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Study on the impact of logical-mathematical intelligence on academic performance of secondary school students

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Abstract
This study investigates the relationship between logical-mathematical intelligence and academic performance among secondary school students in Raipur, Chhattisgarh. Grounded in Howard Gardner's Theory of Multiple Intelligences, the study explores how structured reasoning, pattern recognition, and numerical operations influence overall academic achievement. A survey methodology was used to examine a sample of 80 Seventh Standard students (N = 80; 40 boys, 40 girls) selected via random sampling from a prominent CBSE English medium school in Raipur. Data collection utilized a self-made closed-ended questionnaire structured on a dichotomous scale, verified for content validity and internal consistency. Statistical evaluation was completed using the arithmetic mean, standard deviation, Karl Pearson's coefficient of correlation (r), independent sample T tests and paired samples T tests. The empirical findings reveal an extremely strong positive relationship between logical-mathematical intelligence and academic achievement for both boys ($r = 0.9779$) and girls ($r = 0.9886$), leading to the rejection of the primary null hypothesis (H01). Furthermore, while significant variations in logical reasoning capacities were observed across the general student body ($t = 9.6484$, $df = 79$, $p < 0.05$), comparative gender analysis indicated no statistically significant difference between male and female cohorts ($t = 1.595$, $df = 78$, $p > 0.05$). The paper details critical pedagogical implications, advocating for interactive, problem-based, and strategy driven instructional ecosystems over conventional rote systems to optimize logical development.

Keywords: Multiple intelligences, logical-mathematical intelligence, academic performance, secondary school students, pedagogical strategy

Introduction

The present-day classroom functions as a structural reflection of our broader macro society. It encompasses a wide range of student variety, as demonstrated by different cognitive styles, psychological aptitudes, sociolinguistic backgrounds, and ancestral cultures. In traditional institutional structures, competitive learning modalities are prioritized, sometimes ignoring slow grasping or unusual learners while rewarding those with good algorithmic recall. However, accurate holistic education must accommodate the fundamental tripartite integration of human development: the cultivation of the head (cognitive reasoning, analytical scaffolding), the hands (psychomotor execution, applied theory), and the heart (balanced living, empathy, and emotional intelligence).

To realize a student's full potential, educators must overcome historical misconceptions that associate human intellect primarily with static, unique IQ scores. Howard Gardner's pioneering theory of multiple intelligences transformed cognitive science by proving that intelligence is multifaceted. Among these dimensions, logical-mathematical intelligence stands out as a crucial operational pillar. It effects an individual's ability to systematically solve complicated problems, recognize abstract relational patterns, perform extensive chains of inductive/deductive reasoning, and conduct controlled scientific research.

Encouraging this intelligence is essential in secondary educational settings, particularly during early adolescence. It focuses on common classroom issues such as mathematics anxiety and disengagement by converting abstract numerical problems into concrete, practical frameworks for real life investigations.

Need and Significance of the Study

The theoretical significance is in presenting logical-mathematical intelligence as an essential current topic related to student intelligence, which allows us to explain individual differences between students and improve their educational performance. While traditional educational systems have emphasized consistent, direct instructional approaches based on rote memorization and surface level formula application, they frequently result in conceptual gaps and deep-seated arithmetic anxiety among young adolescents. Standard VII represents an important developmental phase in which students actively transition from concrete operational thinking to formal operational abstract reasoning. Investigating logical-mathematical intelligence at this crucial stage allows academics to better understand how structured reasoning processes develop during early adolescence. By focusing on separate logic measures, this study challenges the usual, limiting emphasis on specific IQ tests, revealing that cognitive capacity is a multifaceted framework that determines how a student processes information.

-solving abilities. Practically, this research provides mathematics teachers actual insights about classroom range, allowing Mathematics has always been viewed as a scary and challenging subject by the majority of school age students. This study highlights how engaging in basic logical reasoning can replace anxiety with formal problemthem to move beyond traditional lectures and

implement targeted strategies such as activity-based learning and puzzle centric frameworks. Modern global frameworks emphasize logical reasoning and critical thinking in personal and national development. Strengthening these skills immediately prepares students to satisfy the analytical needs of a data driven, technology focused workforce. By demonstrating how reasoning levels differ across a regular classroom, the study highlights the importance of specific remedial procedures in ensuring that average and slow learners receive the cognitive framework they require to improve their performance.

Review of Related Literature

- Aksu, G. *et al*. (2015) [2] analyzed the direct and indirect pathways influencing mathematics success among vocational high school students. Using mediation analysis, they found low but statistically significant positive relations between logical thinking skills and subject success and discovered that a student's attitude toward the course plays a vital role in connecting critical thinking tendencies to high academic outcomes.
- Arum, D. P. *et al*. (2018) [3] profiled secondary students' logical-mathematical intelligence across distinct internal operational metrics. Their analysis indicated that while students generally performed at a moderate baseline level, their logical capabilities were heavily driven by their capacity to classify, understand patterns, and establish structural relationships, whereas comparative extraction remained their weakest skill set.
- LR, R. S. *et al*. (2018) [6] investigated the structural relationship between logical-mathematical intelligence and academic achievement in mathematics among Standard IX students. Their findings demonstrated an exceptionally high positive correlation coefficient (r = 0.82), concluding that higher levels of logical-mathematical intelligence are directly linked to superior academic outcomes in analytical subjects.
- Yavich, R. *et al*. (2020) [8] conducted a targeted case study in Israel evaluating the relationship between dominant multiple intelligence types and middle school academic achievement. Their findings revealed that 80.9% of students in high-achieving, accelerated tracks possessed logical intelligence as their primary dominant cognitive trait.
- Herawati, A. *et al*. (2021) [4] investigated the interaction effects between inquiry-based learning frameworks and a student's baseline logical-mathematical intelligence. The empirical evidence confirmed a significant interaction effect, demonstrating that students with high logical-mathematical intelligence excel significantly more under guided inquiry models than those with lower logic baselines.
- Nurhalisa, T. *et al*. (2022) [7] explored the step-by-step problem-solving processes of secondary students across different levels of logical thinking ability. Their findings showed that students with high logical thinking successfully completed all core phases of problem-solving—entry, attack, and review. Conversely, students with low logical thinking only met basic entry requirements and failed to complete the review stage entirely.
- Akhash, S. (2024) [1] evaluated the direct impact of structured logical-mathematical intelligence training on elementary and middle school cohorts. The empirical findings confirmed that targeted cognitive training significantly improved general academic competence, critical thinking, reading aptitude, classroom engagement, and overall learning motivation, proving that logical capacities can be systematically enhanced through deliberate instructional design.

Statement of the Problem

The precise problem under investigation is formally stated as "Study on the Impact of Logical-mathematical Intelligence on Academic Performance of Secondary School Students."

Objectives of the Study

1. To find out the relationship between logical-mathematical intelligence and academic performance
2. To find out the level of logical-mathematical intelligence of standard VII students
3. To study the significant difference between boys and girls with respect to logical-mathematical intelligence of standard VII

Hypotheses of the Study

- **H01:** There is no significant relationship between logical-mathematical intelligence and academic performance.
- **H02:** There will be no difference in the logical-mathematical intelligence of students of standard VII.
- **H03:** There will be no difference between boys and girls with respect to logical-mathematical intelligence of standard VII.

Delimitations of the Study

1. Raipur District has been taken for the research study.
2. Only one CBSE English medium school is taken for the study.
3. The study is delimited only to the students studying in class VII. Each class has 5 sections.
4. The study is limited to 80 students, 40 boys and 40 girls.

Variables of the Problem

- Independent Variable: The level of logical-mathematical intelligence possessed by the secondary school students.
- Dependent Variable: The academic performance of the students.

Target Population and Sampling Frame

The target population comprised secondary school students enrolled in CBSE English Medium institutions within the Raipur District of Chhattisgarh, India. Through convenient school selection and subsequent random sampling across distinct classroom sections, a finalized sample of 80 Seventh Standard students was established.

Table 1: Sampling Distribution Matrix

S. No	Name of Selected School	Boys	Girls	Total
1	Holy Cross S.S. School, Kapa, Raipur (C.G.)	40	40	80

Collection of Data

The questionnaire used for the survey in this research was self-made and verified by the research guide for content validity and clarity.

Tabulation and Analysis of Data
The data collected from the students were tabulated and analyzed using statistical methods.

Statistical Analysis
Mean, standard deviation, Karl Pearson's coefficient of correlation, and T test were calculated for the verification of the hypotheses.

Verification of Hypotheses
On the basis of the objectives of the study, the following hypotheses have been formulated:

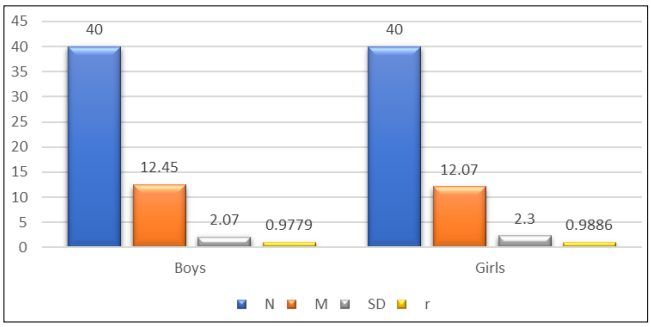
Hypothesis 1 (H01)
There is no statistically significant relationship between logical-mathematical intelligence and academic performance.

Table 2: Correlation Analysis Between Logical-mathematical Intelligence and Academic Performance

Group	N	M	SD	r	Significant or not significant
Boys	40	12.45	2.07	0.9779	Significant
Girls	40	12.07	2.30	0.9886	

Degrees of Freedom (df) = 78

Interpretation
The analysis reveals a strong positive correlation between logical-mathematical intelligence and academic performance across both groups (r boys = 0.9779; r girls = 0.9886). The combined correlation coefficient of 0.9838 with 78 degrees of freedom (df = 78) indicates that higher logical-mathematical intelligence is closely linked to stronger academic performance. Consequently, the null hypothesis H01 is rejected.



Graph 1: Comparison of Logical-mathematical Intelligence and Academic Performance

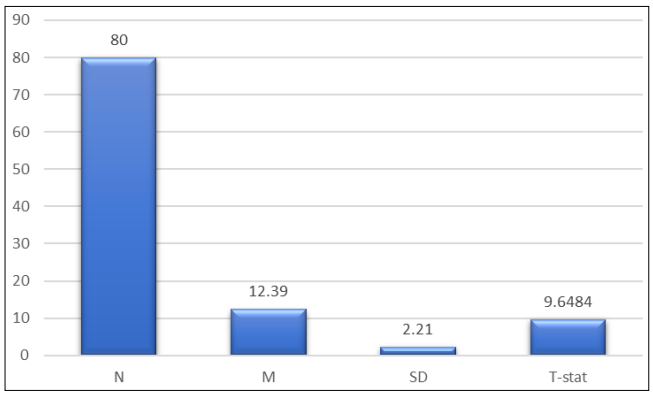
Hypothesis 2 (H02)
There will be no difference in the logical-mathematical intelligence of students of standard VII.

Table 3: One Sample T Test on General Intelligence Distribution

Group	N	M	SD	T stat	Significant or not significant
Combined students of class VII	80	12.39	2.21	9.6484	Significant

Degrees of Freedom (df) = 79

Interpretation
The statistical analysis revealed a mean score of 12.39 and a standard deviation of 2.21. With df = 79, the calculated t value of 9.6484 far exceeds the critical standard table value of 1.99 at the 0.05 significance level. This indicates significant variance in logical-mathematical intelligence levels across individual students in the classroom. Therefore, the null hypothesis H02 is rejected.



Graph 2: Level of Logical-Mathematical Intelligence in Class VII Students

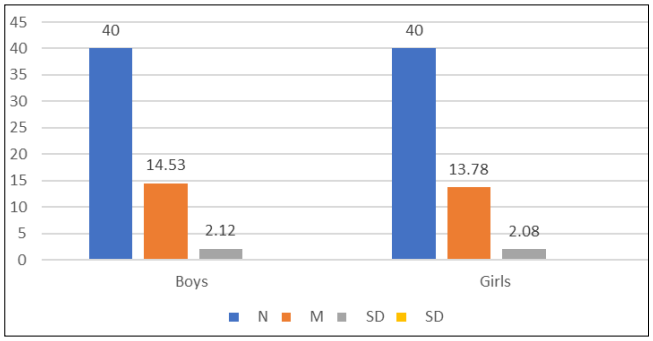
Hypothesis 3 (H03)
There will be no difference between boys and girls with respect to Logical-mathematical Intelligence of standard VII

Table 4: Two Sample Independent T Test Comparing Gender

Group	N	M	SD	T stat	Significant or not significant
Boys	40	14.53	2.12	1.595	Not Significant
Girls	40	13.78	2.08		

Degrees of Freedom (df) = 78

Interpretation
The mean score for boys was 14.53 (σ = 2.12), and for girls, it was 13.78 (σ = 2.08). The calculated independent T statistic of 1.595 (df = 78) is lower than the critical table value of 1.99. This indicates that the minor difference in means is not statistically significant. Thus, H03 is accepted, showing that gender does not significantly affect baseline logical-mathematical intelligence in this cohort.



Graph 3: Comparison of Logical-Mathematical Intelligence of Boys and Girls

Key Findings
1. **Significant Positive Correlation between Intelligence and Academic Performance (H01 Verification)**

The investigation revealed an exceptionally strong, statistically significant positive relationship between logical-mathematical intelligence and academic performance among standard VII students (rcombined = 0.9838, df = 78, p < 0.05). When analyzed by gender subgroups, the correlation

values remained high for both boys (r = 0.9779) and girls (r = 0.9886), resulting in the decisive rejection of the first null hypothesis (H01).

2. Individual Classroom Variance (H02 Verification)

The study established that logical-mathematical intelligence is not uniformly distributed across the student body, revealing a significant internal difference in scores among individual standard VII students. The aggregate student population produced a mean score of 12.39 with a standard deviation of 2.21. The resulting calculated T statistic of 9.6484 (df = 79) significantly exceeded the critical table value of 1.99 at the 0.05 significance level, leading to the rejection of the second null hypothesis (H02).

3. Gender Equality in Logic (H03Verification)

In terms of gender comparison, the two-sample independent T-test revealed that there is no statistically significant difference between boys and girls regarding their baseline logical-mathematical intelligence levels. The mean score achieved by boys was 14.53 (SD = 2.12, n1 = 40), whereas the mean score for girls was 13.78 (SD = 2.08, n2 = 40). Because the calculated T statistic of 1.595 (df = 78) was below the critical standard table value of 1.99, the third null hypothesis (H03) was accepted.

Educational Implications & Recommendations

- **Shift Away from Rote Methods:** Educators should transition from passive memorization to interactive strategies, such as problem-based learning, mathematical logic games, and conceptual visualization tools.

- **Differentiated Learning Support:** Because classrooms exhibit a wide range of logical abilities, schools should implement tiered intervention strategies to support weaker logical-mathematical profiles while challenging advanced students.

- **Enriched Curricular Design:** Curriculum planners should introduce hands-on science activities, puzzle solving, coding principles, and real-world data analysis early in the middle school curriculum.

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