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Assessing Gender Parity in Mathematical Skills Among IX Graders: A Statistical Analysis

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Abstract

This research examines the distinct ways in which boys and girls in Grade IX in Vadodara city develop their mathematical abilities. It employs a descriptive survey method. A total of 261 students were chosen from four randomly selected schools that belong to the Gujarat Secondary and Higher Secondary Education Board (GSHSEB). For data collection, a specialized instrument was employed that featured a "Mathematical Skills Achievement Test" and a questionnaire to obtain details about the students and their perspectives. The evaluation measured five essential aspects of mathematics: spatial reasoning, numerical skills, algebraic functions, data interpretation, and problem-solving abilities. Descriptive and inferential statistical techniques were applied for data analysis.

The independent samples t-test was utilized to compare the mean scores for boys and girls. The findings indicated that there was no notable difference in math skills between male and female students, signifying that both groups demonstrated comparable abilities. These results dispute the widely held notion that there are considerable gender disparities in math performance. They also emphasize the importance of offering equal educational opportunities and assistance for every student. Furthermore, the research indicates that elements such as student motivation, instructional techniques, and classroom activities could influence math performance more significantly than gender by itself.

Keywords: *Gender differences, Mathematical skills, Secondary education, Educational equity*

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Introduction

Differences in mathematical achievement between boys and girls have intrigued educational researchers for numerous years. Results from standardized tests often show that male students tend to score higher, particularly in secondary and post-secondary levels (Hyde, Fennema, & Lamon, 1990). Nonetheless, the nature of the mathematical tasks can influence these disparities. Studies show that boys typically excel in intricate or unconventional problems, whereas girls tend to succeed in typical, classroom-focused math activities (Gallagher et al., 2000).

Solving mathematical problems entails multiple steps, such as comprehending the issue, formulating a strategy, implementing the solution, and assessing the outcomes (Willson, Fernandez, & Hadaway, 1993). Additional studies indicate that boys and girls frequently employ different approaches in tackling math problems. Boys generally utilize visual and spatial reasoning combined with estimation techniques, while girls are more inclined to employ systematic and sequential strategies learned in school (Carr & Jessup, 1997). These variations highlight the importance of examining how learners tackle problems instead of solely concentrating on the solutions they offer.

For numerous years, both researchers and society have been focused on exploring potential variances in cognitive skills between genders.

The Research on Mathematically Gifted Youth indicated that a higher number of boys were present among individuals with exceptional mathematical reasoning abilities (Benbow & Stanley, 1980). Nonetheless, newer research indicates that these disparities have diminished over time and are typically not significant (Hyde et al., 2008). Although there is no considerable difference in overall intelligence between men and women, differences in problem-solving approaches and the nature of math problems can influence performance results.

Historical Background

Mathematics has historically been regarded as an essential aspect of human advancement, representing logical reasoning, accuracy, and analytical abilities. Nonetheless, involvement with and attitudes towards mathematics for individuals have frequently been influenced by societal norms and perceptions regarding gender. For many years, math was viewed as an area where males excelled more, while females were considered to possess less inherent ability in

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it (Hyde, Fennema, & Lamon, 1990). Even though changes in education and new studies have questioned these ideas, their effects still influence how students feel about math, their confidence, and how well they do in it, in many different parts of the world (NCERT, 2006). The idea of "greater male variability" makes more sense when we consider the changing roles of men and women in society. This theory became more well-known in the late 1800s and early 1900s, a time of major social change and growing demands for women's rights and better education. At that time, both society and science often believed that women were not as smart as men. The theory became more popular again in the 1970s, during the rise of the women's movement, when people started to closely look at old gender roles. As studies showed that differences in thinking between men and women were small or even decreasing, those who supported the greater male variability idea used it to explain why more men were often found in areas where there was a very high level of math ability (Benbow, 1988).

Importance of Math Skills in Secondary Education

Secondary education is a vital period for students' academic development, as it establishes a solid groundwork of essential knowledge and influences future learning trajectories. Possessing strong mathematical abilities at this level is crucial for pursuing further education and entering careers in the fields of science, technology, engineering, and mathematics (STEM) (Hine et al., 2016). Improving mathematical abilities at this stage also contributes to enhancing logical thinking, reasoning skills, and confidence in solving issues (Joyce, Hine, & Anderton, 2017).

In secondary schools, teaching mathematics is essential for fostering students' critical thinking and problem-solving skills.

The National Council of Teachers of Mathematics (2000) states that solid math abilities significantly influence students' future educational and career prospects. Simultaneously, gender-related factors still influence the way students grasp mathematics. These elements encompass teacher expectations, peer influence, curriculum design, and students' self-perception (Gafoor & Kurukkan, 2015). These factors can impact how boys and girls engage, express interest, and excel in mathematics in various ways.

Overview of Existing Debates and Studies on Gender Differences

The conversation regarding gender disparities in math performance has evolved significantly over the years. Initial studies frequently indicated that boys generally excelled in mathematical

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reasoning, particularly in advanced educational settings. Nevertheless, subsequent research evaluating numerous earlier findings, such as those conducted by Hyde et al. (1990) and Lindberg, Hyde, Petersen, and Linn (2010), revealed that there are typically minimal or no significant discrepancies in math performance between boys and girls across most groups. Nonetheless, societal norms, educational environments, and upbringing continue to influence girls' confidence levels, their interest, and their engagement in math-related subjects and activities (Sharma & Devi, 2014).

Methodology

Research Design

This research employed a Descriptive Survey Research Design to investigate gender disparities in mathematical abilities among Grade IX learners. This method enabled the researcher to methodically collect, interpret, and analyze data while keeping all variables unchanged. The primary goal was to outline students' existing math skills and examine differences based on gender.

Population

The target population included all Grade IX students enrolled in GSHSEB-affiliated schools in Vadodara city during the academic year 2024–2025.

Sample and Sampling Technique

A simple random sampling method was used to select a representative sample. Four schools were randomly chosen from GSHSEB schools in Vadodara. From each selected school, about 50% of Grade IX students were randomly picked based on class sections. The final sample consisted of 261 students (117 girls and 144 boys). The table below shows the school-wise and gender-wise breakdown of the sample:

S.N.	Name of the School	Male	Female	Total	Type of School
1	Vidyut Board Vidyalaya	24	25	49	Grant-in-aid
2	Kelawani English Medium School	50	28	78	Grant-in-aid
3	University Experimental School	15	17	32	Private
4	Jai Ambe Vidyalaya	58	44	102	Private

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Tools for Data Collection

Two main tools were used:

1. Student Information and Attitude Sheet: This sheet collected:

- Demographic details (name, age, gender, school)
- Interest in math (Yes/No)
- Subject-wise interest ratings
- Marks obtained in Grade VIII math
- Frequency of math practice at home
- Motivational and demotivational factors influencing math learning.

2. Achievement Test on Mathematical Skills

This test consisted of 25 questions evenly spread across five key mathematical skill areas:

- Spatial Awareness
- Arithmetic
- Algebraic Manipulation
- Statistical Reasoning
- Problem Solving

Each skill area had five questions in five formats: multiple-choice, true/false, fill in the blanks, match the following, and short descriptive answers. Each question was worth one mark, giving a total score of 25. The test lasted one hour.

Procedure for Data Collection

Approval was secured from the head administrators of the chosen schools. The researcher directly conducted the tests in collaboration with the school officials, aiming to minimize interference with normal academic operations. Participants were made aware of the study's aim and were given uniform guidelines. Testing conditions remained uniform to guarantee the dependability of outcomes. The researcher gathered Grade VIII math scores of students from official school records to analyze the comparison between previous performance and current abilities.

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Data Analysis

The information gathered was assembled and examined with Microsoft Excel. The study incorporated both descriptive statistics (mean, median, mode, standard deviation, range, frequencies, and percentages) and inferential statistics for hypothesis testing.

• Overall performance was summarized using descriptive statistics.

• Inferential statistics utilized the independent samples t-test (assuming equal variances) to assess the significance of the differences in mean scores between boys and girls.

Statement of the Research Problem

"Gender-based differences in the mathematical skill development of Grade IX students in Vadodara city."

Objectives of the Study

To compare the mean mathematical skill scores of Grade IX boys and girls in Vadodara city.

Research Hypothesis

The hypothesis aims to find out if there is a significant difference in the mean scores of mathematical skills between girls and boys.

Null Hypothesis (H_0): There is no significant difference in the mean scores of mathematical skills between girls and boys. Mathematically,

Ho: $\mu_1 = \mu_2$

Alternative Hypothesis: There is a significant difference in the mean scores of mathematical skills between girls and boys. Mathematically,

H_1: $\mu_1 \neq \mu_2$

where,

x_1: represents the mathematical skills scores of girls.

x_2: represents the mathematical skills scores of boys.

μ_1: Mean of mathematical skills scores of girls.

μ_2 = Mean of mathematical skills scores of boys.

Statistical Test Used

To test this hypothesis, a t-Test: Two-Sample Assuming Equal Variances was conducted using Microsoft Excel **t-Test summary:**

The results obtained from the t-test are presented in the following table:

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Statistic	Girls (Variable 1)	Boys (Variable 2)
Mean	13.5263	14.3809
Variance	19.2073	23.7306
Observations (n)	114	147
Pooled Variance	21.7571	-
Hypothesized Mean Difference	0	-
Degrees of Freedom (df)	259	-
t-Statistic (t_{cal})	-1.4682	-
P(T<=t) one-tail	0.0716	-
t Critical one-tail	1.6508	-
P(T<=t) two-tail	0.1433	-
t Critical two-tail	1.9692	-

Interpretation of Results

Step 1: Identify the Test Statistic and Decision Rule

Since the sample sizes are greater than 30, the t-test assumes normality under the Central Limit Theorem. The decision rule for hypothesis testing is as follows:

The test statistic is calculated as:

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{s * \sqrt{\frac{1}{n1} + \frac{1}{n2}}}$$

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Null Hypothesis	Alternative Hypothesis	Test statistic	Rejection criterion Reject H_0 if
$H_0 : \mu_1 = \mu_2$	(1) $H_1 : \mu_1 > \mu_2$ (2) $H_1 : \mu_1 < \mu_2$ (3) $H_1 : \mu_1 \neq \mu_2$	$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{s * \sqrt{\frac{1}{n1} + \frac{1}{n2}}}$ where $s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$	(1) $t_{cal} > t_{v,\alpha}$ (2) $t_{cal} < -t_{v,\alpha}$ (3) $\lvert t_{cal} \rvert > t_{v,\alpha/2}$ where, $v = n_1 + n_2 - 2$

- The null hypothesis is tested against the alternative hypothesis using a two-tailed test at a 5% level of significance (α=0.05).
- The critical value from the t-distribution table for df = 259 at α/2 = 0.025 (two-tailed test) is 1.9692.

Step 2: Compare Test Statistic with Critical Value

The calculated t-statistic is $|t_{cal}| = 1.468$, which is less than the critical value 1.969.

1.468<1.969

Step 3: Decision Making

At the 5% significance level (α = 0.05), the critical t-value for a two-tailed test with 259 degrees of freedom is approximately ±1.9692.

Since the calculated t-value (-1.4682) lies within the range -1.9692 to +1.9692, and the p-value (0.1433) > 0.05, that is the absolute value of the calculated t-statistic does not exceed the critical value, we do not reject the null hypothesis (H_0) at the 5% significance level we that is we fail to reject the null hypothesis (H_0).

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Step 4: Conclusion

Because we fail to reject H_0, we determine that there is no meaningful difference in the average mathematical skills scores of girls and boys.

This discovery indicates that boys and girls exhibit comparable mathematical abilities in the examined sample. Any small variations in scores might result from random fluctuations instead of a fundamental gender-related gap in math abilities.

Conclusion from Statistical Analysis

The study indicates that gender has no meaningful impact on mathematical skill scores for Grade IX students in the analyzed sample. The results affirm the null hypothesis, suggesting that boys and girls achieve similar performance in mathematics at this educational stage.

This finding aligns with numerous international studies that have discovered minimal to no gender disparities in math achievement among school-aged students (Hyde et al., 1990; Lindberg et al., 2010).

Implications and Insights

1. **Equity in Performance**: This result promotes the view that mathematical ability is not inherently gendered. Both boys and girls demonstrate comparable competence when provided with similar learning environments.
2. **Policy and Pedagogical Application**: Teachers and educational planners should design instructional strategies free from gender bias and ensure that support systems are equally accessible to all students.
3. **Encouraging Girls in STEM**: Although boys scored slightly higher, the difference was not statistically significant. Thus, girls should be encouraged just as much to study mathematics and related fields, since they have similar abilities.
4. **Focusing on Individual Needs**: Since gender does not play a major role, educators should focus on other factors like socio-economic background, motivation, teaching quality, and learning styles, which may more accurately account for differences in math performance.

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