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A Study Of Relationship Between Academic Achievement In Mathematics And Mathematical Aptitude Of Secondary School Students Of Aizawl

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ABSTRACT

This study explores the relationship between academic achievement in mathematics and mathematical aptitude among secondary school students in Aizawl, Mizoram. Using a sample of 220 students, the research investigates variations in mathematical performance based on gender and school type while examining the correlation between mathematical aptitude and academic success. The findings reveal no significant gender-based differences in academic achievement, but male students show higher mathematical aptitude. Private school students significantly outperform government school students in both academic achievement and mathematical aptitude. A strong positive correlation is identified between academic achievement in mathematics and mathematical aptitude, highlighting the predictive role of aptitude in academic performance. These insights emphasize the need for targeted interventions, gender equity, and improved support systems in mathematics education to enhance learning outcomes.

Keywords: Academic Achievement, Mathematical Aptitude, Gender Differences, Secondary Education

1. Introduction

India has a rich and illustrious history in mathematics, contributing immensely to its development in diverse fields such as algebra, geometry, and number theory. Scholars like Aryabhata, Bhaskara, and Srinivasa Ramanujan have made significant contributions to the global mathematical community, creating a legacy that continues to inspire modern education, as highlighted by Sandhu [1], Joseph [2], and Raju [3]. Mathematics remains a crucial aspect of India's education system, where emphasis on mental calculations, problem-solving, and analytical skills is instilled early, as noted by Singh [4]. This system has enabled Indian students to excel internationally, as demonstrated by their remarkable achievement of securing the fourth position globally at the 2024 International Mathematics Olympiad, according to the IMO [5].

However, the state of Mizoram, despite having the third-highest literacy rate in India, as reported by the Government of India [6], presents a paradoxical scenario where students consistently show poor performance in mathematics. This underachievement raises critical questions about the factors influencing mathematical performance in the region. Kumar and Sinha [7] argue that many students with low academic achievement in mathematics have the potential to improve their performance if provided with the right guidance, resources, and a supportive learning environment. Conversely, Sharma [8] points out that students who score high in mathematics exams may lack a deeper understanding or aptitude for the subject, relying instead on rote memorization or examination-focused strategies.

Bala [9] and Gupta [10] emphasize that understanding mathematical aptitude becomes a key area of focus in such a context. Mathematical aptitude, which refers to an individual's natural ability to understand and solve mathematical problems, is considered a strong predictor of mathematical achievement. Pathak and Srivastava [11] advocate for evaluating mathematical aptitude in secondary school students to identify their unique strengths and weaknesses. This understanding, they argue, helps educators design tailored

interventions to support students' learning processes, maximize their abilities, and foster a more engaging and inclusive approach to mathematics education.

Furthermore, Kaur [12] and Mishra [13] suggest that interventions in mathematics education should not solely aim at improving students' scores but also focus on making mathematics-related occupations and higher studies more appealing to secondary school students. Mukhopadhyay [14] adds that such interventions must address the psychological and social factors influencing students' attitudes toward mathematics, including their confidence, interest, and perceived utility of the subject.

The role of gender in mathematical performance is another area of ongoing debate and research. Heyder et al. [15] and Hyde et al. [16] challenge the common stereotype that males outperform females in mathematics, presenting empirical evidence that the differences in performance between genders are statistically negligible. Choudhary [17] argues that addressing these misconceptions is vital to promoting gender equity in mathematics education and encouraging all students to reach their full potential.

Singh and Verma [18] conclude that assessing the relationship between mathematical aptitude and academic achievement in mathematics is crucial for understanding the diverse factors that impact students' performance. By identifying the specific needs and potential of secondary school students, educators and policymakers can create effective strategies to improve mathematical learning outcomes in Mizoram and beyond.

2. Needs of the Study

Mathematics is universally regarded as a critical subject in shaping cognitive abilities, logical reasoning, and problem-solving skills among students. Despite Mizoram's commendable literacy rate, students in the state exhibit a persistent struggle in achieving satisfactory outcomes in mathematics. This paradox underscores the need to investigate the factors influencing students' mathematical performance, particularly the role of mathematical aptitude. Academic achievement in mathematics and mathematical aptitude are interconnected but distinct constructs, and understanding their relationship can provide valuable insights into students' strengths and weaknesses.

The necessity of this study arises from the observation that high academic achievement in mathematics does not always reflect true mathematical aptitude. Some students who perform well in mathematics exams might lack a deep understanding of the subject, while others who underperform may have latent potential that remains untapped due to a lack of appropriate support, teaching methods, or resources. Therefore, a focused analysis of mathematical aptitude is essential for identifying and addressing the individual needs of students to help them realize their full potential. Additionally, there is a pressing need to design interventions that not only enhance students' academic performance in mathematics but also nurture their interest in pursuing mathematics-related careers. This is especially relevant in a global context where STEM (Science, Technology, Engineering, and Mathematics) fields are increasingly pivotal in driving economic growth and innovation.

This study also seeks to address gender-related misconceptions in mathematical ability, providing evidence-based insights to dispel stereotypes and promote gender equity in mathematics education. By exploring the relationship between academic achievement and mathematical aptitude among secondary school students in Aizawl, this research aims to contribute to the development of a more inclusive and effective mathematics education framework that supports students in achieving both academic success and real-world application of mathematical skills.

3. Objectives of the Study:

1. To assess the academic achievement in mathematics among secondary school students in Aizawl.
2. To evaluate the mathematical aptitude of secondary school students in Aizawl.
3. To compare the academic achievement in mathematics of secondary school students of Aizawl based on:
   a. Gender
   b. Type of the school management (Government vs Private)
4. To compare the mathematical aptitude of secondary school students of Aizawl based on:
   a. Gender
   b. Type of the school management (Government vs Private)
5. To determine the relationship between academic achievement in mathematics and mathematical aptitude among secondary school students.

4. Hypotheses

1. There is no significant difference in the academic achievement in mathematics between male and female secondary school students.
2. There is no significant difference in the academic achievement in mathematics between secondary school students from private schools and government schools.
3. There is no significant difference in the mathematical aptitude of male and female secondary school students.

4. There is no significant difference in the mathematical aptitude of secondary school students from private schools and government schools.
5. There is no significant relationship between academic achievement in mathematics and mathematical aptitude among secondary school students.

5. Method of Study

5.1 Sample
The study was conducted on a sample of 220 secondary school students from Aizawl, Mizoram. The students were selected using a stratified random sampling technique to ensure representation across different schools, genders, and academic levels. This diverse sample was chosen to provide a comprehensive understanding of the relationship between mathematical aptitude and academic achievement in mathematics within the context of Aizawl's education system.

5.2 Tools Used
To assess the mathematical aptitude of the students, *a standardized Mathematical Aptitude Test* was constructed and validated by the researcher. The test was designed to measure various dimensions of mathematical aptitude, including logical reasoning, numerical ability, spatial visualization, and problem-solving skills. The test underwent rigorous validation procedures, including item analysis and reliability testing, to ensure its accuracy and effectiveness in capturing students' mathematical potential.

5.3 Statistical Techniques
The collected data were analyzed using a combination of descriptive and inferential statistical techniques:
Mean and Standard Deviation (SD): These measures were used to describe the central tendency and variability of students' mathematical aptitude and academic achievement scores.
Percentage and Percentile: These statistical tools were employed to categorize and compare students' performance levels in mathematics and aptitude scores.
t-Test: The t-test was used to determine whether significant differences existed in mathematical aptitude and academic achievement across subgroups, such as gender or school type.
Correlation Coefficient: To examine the relationship between mathematical aptitude and academic achievement, the Pearson correlation coefficient was calculated. This provided insights into the strength and direction of the association between the two variables.
By employing these methods, the study aims to uncover patterns and relationships that can inform targeted interventions to improve mathematical performance and foster a supportive educational environment for secondary school students in Aizawl.

6. Analysis and Interpretation of Data
6.1 Academic Achievement in Mathematics
Academic achievement in mathematics reflects the performance levels of students and serves as an essential metric for evaluating their understanding and application of mathematical concepts. Table 1 provides a summary of the academic achievement scores of secondary school students, including the minimum and maximum scores, mean, and standard deviation (SD). This data highlights the range and variability in students' performance, shedding light on the diverse proficiency levels within the sample.

Table No. 1

No. of Student	Minimum Score	Maximum Score	Mean	S.D
220	9	98	55.29	22.7

Observation:
- The minimum academic achievement score in mathematics is 9, while the maximum is 98.
- The mean score is 55.29, and the SD is 22.7.

Interpretation:
The average performance level (mean score of 55.29) indicates that most students have a moderate understanding of mathematics. The high SD of 22.7 suggests significant variability in performance, pointing to the need for targeted interventions to bridge the gap between low and high achievers.

6.2 Mathematical Aptitude of Students
Mathematical aptitude refers to the natural ability of students to understand and solve mathematical problems. It is a crucial determinant of their academic achievement and potential in mathematics-related fields. Table 2 summarizes the results of the Mathematical Aptitude Test administered to the students, highlighting the range of scores, mean, and SD.

Table No. 2

No. of Student	Minimum Score	Maximum Score	Mean	S.D
220	2	19	10.59	4.07

Observation:
- The minimum score in the Mathematical Aptitude Test is 2, and the maximum score is 19.
- The mean score is 10.59, with an SD of 4.07.

Interpretation:
The average score of 10.59 (out of 20) reflects moderate mathematical aptitude among students. The slight shortfall from the midpoint indicates room for improvement in fostering students' problem-solving and analytical skills. The SD of 4.07 highlights moderate variability in aptitude levels within the sample.

6.3 Levels of Mathematical Aptitude

To further analyze the aptitude levels, the students' scores were categorized into five levels: Very Low, Low, Average, High, and Very High. Table 3 presents the distribution of students across these levels, expressed in terms of numbers and percentages.

Table No.3

Level	No. of Student as per level	Percentage
Very Low (1 to 3)	8	3.64
Low (4 to 7)	51	23.18
Average (8 to 14)	121	55
High (15 to 17)	33	15
Very High (18 to 20)	7	3.18

Observation:
- Most students (55%) fall under the Average category of mathematical aptitude.
- A smaller proportion of students are in the Very Low (3.64%) and Very High (3.18%) categories.

Interpretation:
The predominance of students in the Average category suggests a need for consistent academic support to enhance their mathematical abilities. Special attention should be directed to students in the Low and Very Low categories, while students in the High and Very High categories can benefit from enrichment programs to challenge their potential further.

7. Results and Discussion

7.1 Hypothesis No.1: *There is no significant difference in the academic achievement in mathematics between male and female secondary school students*.
An analysis of academic achievement in mathematics among male and female secondary school students aims to determine the presence of any significant differences in performance.

Table No.4: Comparison of Male and Female secondary school students of Mizoram in their Academic Achievement in Mathematics.

Groups	N	Mean	SD	Df	t-value	Level of Significance
Male	84	57.7	23.37	169	1.249	0.05
Female	136	53.77	22.23			

Table 4 shows that the mean academic achievement in mathematics for male students is 57.7 with a standard deviation of 23.37, while female students have a mean of 53.77 with a standard deviation of 22.23. The calculated t-value of 1.249 is lower than the critical value of 1.97 at the 0.05 level of significance. As a result, the null hypothesis is accepted, indicating no statistically significant difference in academic achievement in mathematics between male and female secondary school students in Aizawl City. This suggests that gender does not play a decisive role in determining academic performance in mathematics among the students sampled.

7.2 Hypothesis No.2: *There is no significant difference in the academic achievement in mathematics between secondary school students from private schools and government schools*.
The study compares academic achievement in mathematics between government and private school students to evaluate how institutional factors may impact performance.

Table No.5: Comparison of Govt. School and Private School students of Mizoram in their Academic Achievement in Mathematics.

Groups	N	Mean	SD	Df	t-value	Level of Significance
Male	112	43.56	16.71	201	- 9.12	0.05
Female	108	67.45	21.72			

Table 5 reveals that the mean academic achievement in mathematics for government school students is 43.56 with a standard deviation of 16.71, whereas private school students achieve a substantially higher mean of 67.45 with a standard deviation of 21.72. The observed absolute t-value of 9.12 significantly exceeds the critical value of 1.97 at the 0.05 level of significance. Consequently, the null hypothesis is rejected, indicating a statistically significant difference in academic achievement between students from government and private schools. This result highlights the superior academic performance of private school students in mathematics, which could be attributed to differences in teaching methodologies, resources, or overall academic environments between the two types of institutions.

7.3 Hypothesis No.3: *There is no significant difference in the mathematical aptitude of male and female secondary school students*.
The focus is on identifying any significant differences in mathematical aptitude between male and female students, addressing potential gender-based disparities.

Table No.6: Comparison of Male and Female secondary school students of Mizoram in their Mathematical Aptitude

Groups	N	Mean	SD	Df	t-value	Level of Significance
Male	84	11.53	4.23	164	- 2.67	0.05
Female	136	10.01	3.87			

As presented in Table 6, the mean mathematical aptitude score for male students is 11.53 with a standard deviation of 4.23, while female students have a mean score of 10.01 with a standard deviation of 3.87. The absolute *t*-value of 2.67 surpasses the critical value of 1.98 at the 0.05 significance level. This leads to the rejection of the null hypothesis, confirming a statistically significant difference in mathematical aptitude between male and female students. The results indicate that male students exhibit higher mathematical aptitude than their female counterparts.

7.4 Hypothesis No.4: *There is no significant difference in the mathematical aptitude of secondary school students from private schools and government schools*.
This analysis investigates how the type of school, government or private, influences the mathematical aptitude of secondary school students.

Table No.7: Comparison of Government and Private secondary school students of Aizawl in their Mathematical Aptitude

Groups	N	Mean	SD	df	t-value	Level of Significance
Govt. School	112	8.72	3.66	218	7.85	0.05
Private School	108	12.54	3.53			

Government school students exhibit a mean mathematical aptitude score of 8.72 with a standard deviation of 3.66, whereas private school students achieve a higher mean score of 12.54 with a standard deviation of 3.53. The calculated *t*-value of 7.85 exceeds the critical value of 1.97 at the 0.05 significance level, leading to the rejection of the null hypothesis. This indicates a statistically significant difference in mathematical aptitude between the two groups, with private school students outperforming their government school peers.

7.5 Hypothesis No.5: *There is no significant relationship between academic achievement in mathematics and mathematical aptitude among secondary school students*.
Exploring the correlation between academic achievement in mathematics and mathematical aptitude provides insights into patterns that can guide targeted educational interventions and support strategies.

Table No. 8: Comparison of Academic Achievement in Mathematics and Mathematical Aptitude of Secondary School Student of Aizawl City

Group	N	Mean	S.D	Cor Coff (r)	Level
Academic Achievement in Mathematics	220	55.29	22.7	$r = 0.67$	
Mathematical Aptitude	220	10.59	4.07		

The correlation coefficient (r) of 0.67 indicates a significant positive relationship between academic achievement in mathematics and mathematical aptitude. This finding leads to the rejection of the null hypothesis, affirming that students with stronger mathematical aptitude are more likely to excel academically in mathematics. In essence, the data supports the conclusion that higher mathematical aptitude is associated with better performance in mathematics.

Conclusion

The research provides valuable insights into how academic performance in mathematics correlates with mathematical aptitude among secondary school students in Aizawl. It finds no notable differences in mathematics achievement between genders; however, male students demonstrate stronger mathematical aptitude. The analysis also highlights significant differences in both achievement and aptitude levels between students from government and private schools, with the latter performing better. Additionally, a robust positive relationship is evident between mathematical aptitude and academic achievement, emphasizing the critical role of aptitude in determining success. These results reveal the complex interplay of individual skills, institutional environments, and inherent abilities in shaping mathematical outcomes. To enhance mathematics education, it is vital to address these aspects comprehensively.

Educational Implications

- ***Curriculum Development:*** Emphasizing mathematical aptitude in the curriculum could help nurture problem-solving and logical reasoning skills in students, fostering a deeper understanding of mathematics beyond rote learning.
- ***Teacher Training:*** Teachers should be trained to identify and support students with varying levels of mathematical aptitude, enabling personalized interventions to enhance learning outcomes.
- ***Targeted Interventions:*** Special programs should be designed for government school students to bridge the gap in academic achievement and aptitude compared to private school students. These programs can include remedial classes, additional resources, and mentorship.
- ***Gender Equity:*** Efforts should be made to encourage female students to enhance their mathematical aptitude through mentorship, workshops, and exposure to female role models in STEM fields.
- ***Parental Involvement:*** Parents should be involved in fostering a positive attitude toward mathematics at home, ensuring that students receive consistent encouragement and support.
- ***Aptitude Assessment:*** Regular assessment of mathematical aptitude could help identify students' strengths and areas for improvement, guiding the design of customized learning strategies.
- ***Focus on Government Schools:*** Policymakers should allocate additional resources to government schools, ensuring equitable access to quality mathematics education for all students.

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