

Multiple Intelligences, Critical Thinking Skills, and Academic Performance of Students in Mathematics

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ABSTRACT

This quantitative descriptive-correlational study examined the relationships among multiple intelligences, critical thinking skills, and academic performance in Mathematics among Grade 9 students at a private institution in Negros Occidental. Guided by the Theory of Multiple Intelligences and a critical thinking framework, the research utilized an adopted Multiple Intelligence Inventory, a critical thinking skills questionnaire, and students' Mathematics grades to gather data. The respondents were Grade 9 students who had previously completed the Multiple Intelligence Inventory. Descriptive statistics revealed varied intelligence profiles, generally high critical thinking skills, and satisfactory academic performance in Mathematics among the students. However, correlational tests indicated no statistically significant relationships between the independent variables (multiple intelligences and critical thinking skills) and academic performance. These findings suggest that Mathematics achievement may be influenced by a complex interplay of cognitive, instructional, learner-related, and environmental factors, rather than solely by multiple intelligences or critical thinking skills. The study offers insights for educators to develop more diverse and responsive Mathematics learning experiences and encourages further research into the multifaceted factors contributing to students' academic success.

Keywords: multiple intelligences, critical thinking skills, academic performance, Mathematics, Grade 9

INTRODUCTION

Mathematics is recognized as a discipline that develops logical reasoning, analytical thinking, and problem-solving skills. Its concepts and processes support learning in other disciplines and contribute to mathematical literacy, which includes reasoning and the ability to formulate, apply, and interpret mathematics in different contexts (OECD, 2023). Despite its importance, mathematics achievement remains a challenge for many learners. The PISA 2022 results highlighted low levels of proficiency among many Filipino learners, underscoring the need to strengthen mathematics instruction and higher-order thinking.

One learner-related factor considered in the present study is multiple intelligences (MI). Howard Gardner's theory proposes that intelligence is not a single general ability but consists of different forms, including linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligences (Gardner, 1983, 1999). Understanding students' intelligence profiles may help teachers recognize varied ways of learning and design diverse classroom experiences. Research cited in the original study likewise reports that students commonly demonstrate combinations of intelligences and that varied instructional approaches may support engagement and learning (Armstrong, 2020; Sulaiman & Ismail, 2021).

Critical thinking is another learner-related variable relevant to Mathematics. It involves analyzing, interpreting, evaluating, and reflecting on information to make reasoned judgments and decisions. Paul and Elder's framework views critical thinking as a disciplined process that uses evidence, logical reasoning, and reflective

judgment. In mathematics, these processes can be applied when students analyze problems, evaluate solution strategies, and justify their reasoning.

Previous studies cited in the paper have reported positive associations among intelligence profiles, critical thinking, and academic achievement, but findings have varied across contexts. Many studies have examined only one or two of these variables. This created a need for a localized investigation involving Grade 9 students in the study setting. Accordingly, the present study examined the prevailing multiple intelligences, level of critical thinking skills, level of Mathematics performance, and the relationships of multiple intelligences and critical thinking skills with Mathematics performance.

METHODOLOGY

Research Design

The study employed a quantitative approach using a descriptive-correlational research design. The descriptive component was used to determine the levels and distributions of multiple intelligences, critical thinking skills, and academic performance. The correlational component was used to determine whether significant relationships existed between multiple intelligences and academic performance and between critical thinking skills and academic performance. Because the variables were observed without experimental manipulation, the design was appropriate for examining associations rather than cause-and-effect relationships (Creswell & Creswell, 2022).

Subject and Respondents of the Study

The respondents were 103 Grade 9 junior high school students enrolled in a private institution in Negros Occidental during school year 2026–2027.

Population and Sample Size

All Grade 9 students of the said private institution in Negros Occidental who had been administered the Multiple Intelligence Inventory during school year 2025–2026 were included; therefore, no additional sample-size determination or sampling procedure was used.

Data Gathering Instrument

Multiple intelligences were measured using the 70-item Multiple Intelligences Inventory (MII) based on Armstrong's instrument. The inventory assessed seven categories used in the study: Interpersonal, Spatial, Intrapersonal, Musical, Linguistic, Logical (Math), and Bodily/Kinesthetic. The MII data were obtained from the school Guidance Office. The reported internal consistency for the MII in the study sample was Cronbach's $\alpha = 0.77$.

Critical thinking skills were measured using an adapted questionnaire based on Abbas et al. (2025). It consisted of five dimensions—Analysis and Interpretation, Evaluation of Information Sources, Logical Reasoning and Decision-Making, Creativity and Innovation in Solving Tasks, and Reflective Thinking and Self-Assessment—with five items per dimension. Responses used a five-point scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Content validity was established through subject-matter expert evaluation, and a pilot test with 20 secondary school students produced Cronbach's $\alpha = 0.82$.

Academic performance was measured using the students' average Mathematics grade during school year 2025–2026. The grading descriptors used in the study were: 90–100 Outstanding; 85–89 Very Satisfactory; 80–84 Satisfactory; 75–79 Fairly Satisfactory; and below 75 Did Not Meet Expectations.

Data Analyses

Frequency and percentage were used to determine the distribution of prevailing multiple intelligences. Means and standard deviations were used to describe critical thinking skills and Mathematics performance. The Chi-

square test of independence was used to test the relationship between prevailing multiple intelligences and academic performance. Spearman's rank-order correlation was used to test the relationship between critical thinking skills and academic performance. Statistical decisions were made using a 0.05 level of significance.

The formula for mean is presented below:

$$\bar{X} = \frac{\sum x}{n}$$

Where:

$\bar{X}$ = mean

$\sum x$ = sum of all scores

N = number of respondents

The formula for standard deviation is presented below:

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N - 1}}$$

Where:

SD = Standard Deviation

X = Individual score

$\bar{X}$ = Mean

N = Number of respondents

The mean scores of students' critical thinking skills were interpreted as follows:

Score	Description	Mean Score Range	Interpretation	Verbal Description
5	Strongly Agree	4.21 – 5.00	Highly Skilled	Demonstrates critical thinking skills consistently and effectively in most situations.
4	Agree	3.41 – 4.20	Skilled	Frequently demonstrates critical thinking skills in analyzing and evaluating information.
3	Moderately agree	2.61 – 3.40	Moderately Skilled	Sometimes demonstrates critical thinking skills but may require guidance in complex situations.
2	Disagree	1.81 – 2.60	Less Skilled	Seldom demonstrates critical thinking skills and often needs assistance in evaluating information.
1	Strongly Disagree	1.00 – 1.80	Not Skilled	Rarely demonstrates critical thinking skills and has difficulty analyzing information independently

The level of academic performance of Grade 9 students in Mathematics was interpreted using the scale below from DepEd Order no. 8, s.2015.

Grading Scale	Descriptor
90 – 100	Outstanding
85 – 89	Very Satisfactory
80 – 84	Satisfactory
75 – 79	Fairly Satisfactory
Below 75	Did not Meet Expectations

Below is the formula for Chi-square test:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where:

χ^2 = Chi-square Test

$\sum$ = Summation

O = Observed Frequency

E = Expected Frequency

The formula for Spearman Rank Order Coefficient Correlation is presented below:

$$r_s = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

Where:

r_s = Spearman Rank Order Coefficient Correlation

$\sum D^2$ = sum of the squares of the difference between rank x and rank y

n = sample size

6 = constant

RESULTS AND DISCUSSION

This chapter presents, analyzes, and interprets the data gathered in the study. The information is arranged in an organized manner to clearly address the research questions and objectives, with the use of appropriate statistical methods and tools for accurate interpretation of the results.

Prevailing Multiple Intelligence

Table 1 on the next page shows the prevailing multiple intelligences of grade 9 students.

Table 1. Frequency and Percent Distribution of the Prevailing Multiple Intelligences

Profile	Category	f	%
Multiple Intelligence			
	Interpersonal	3	2.91
	Spatial	9	8.74
	Intrapersonal	9	8.74
	Musical	10	9.71
	Linguistics	6	5.83
	Logical (Math)	18	17.48
	Bodily/Kinesthetic	8	7.77
	Multiple Intelligences	40	38.83
	Total	103	100.00

Table 1 shows the percentage and frequency distribution of the prevailing multiple intelligences of Grade 9 students. Out of 103 students, the highest frequency falls under the Multiple Intelligences category ($f = 40$, 38.83%), followed by Logical (Math) intelligence ($f = 18$, 17.48%). The next higher categories are Musical ($f = 10$, 9.71%), Spatial and Intrapersonal intelligences (both $f = 9$, 8.74%), and bodily kinesthetic intelligence ($f = 8$, 7.77%). The least dominant intelligence is Interpersonal intelligence ($f = 3$, 2.91%).

The result suggests that Grade 9 students exhibit a variety of intellectual strengths rather than being dominated by a single intelligence style. Teachers may anticipate that most learners perform well in mathematics specially in problem-solving, reasoning, and pattern-based activities since the highest specific intelligence is logical (math). The high percentage result on the broad category “multiple intelligences” suggests that teachers’ teaching style and activities must be diverse to address students’ varied cognitive strengths.

The outcome of this study supports the findings of Ndia, Solihatin, and Syahrial (2020) that students with stronger mathematical logic intelligence had higher mathematics achievement rather than those with spatial intelligence which agrees to the idea that logical-mathematics intelligence is positively related to academic performance in mathematics. Moreover, Macalangcom and Guillena (2024) reported that multiple intelligences were associated to academic performance among junior high school students, which supports the importance of assessing the intelligence profile in relation to achievement. The findings also align with the study of Laguda (2021), which stated that intelligence profiles can be meaningfully connected with mathematics-related performance.

Level of Critical Thinking Skills

Table 2 shows the mean and standard deviation of the level of critical thinking skills of grade 9 students.

Table 2. Level of Critical Thinking Skills of Grade 9 Students.

Statements	Mean	SD	Interpretation
Analysis and Interpretation	3.58	0.70	High
I can analyze information from different sources.	3.68	0.92	High

I can interpret ideas and explain them in my own words.	3.52	0.88	High
I can identify the important points in a reading material.	3.68	0.93	High
I can compare different viewpoints before making conclusions.	3.63	0.92	High
I can explain why an answer is correct.	3.38	0.90	High
Evaluation of Information Sources	4.16	0.69	High
I check if online information is reliable before using it.	4.31	0.84	Very High
I can identify fake news or misleading information.	4.01	0.99	High
I verify sources before including them in schoolwork.	4.26	0.78	Very High
I evaluate whether a source is credible or biased.	3.97	0.93	High
I can differentiate facts from opinions.	4.26	0.91	Very High
Logical Reasoning and Decision Making	3.73	0.71	High
I use logical reasoning when answering difficult questions.	3.74	1.03	High
I think carefully before making decisions in academic tasks.	4.08	0.82	High
I can defend my answers with evidence.	3.66	0.98	High
I can identify errors in reasoning when solving problems.	3.46	0.93	High
I use facts and logic rather than guesses in answering.	3.73	0.90	High
Creativity and Innovation	3.80	0.76	High
I can think of creative ways to solve academic problems.	3.70	1.00	High
I can create original ideas when doing projects.	3.67	1.00	High
I can use technology to explore new ideas and solutions.	4.18	0.87	High
I can design unique outputs using digital tools.	3.79	1.07	High
I can think beyond common answers to solve challenges.	3.66	1.05	High
Reflective Thinking and Self-Assessment	3.97	0.70	High
I reflect on my mistakes to improve my learning.	4.05	0.91	High
I evaluate my work before submitting it.	3.98	0.90	High
I accept feedback and use it to improve my performance.	4.33	0.83	High
24. I assess whether my solution is effective.	3.84	0.93	High
25. I revise my answers after reviewing the results.	3.63	1.11	High
Critical Thinking Skills As a Whole	3.85	0.59	High

Legend: (4.21 – 5.00)-Very High; (3.41 – 4.20)-High; (2.61 – 3.40)-Moderate; (1.81 – 2.60)-Low; (1.00 – 1.80)-Very Low

Table 2 shows the level of critical thinking skills as a whole and in terms of Analysis and Interpretation, Evaluation of Information Sources, Logical Reasoning and Decision Making, Creativity and Innovation, and Reflective Thinking and Self-Assessment. The overall mean ($M = 3.85$, $SD = 0.59$) indicates that the students' critical thinking skills are high. The highest among the dimensions is the Evaluation of Information Services ($M = 4.16$, $SD = 0.69$), with the highest mean obtained by "I check if online information is reliable before using it." ($M = 4.31$, $SD = 0.84$) and the lowest mean was obtained by "I evaluate whether a source is credible or biased." ($M = 3.97$, $SD = 0.93$). For Logical Reasoning and Decision-Making, the highest indicator was obtained by "I think carefully before making decisions in academic tasks.", with a mean of 4.08 ($SD = 0.82$) and the lowest indicator is "I can identify errors in reasoning when solving problems.", with a mean of 3.46 ($SD = 0.93$). For Creativity and Innovation, the highest mean was obtained by "I can use technology to explore new ideas and solutions.", with a mean of 4.18 ($SD = 0.87$). For Reflective Thinking and Self-Assessment, the highest mean was obtained by "I accept feedback and use it to improve my performance." ($M = 4.33$, $SD = 0.83$) and the lowest was obtained by "I revise my answers after reviewing the results." ($M = 3.63$, $SD = 1.11$). Lastly, Analysis and Interpretation was reported to have the lowest overall mean among the five dimensions ($M = 3.58$, $SD = 0.70$) and the indicator with the highest mean was obtained by "I can analyze information from different sources" and "I can identify the important points in a reading material," both with a mean of 3.68. The lowest mean was obtained by "I can explain why an answer is correct." with a mean of 3.38.

The result implies that the Grade 9 students already possess strong critical thinking abilities that enable them to perform well in mathematics and other academic tasks. They develop skills that are essential in their schoolwork and decision-making such as being meticulous in verifying information, identifying fabricated content, and distinguishing facts from opinions as evidenced by their high score in evaluating information sources.

These outcomes support the claim of Cayud-ong and Futralan (2024) that mathematics teachers' strategies for improving scientific reasoning and critical thinking were linked to students' academic performance, showing the importance of critical thinking in mathematics learning. Also, Viado and Espiritu (2023) mentioned in their findings that students in the Philippines can enhance their higher-order thinking when they perform mathematical tasks through a collaborative-individual learning. Furthermore, Lapuz and Fulgencio (2024) found that critical thinking skills of secondary school students in the Philippines are significantly enhanced by problem-based learning which shows that employing appropriate instructional strategies can strengthen their cognitive abilities.

Level of Academic Performance in Mathematics

Table 3 below shows the level of academic performance of Grade 9 students in Mathematics.

Table 3. Level of Academic Performance of Grade 9 Students in Mathematics

Level of Academic Performance	f	Mean	SD	Interpretation
Very Satisfactory	65	89.23	2.50	Very Satisfactory
Satisfactory	2			
Fairly Satisfactory	0			
Did Not Meet Expectations	0			
Total	103			

Legend: (90-100)-Excellent; (85-89)-Very Satisfactory; (80-84)-Satisfactory; (75-79)-Fairly Satisfactory; (Below 75)-Did Not Meet Expectations

Table 3 presents the level of academic achievement of Grade 9 students in Mathematics. The results show that most of the students belong to the very satisfactory level, with 65 students under this category. Moreover, 36 students fall under the outstanding category while 2 students obtained a satisfactory level. No respondents

were classified as fairly satisfactory and did not meet expectations. The overall mean of 89.23 and standard deviation of 2.50 indicates that the students' academic achievement in Mathematics is generally very satisfactory based on the legend.

The results reveal that Grade 9 students generally perform well in Mathematics and most of them can meet the expected academic standards. Since most of the students fall under very satisfactory and Outstanding categories suggests that the class has a generally strong level of achievement. On the other hand, the few students who belong to the satisfactory level may still need additional support or remediation to further improve their performance.

Recent studies show that students' mathematics achievement is shaped by different academic and personal influences. A rapid systematic review by Ayebale, Habaasa, and Tweheyo (2020) found that mathematics achievement in secondary schools is affected by learner characteristics, teacher factors, school environment, and home background. This supports the idea that those students who excel in mathematics often gain from effective instruction and conducive learning environment. Moreover, Wang et al. (2023) stated in their findings that mathematics achievement are mainly influenced by self-efficacy while mathematics anxiety results to a negative effect indicating that emotional factors and students' perceptions also affect their performance in mathematics.

Relationship between Prevailing Multiple Intelligences and Academic Performance

Table 4 below shows the relationship between multiple intelligences and academic performance of Grade 9 students.

Table 4. Relationship between the Prevailing Multiple Intelligences and Academic Performance

Variable	Test Statistics (χ^2)	p-value	Decision for H_0	Interpretation
Multiple Intelligences vs.	11.753	0.626	Failed to Reject H_0	Not Significant
Academic Performance				

Table 4 presents the results of the Chi-square test examining the relationship between students' prevailing multiple intelligences and academic performance. The computed Chi-square value of 11.753 with a p-value of 0.626 indicates that the relationship is not statistically significant at the 0.05 level of significance. Since the p-value go beyond the established alpha level, the null hypothesis was failed to be rejected. Therefore, the results indicate that no significant relationship exists between the respondents' prevailing multiple intelligences and academic achievement.

This finding implies that academic achievement cannot only be credited to a student's dominant intelligence, as proposed by Gardner's Multiple Intelligences Theory. Instead, academic success may be influenced by different interconnected factors, such as academic motivation, study habits, instructional procedures, learning environment, family support, and other personal variables. Although multiple intelligences may impact how students learn and process information, they do not necessarily determine the level of academic achievement. Accordingly, educators should continue to recognize learners' diverse intelligence profiles when planning instruction while also addressing other factors that contribute to academic success.

The results of the study are consistent with the findings of Limon (2025) which reported that multiple intelligences were associated with academic performance even though the relationships are not that strong across all intelligence types. Macalangcom and Guillena (2024) also stated in their findings that despite examining the relationship between multiple intelligences and academic performance, these intelligence domains do not significantly predict students' academic achievement.

Relationship between Critical Thinking Skills and Academic Performance

Table 5 below shows the relationship between critical thinkings skills and academic performance of Grade 9 students.

Table 5. Relationship between Critical Thinking Skills and Academic Performance

Variable	Test Statistics (r_s)	p-value	Decision for H_0	Interpretation
Level of Critical Thinking Skills vs.	0.105	0.292	Failed to Reject H_0	Not Significant
Academic Performance				

Table 5 shows the relationship between critical thinking skills and academic performance using Spearman's rank-order correlation. The computed correlation coefficient was $r_s = 0.105$, indicating a very weak positive relationship between the two variables. However, the p-value of 0.292 exceeded the 0.05 level of significance, leading to the decision to fail to reject the null hypothesis. Therefore, the findings indicate that there is no significant relationship between students' critical thinking skills and their academic achievement.

The findings indicate that critical thinking skills were not significantly associated with students' academic achievement. This suggests that there are other factors that may influence academic achievement such as study habits, prior knowledge, and instructional practices, rather than critical thinking skills alone. Therefore, improving academic performance may require addressing multiple cognitive and non-cognitive factors.

The present finding is supported by Alinsunurin (2021), who emphasized that Filipino students' academic performance is influenced by multiple learner-related and contextual factors. Similarly, Odani and Orongan (2021) found that although critical thinking contributes to mathematics learning, academic achievement is shaped by multiple factors, including mathematical disposition and metacognitive awareness, implying that critical thinking by itself does not significantly determine students' academic performance.

CONCLUSION

The study revealed that Grade 9 students possess diverse multiple intelligence profiles, with linguistic and logical-mathematical intelligence being the most prevalent. They also demonstrated strong critical thinking skills, particularly in evaluating information services, and achieved a generally very satisfactory performance level in Mathematics. While students performed satisfactorily in Mathematics, the study found no statistically significant correlation among their dominant multiple intelligences, critical thinking skills, and academic performance. However, these findings do not allow for a definitive conclusion regarding the influence of underlying factors such as study habits, learner motivation, or specific classroom environments, which were not measured in this analysis. Therefore, educators should continue to employ diverse and learner-centered approaches while addressing the various factors contributing to academic success. The findings also underscore the importance of recognizing individual differences among learners and providing appropriate opportunities for them to develop their academic abilities. Future studies should integrate these multidimensional variables and employ larger, more diverse groups to better delineate the complex interplay between individual dispositions and academic achievement.

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