Class VIII but stunted in X. But the achievement of girls has increased gradually from class VI to X (Table -). The trend is pretty consistent that the disparity remains throughout the secondary school. Again it can be stated that there is a trend is the difference in mathematical achievement between boys and girls as they proceed through their secondary school years.

8. Conclusion

The main objective of the study was to ascertain the disparity if any, in mathematical achievement between boys and girls in the secondary schools of West Bengal and upto what extent the disparity exists? For this purpose, the result of the “Achievement Cum Diagnostic Test” in Mathematics, conducted by the centre for pedagogical study in Mathematic in West Bengal from the representative district of the South 24 Parganas was selected on the population of the study. In order to assess the achievement throughout secondary school, the result of the three classes i.e. Class VI, VIII and X had been considered. Finally, the outcome of the analysis had been predicted for the purpose of getting an idea about secondary school boys and girls as a whole. The test was multidimensional and included assessments of Knowledge and skill, understanding, Application and Arithmetics, Algebra and Geometry.

From the study, it can be concluded that the boys appear to be higher achievers than girls in all aspects, i.e., class VI, VIII and X. In particular, the boys of class VI and VIII have achieved significantly better / higher than that of the girls in all the aspects of the ADTM test. This indicates that boys are

possibly better achievers in mathematics than that of the girls throughout the secondary school stages (Class VI, VIII and X). However the margins of difference of achievement is slightly less in the higher class, specifically in class X. This is probably because girls who appeared for the test, in class X had persisted with education and were ambitious enough to have submitted themselves to this essential voluntary evaluation. They are possibly not the most ordinary sort of girls students and they may represent a selective sample. Yet, it remains that the trend throughout secondary school stages, boys had a district advantage over the girls in mathematics.

9. Limitations

The investigation had the following limitations:

- 1) It is an initial study to seen whether there is any disparity in mathematical achievement between boys and girls, the roof of which exists in the social and psychophysical development.
- 2) A greater representativeness of sampling might have givent more effective result related to the performance of boys and girls.
- 3) Only class VI, VIII and X were selected for the purpose of study, and class VII and IX had been eliminated.
- 4) ADTM test was not a standardised test a standardised test must be constructed with a higher index of reliability and validity of ADTM test to make the test more- sound.
- 5) The difference of achievement in mathematical achievement between boys and girls could have been studied on the basis of the socio- economic strata of the society.
- 6) The investigator could have had a longitudinal dimension to see whether the difference in mathematical achievement between boys and girls increased or decreased over the years, and if so, to what extent if occurred?
- 7) The socio- cultural status of girls in the society requires an in-depth study to determine under achievement of girls in mathematics as compared to the boys.
- 8) The limitation of the study is unavoidable to pressure of time and resource.

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