

Effectiveness of Critical Thinking Skills on the Academic Performance of Elementary Level Students

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ABSTRACT

Critical thinking has emerged as one of the most essential skills for students to navigate the complexities of the 21st century. This study investigates the effectiveness of critical thinking skills specifically logical reasoning, analytical skills, evaluation skills, and problem-solving skills on the academic performance of elementary level students. A descriptive survey method was employed with a sample of 1,000 students from 10 schools (5 CBSE and 5 M.P. Board) in Indore city, comprising both government and private institutions. Data were collected using a self-developed questionnaire measuring four critical thinking skills, while academic performance records were obtained from school databases. The findings reveal a significant positive correlation between critical thinking skills and academic performance ($r = 0.624$, $p < 0.01$). Among the four skills, problem-solving emerged as the strongest predictor of academic achievement. Significant differences were found based on gender, type of board, and type of institution, while age showed no significant role. The study underscores the need for integrating critical thinking instruction across the elementary curriculum.

Keywords: Critical thinking, academic performance, elementary education, logical reasoning, analytical skills, evaluation skills, problem-solving skills

1. INTRODUCTION

1.1 General Introduction

Critical thinking encompasses the element skills of argument analysis, drawing inductive or deductive inferences, evaluating or appraising, and decision-making or problem-solving. Background knowledge is a condition but not a sufficiency to allow one to be able to think critically in a given subject. Critical thinking encompasses cognitive abilities as well as dispositions. These can be referred to as dispositions or attitudes or habits of mind and they consist of open and fair-mindedness, inquisitiveness, flexibility, propensity to seek reason, willingness and inclination to be well informed and respect of various viewpoints and willingness to listen and entertain different views.

Teachers have long known about the value of being able to think critically as a result of learning in a student. In much more recent work, the Partnership 21 st Century Skills have

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listed critical thinking as one of the few learning and innovation skills required to equip students to post-secondary education and workforce. Moreover, the Common Core State Standards which were developed recently encompass the cross-disciplinary skill of critical thinking which is essential in college and employment.

1.2 Background

Literature on critical thinking was based on two main areas of academics which are philosophy and psychology (Lewis and Smith, 1993). Sternberg (1986) has also identified a third strand of critical thinking in the area of education.

The philosophical approach, exemplified by Socrates, Plato, Aristotle and more recently Matthew Lipman and Richard Paul, puts greater emphasis on the hypothetical critical thinker, and lists the qualities and characteristics of such an individual instead of the actions or activities that the critical thinker can carry out. Other definitions within this tradition involve an act of reflective and reasonable thinking, which is focused on decision making of what to believe or to do, according to Ennis (1985) and a purposeful and self-focused act which leads to interpretation, analysis, evaluation, and inference, according to Facione (1990).

The cognitive psychological approach is concerned with the way individuals actually think, rather than the ways or means they ought to think in an ideal situation (Sternberg, 1986). The people who have practiced this tradition are inclined to consider critical thinking in terms of what critical thinkers can do. According to Halpern (1998), it is defined as the application of those cognitive skills or strategies with the ability to increase the possibility of a desirable outcome.

This learning method, with the taxonomy of Bloom (1956), is anchored on years of classroom teaching experience, and observations of student learning. Critical thinking is often reported to be expressed in the three high levels of the Bloom taxonomy (analysis, synthesis and evaluation) (Kennedy et al., 1991).

1.3 Types of Critical Thinking Skills

This study focuses on four critical thinking skills:

- **Logical Reasoning:** The ability to use and understand logical connections between facts or ideas
- **Analytical Skills:** The ability to collect and process information and knowledge
- **Evaluation Skills:** The ability to make decisions based on available information
- **Problem-Solving Skills:** The ability to tackle unexpected problems and resolve conflicts

2. REVIEW OF RELATED LITERATURE

Paul (1989) found that dispositions to be disciplined and self-directed thinking could be taught. He maintained that critical thinking was constructed from skills such as spotting conclusions, examining premises, forming conclusions, and diagnosing fallacies.

Dr. Richard Paul, Dr. Linda Elder, and Dr. Ted Bartell (1995) conducted a study of 38 public and 28 private universities to determine faculty emphasis on critical thinking. They found that

although 89% claimed critical thinking to be a primary objective, only 19% could give a clear explanation of what critical thinking is.

Jenny Reed (1998) studied the effect of integrating Richard Paul's model for critical thinking into a U.S. history course and found that community college students' abilities to think historically and critically improved in a single course without sacrificing content knowledge.

Kurum (2002) investigated teacher candidates' critical thinking dispositions and found them to be at mid-level, affected by factors such as age, high school type, and program of study. A positive but weak relationship was found between critical thinking dispositions and academic achievement.

Giancarlo, Blohm, and Urdan (2004) developed the California Measure of Mental Motivation (CM3) and provided evidence that critical thinking disposition exists in adolescents.

Zohre Ghazivakili et al. (2012, 2014) studied the role of critical thinking skills and learning styles in university students' academic performance, finding significant relationships between inferential skills, evaluation skills, deductive reasoning, and academic performance.

I. Lenin in his work "Critical Thinking and its Importance in Education" emphasized that critical thinking can provide a more insightful understanding of oneself and offers an opportunity to be objective, less emotional, and more open-minded.

3. RESEARCH METHODOLOGY

3.1 Statement of the Problem

The present study is an attempt to study the effectiveness of critical thinking skills on the academic performance of elementary level students.

3.2 Variables

1. Major Variables:

- Independent Variable: Critical thinking skills (logical reasoning, analytical skills, evaluation skills, problem-solving skills)
- Dependent Variable: Academic performance

2. Demographic Variables:

- Gender (Male/Female)
- Age (Below 12 years/Above 12 years)
- Board (CBSE/M.P. Board)
- Type of Institution (Government/Private)

3.3 Objectives

1. To study the different levels of critical thinking skills among elementary level students
2. To study the effectiveness of critical thinking skills on students' academic performance at elementary level
3. To study the role of age in developing critical thinking skills among elementary level students

3.4 Hypotheses

1. There is no significant level of critical thinking skills among elementary level students
2. There is no significant effectiveness of critical thinking skills on students' academic performance at elementary level
3. There is no significant role of age in developing critical thinking skills among elementary level students

3.5 Method of Research

The present research employed the Descriptive Survey Method with Sample Survey Technique.

3.6 Population

The population comprised all students studying at elementary level in CBSE and M.P. Board affiliated schools of Indore city.

3.7 Sample

A stratified random sampling technique was used to select 1,000 students from 10 schools:

- 5 CBSE schools (2 government, 3 private): 500 students
- 5 M.P. Board schools (3 government, 2 private): 500 students

Table 1: Sample Distribution

Type of Institution	CBSE	M.P. Board	Total
Government	200	300	500
Private	300	200	500
Total	500	500	1000

3.8 Tools and Techniques of Data Collection

1. **Self-developed Questionnaire:** A two-part questionnaire was developed:
 - Part A: Demographic information (name, age, gender, school, board, class)
 - Part B: 60 items (15 each) measuring four critical thinking skills through MCQs with 4 alternative answers.
2. **School Records:** Annual academic performance percentages were collected from school records

Validity and Reliability: The questionnaire was validated by experts in education and psychology. Reliability was established through test-retest method ($r = 0.86$) and internal consistency (Cronbach's $\alpha = 0.89$).

3.9 Statistical Techniques

Data were analysed using:

- Descriptive statistics (frequency, percentage, mean, standard deviation)
- Inferential statistics (t-test, ANOVA, Pearson's correlation coefficient)
- Multiple regression analysis

4. DATA ANALYSIS AND INTERPRETATION

4.1 Descriptive Analysis of Critical Thinking Skills

Table 2: Descriptive Statistics of Critical Thinking Skills (N=1000)

Critical Thinking Skill	Minimum	Maximum	Mean	SD	Percentage
Logical Reasoning (15)	3	15	10.84	2.76	72.27%
Analytical Skills (15)	1	14	8.42	2.51	56.13%
Evaluation Skills (15)	0	15	9.87	2.98	65.80%
Problem-Solving (15)	0	15	10.23	3.12	68.20%
Total (60)	8	58	39.36	9.87	65.60%

Interpretation: The overall mean score of critical thinking skills among elementary students is 39.36 out of 60 (65.60%), indicating a moderate level. Logical reasoning scored highest (72.27%), while analytical skills scored lowest (56.13%). This suggests that students perform better in logical reasoning tasks but struggle with analytical thinking, which requires deeper processing of information.

4.2 Levels of Critical Thinking Skills

Table 3: Classification of Students Based on Critical Thinking Levels

Level	Score Range	Frequency	Percentage
Low (Below 30)	< 30	186	18.6%
Average (30-45)	30-45	524	52.4%
High (Above 45)	> 45	290	29.0%
Total		1000	100%

Interpretation: More than half of the students (52.4%) possess average critical thinking skills, while 29% demonstrate high skills. However, 18.6% of students show low critical thinking abilities, indicating a need for targeted interventions.

4.3 Relationship Between Critical Thinking Skills and Academic Performance

Table 4: Correlation Between Critical Thinking Skills and Academic Performance

Variable	Logical Reasoning	Analytical Skills	Evaluation Skills	Problem-Solving	Total CTS	Academic Performance
Logical Reasoning	1.00					
Analytical Skills	0.412**	1.00				
Evaluation Skills	0.456**	0.498**	1.00			
Problem-Solving	0.523**	0.467**	0.512*	1.00		
Total CTS	0.782**	0.743**	0.801*	0.798**	1.00	
Academic Performance	0.512**	0.487**	0.534*	0.589**	0.624*	1.00

**Correlation is significant at the 0.01 level (2-tailed)

Interpretation: There is a significant positive correlation ($r = 0.624$, $p < 0.01$) between critical thinking skills and academic performance. Among the four skills, problem-solving shows the highest correlation ($r = 0.589$), followed by evaluation skills ($r = 0.534$). This indicates that students with better critical thinking abilities tend to perform better academically.

4.4 Regression Analysis: Predicting Academic Performance from Critical Thinking Skills

Table 5: Multiple Regression Analysis Summary

Predictor	B	SE	β	t	p
(Constant)	32.45	3.21		10.11	0.000
Logical Reasoning	1.23	0.34	0.156	3.62	0.000
Analytical Skills	1.08	0.31	0.142	3.48	0.001

Evaluation Skills	1.45	0.36	0.189	4.03	0.000
Problem-Solving	1.89	0.38	0.234	4.97	0.000

$R = 0.642$, $R^2 = 0.412$, Adjusted $R^2 = 0.408$, $F(4,995) = 174.23$, $p < 0.001$

Interpretation: The regression model explains 41.2% of the variance in academic performance ($R^2 = 0.412$). Problem-solving skills ($\beta = 0.234$) emerged as the strongest predictor, followed by evaluation skills ($\beta = 0.189$). All four skills significantly contribute to predicting academic performance ($p < 0.01$).

4.5 Hypothesis Testing

Hypothesis 1: Levels of Critical Thinking Skills

H₀₁: There is no significant level of critical thinking skills among elementary level students.

Table 6: Chi-Square Test for Distribution of Critical Thinking Levels

Level	Observed	Expected	χ^2	df	p
Low	186	333.33			
Average	524	333.33	187.56	2	0.000
High	290	333.33			

Interpretation: The chi-square value (187.56, $p < 0.001$) indicates that the distribution of students across different levels of critical thinking skills is not uniform. The null hypothesis is rejected, confirming that there are significant differences in the levels of critical thinking skills among elementary students.

Hypothesis 2: Effectiveness of Critical Thinking Skills on Academic Performance

H₀₂: There is no significant effectiveness of critical thinking skills on students' academic performance.

Based on the correlation ($r = 0.624$, $p < 0.01$) and regression analysis ($F = 174.23$, $p < 0.001$), the null hypothesis is rejected. Critical thinking skills significantly affect academic performance.

Hypothesis 3: Role of Age

H₀₃: There is no significant role of age in developing critical thinking skills.

Table 7: Comparison of Critical Thinking Skills by Age Group

Age Group	N	Mean	SD	t-value	df	p

Below 12 years	456	39.12	9.76	0.842	998	0.401
Above 12 years	544	39.56	9.94			

Interpretation: The t-value (0.842, $p > 0.05$) is not significant, indicating no significant difference in critical thinking skills between younger and older elementary students. The null hypothesis is accepted.

Table 8: Comparison of Critical Thinking Skills by Institution Type

Institution	N	Mean	SD	t-value	df	p
Government	500	36.12	9.45	8.34	998	0.000
Private	500	42.60	8.97			

Interpretation: The t-value (8.34, $p < 0.001$) is significant, indicating that private school students (Mean = 42.60) possess significantly higher critical thinking skills than government school students (Mean = 36.12). The null hypothesis is rejected.

4.6 Two-Way ANOVA: Interaction Effects

Table 11: Two-Way ANOVA for Critical Thinking Skills by Board and Institution Type

Source	Sum of Squares	df	Mean Square	F	p
Board	5640.23	1	5640.23	47.56	0.000
Institution Type	6930.45	1	6930.45	58.43	0.000
Board × Institution	890.12	1	890.12	7.51	0.006
Error	118,000.00	996	118.60		
Total	131,460.80	999			

Interpretation: Both board type ($F = 47.56$, $p < 0.001$) and institution type ($F = 58.43$, $p < 0.001$) have significant main effects. The significant interaction effect ($F = 7.51$, $p < 0.01$) indicates that the advantage of private schools is more pronounced in CBSE than in M.P. Board.

4.7 Skill-wise Analysis

Table 12: Gender-wise Comparison of Individual Critical Thinking Skills

Skill	Male Mean	Female Mean	t-value	p

Logical Reasoning	10.52	11.18	3.89	0.000
Analytical Skills	8.12	8.76	4.02	0.000
Evaluation Skills	9.45	10.32	4.56	0.000
Problem-Solving	10.03	10.46	2.18	0.030

Interpretation: Females outperformed males in all four critical thinking skills, with the largest differences in evaluation skills and analytical skills.

5. MAJOR FINDINGS

- Levels of Critical Thinking Skills:** Elementary students demonstrated moderate levels of critical thinking skills (Mean = 39.36/60, 65.60%). Logical reasoning was the highest-scoring skill (72.27%), while analytical skills were the lowest (56.13%). The distribution showed 18.6% low, 52.4% average, and 29% high critical thinking levels.
- Relationship with Academic Performance:** A significant positive correlation ($r = 0.624$, $p < 0.01$) was found between critical thinking skills and academic performance. Problem-solving skills showed the strongest correlation ($r = 0.589$), followed by evaluation skills ($r = 0.534$).
- Predictive Power:** Critical thinking skills collectively explained 41.2% of the variance in academic performance. Problem-solving emerged as the strongest predictor ($\beta = 0.234$), followed by evaluation skills ($\beta = 0.189$).

6. CONCLUSIONS

Based on the findings of this study, the following conclusions can be drawn:

- Critical thinking skills are essential for academic success:** The significant positive relationship between critical thinking skills and academic performance confirms that these skills are not merely desirable but essential for elementary students' academic achievement.
- Variation in skill development:** Students demonstrate varying levels of proficiency across different critical thinking skills, with logical reasoning being relatively stronger and analytical skills requiring more attention.
- Problem-solving as a key competency:** Problem-solving skills emerged as the most powerful predictor of academic performance, suggesting that curriculum and instruction should prioritize this skill.

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