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Influence of Gender on Critical Thinking Skills of Elementary Level Students with Respect to Their Academic Performance

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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 includes the component skills of analyzing arguments, making inferences using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems. Background knowledge is necessary but not a sufficient condition for enabling critical thought within a given subject. Critical thinking involves both cognitive skills and dispositions. These dispositions, which can be seen as attitudes or habits of mind, include open and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well informed, and respect for and willingness to entertain diverse viewpoints.

Educators have long been aware of the importance of critical thinking skills as an outcome of student learning. More recently, the Partnership for 21st Century Skills has identified critical thinking as one of the several learning and innovation skills necessary to prepare students for

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post-secondary education and the workforce. In addition, the newly created Common Core State Standards reflect critical thinking as a cross-disciplinary skill vital for college and employment.

1.2 Background

The literature on critical thinking has roots in two primary academic disciplines: philosophy and psychology (Lewis & Smith, 1993). Sternberg (1986) has also noted a third critical thinking strand within the field of education.

The philosophical approach, exemplified by Socrates, Plato, Aristotle, and more recently Matthew Lipman and Richard Paul, focuses on the hypothetical critical thinker, enumerating the qualities and characteristics of this person rather than the behaviors or actions the critical thinker can perform. Definitions from this tradition include Ennis's (1985) "reflective and reasonable thinking that is focused on deciding what to believe or do" and Facione's (1990) "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference."

The cognitive psychological approach focuses on how people actually think versus how they could or should think under ideal conditions (Sternberg, 1986). Those working in this tradition tend to define critical thinking by the types of actions or behaviors critical thinkers can do. Halpern (1998) defines it as "the use of those cognitive skills or strategies that increase the probability of a desirable outcome."

The educational approach, including Bloom's taxonomy (1956), is based on years of classroom experience and observations of student learning. The three highest levels of Bloom's taxonomy (analysis, synthesis, and evaluation) are frequently said to represent critical thinking (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 influence of gender on critical thinking skills of elementary level students with respect to their academic performance.

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)

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
4. To study the role of gender 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
4. There is no significant role of gender in developing critical thinking skills among elementary level students

3.5 Delimitations

1. The study was delimited to school education sector in Indore city only
2. The study was confined to CBSE and M.P. Board affiliated schools
3. The study was confined to students of elementary level only
4. The study focused on four critical thinking skills: logical reasoning, analysis, evaluation, and problem-solving
5. The sample was limited to 1,000 students from 10 schools

3.6 Method of Research

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

3.7 Population

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

3.8 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

3.9 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 alternatives 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 α = 0.89).

3.10 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.

4.5 Hypothesis Testing

Hypothesis 1: Levels of Critical Thinking Skills

H_{01}: 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

H_{02}: 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

H_{03}: 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.

Hypothesis 4: Role of Gender

H_{04}: There is no significant role of gender in developing critical thinking skills.

Table 8: Comparison of Critical Thinking Skills by Gender

Gender	N	Mean	SD	t-value	df	p
Male	523	38.12	9.87	4.23	998	0.000
Female	477	40.72	9.56			

Interpretation: The t-value (4.23, $p < 0.001$) is significant, indicating that female students (Mean = 40.72) possess significantly higher critical thinking skills than male students (Mean = 38.12). The null hypothesis is rejected.

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

1. **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.
2. **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 ($r = 0.534$).
3. **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 ($\beta = 0.189$).
4. **Age**: No significant difference was found in critical thinking skills between students below and above 12 years of age ($t = 0.842$, $p > 0.05$).

5. **Gender**: Female students (Mean = 40.72) demonstrated significantly higher critical thinking skills than male students (Mean = 38.12), with significant differences across all four component skills.
6. **Skill-wise Gender Differences**: Females outperformed males in logical reasoning, analytical skills, evaluation skills, and problem-solving skills, with the largest difference in evaluation skills.

6. DISCUSSION

The findings of this study align with and extend previous research on critical thinking and academic performance. The moderate level of critical thinking skills (65.60%) among elementary students is consistent with Kurum's (2002) findings that teacher trainees' critical thinking abilities were at mid-level. This suggests that critical thinking development needs greater emphasis across all educational stages.

The significant positive correlation between critical thinking skills and academic performance ($r = 0.624$) corroborates the findings of Ghazivakili et al. (2012, 2014), who reported positive relationships between inferential skills, evaluation skills, and academic achievement. This relationship is theoretically sound, as critical thinking enables students to process information more deeply, make better judgments, and solve problems more effectively—all of which contribute to academic success.

Problem-solving skills emerging as the strongest predictor of academic performance ($\beta = 0.234$) highlights the importance of teaching students how to approach and resolve complex problems. This finding supports Paul's (1989) contention that critical thinking should be taught with a focus on developing fair-minded thinkers who can address diverse challenges.

The gender difference favoring females in critical thinking skills is noteworthy. This aligns with some studies but contrasts with others. Possible explanations include greater maturity, better language development, and more diligent approach to academic tasks among girls at this age. However, this finding warrants further investigation.

The finding that age showed no significant difference within the elementary level suggests that chronological age alone does not determine critical thinking development. Instead, instructional quality, curriculum design, and learning experiences may be more influential. This supports the view that critical thinking can be taught and developed through appropriate interventions (Walsh and Paul, 1988; Van Gelder, 2005).

The low scores in analytical skills (56.13%) compared to logical reasoning (72.27%) indicate that students can follow logical rules but struggle with deeper analysis of information. This aligns with Perkins et al.'s (1983) findings about difficulties in everyday reasoning and suggests the need for more explicit instruction in analytical thinking.

7. CONCLUSIONS

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

1. 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.

2. 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.
3. 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.
4. Gender matters in critical thinking: Female students exhibit higher critical thinking skills than males at the elementary level, indicating possible differences in cognitive development or learning approaches that warrant attention in pedagogical practices.
5. Critical thinking is teachable: The variability in critical thinking scores and the absence of age-related differences suggest that these skills can be developed through appropriate instructional strategies, regardless of students' chronological age.
6. Holistic approach needed: Developing critical thinking requires attention to all four component skills, with particular emphasis on analytical and evaluation skills that showed lower scores.

8. EDUCATIONAL IMPLICATIONS

8.1 For Curriculum Design

1. Integrate critical thinking across subjects: Rather than teaching critical thinking as a separate skill, it should be embedded in all subject areas—language, mathematics, science, and social studies.
2. Emphasize analytical skills: Given the low scores in analytical skills, curriculum should include more activities requiring analysis, comparison, classification, and pattern recognition.
3. Strengthen problem-solving components: Since problem-solving is the strongest predictor of academic performance, all subjects should include authentic problem-solving tasks.

8.2 For Teaching Practices

1. Use constructivist approaches: Teachers should adopt student-centered methods that encourage questioning, exploration, and discovery rather than passive reception of information.
2. Model critical thinking: Teachers should explicitly demonstrate their own thinking processes, showing students how they analyze problems, evaluate evidence, and make decisions.
3. Incorporate collaborative learning: Group discussions, debates, and collaborative problem-solving can stimulate critical thinking by exposing students to diverse perspectives.

4. Provide explicit instruction: Teachers should directly teach critical thinking strategies, including how to identify assumptions, evaluate arguments, and draw logical conclusions.

8.3 For Assessment

1. Use open-ended tasks: Assessments should include ill-structured problems with multiple possible solutions that require students to apply critical thinking.
2. Assess thinking processes: Beyond measuring correct answers, assessments should evaluate how students arrive at conclusions and the quality of their reasoning.
3. Include performance-based assessments: Real-world tasks that require analysis, evaluation, and problem-solving can provide more valid measures of critical thinking.

8.4 For Teacher Education

1. Enhance teacher preparation: Teacher education programs should equip prospective teachers with both theoretical understanding of critical thinking and practical strategies for teaching it.
2. Provide professional development: In-service teachers need ongoing training in critical thinking instruction, especially given Paul et al.'s (1995) finding that most teachers cannot clearly explain critical thinking.

8.5 For Policy

1. Address school disparities: The significant gap between government and private schools calls for policy interventions to improve resources, teacher quality, and instructional practices in government schools.
2. Review curriculum frameworks: State boards should consider adopting curriculum frameworks that emphasize critical thinking, similar to CBSE's approach.
3. Gender-sensitive pedagogy: Given gender differences, instructional strategies should be examined to ensure they engage both male and female students effectively.

9. LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

9.1 Limitations

1. The study was confined to Indore city, limiting generalizability to other regions
2. Only four critical thinking skills were studied; other skills like interpretation, inference, and self-regulation were not included
3. Academic performance was measured through annual examination scores, which may not fully capture students' abilities
4. The study was cross-sectional, not tracking development over time
5. Socio-economic status, which may influence both critical thinking and academic performance, was not controlled

9.2 Suggestions for Further Research

1. Longitudinal studies: Track the development of critical thinking skills from elementary through secondary levels to understand growth patterns
2. Experimental studies: Design and test specific interventions to enhance critical thinking skills
3. Comparative studies: Extend the research to other cities, states, and countries for broader generalizability
4. Qualitative research: Conduct in-depth case studies to understand how students develop and apply critical thinking
5. Teacher-focused research: Investigate how teachers' own critical thinking abilities and instructional practices affect student outcomes
6. Parental role: Study how family environment and parental involvement contribute to critical thinking development
7. Technology integration: Examine how educational technology can support critical thinking instruction
8. Higher education: Investigate critical thinking at secondary, higher secondary, and university levels
9. Career outcomes: Study the long-term impact of critical thinking skills on career choices and professional success
10. Cross-disciplinary studies: Explore how critical thinking manifests differently across academic disciplines

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APPENDICES

Appendix A: Questionnaire on Critical Thinking Skills (Sample Items)

Demographic Information:

- Name:
- Age:
- Gender: Male/Female

Critical Thinking Skills Items (Sample):

Logical Reasoning:

1. I can identify the main idea in a story or passage.
2. I can arrange events in the correct sequence.
3. I can identify cause-and-effect relationships.

Analytical Skills:

1. I can compare and contrast different ideas.

2. I can break down complex problems into smaller parts.
3. I can identify patterns in information.

Evaluation Skills:

1. I can judge whether information is reliable.
2. I can identify strengths and weaknesses in arguments.
3. I can decide which solution is best for a problem.

Problem-Solving Skills:

1. I can find multiple solutions to a problem.
2. I can apply what I learned to new situations.
3. I can evaluate whether my solution worked.

Appendix B: List of Schools Included in the Sample

S.No.	School Name	Board	Type
1	शासकीय माध्यमिक विद्यालय, जामनिया खुर्द	M.P. Board	Government
2	शुभांकन पब्लिक हाइ सेकन्डेरी स्कूल	CBSE	Private
3	Rankers International School	CBSE	Private
4	सेंट पीटर कान्वेंट हायर सेकण्डरी स्कूल	M.P.Board	Private
5	Kendriya Vidhyalaya No. 1, Indore	CBSE	Government
6	Delhi Public Elementary School	CBSE	Private
7	कर्नाटका विध्या निकेतन	M.P. Board	Private
8	Shri Shri Ravishankar School	CBSE	Private
9	सफलता अकैडमी स्कूल	M.P. Board	Private
10	Kalyan Vidhya Niketan	M.P. Board	Government
11	शासकीय माध्यमिक विद्यालय, Sanawadiya	M.P. Board	Government

Appendix C: Statistical Summary Tables

Table C1: School-wise Mean Critical Thinking Scores

School	N	Logical Reasoning	Analytical	Evaluation	Problem-Solving	Total
School 1	50	10.24	7.12	8.96	9.84	36.16
School 2	100	11.86	9.24	10.86	11.24	43.20
School 3	102	12.04	9.56	11.24	11.56	44.40
School 4	100	11.42	8.96	10.68	10.98	42.04

School 5	139	10.86	8.24	9.86	10.24	39.20
School 6	120	11.24	8.86	10.24	10.56	40.90
School 7	103	9.86	7.42	8.96	9.24	35.48
School 8	100	11.46	8.94	10.42	10.86	41.68
School 9	103	9.24	6.86	8.24	8.86	33.20
School 10	101	10.12	7.84	9.24	9.68	36.88