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# Mathematics Achievement, Critical Thinking, and Student Engagement on Academic Performance of Grade 10 Students in the North District of Isabela City Schools Division

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**ABSTRACT**

This study examined the relationships among mathematics achievement, critical thinking, student engagement, and academic performance of Grade 10 students in the North District of Isabela City Schools Division. A quantitative correlational research design was employed involving 181 students from four public secondary schools selected through stratified random sampling. Data were collected using a validated five-point Likert-scale questionnaire and students' final mathematics grades, then analyzed through descriptive statistics, analysis of variance, and Pearson correlation. Findings revealed average mathematics achievement (M = 3.44) and critical thinking (M = 3.37), high student engagement (M = 3.54), and generally satisfactory academic performance (M = 82.25). Significant moderate positive correlations were established between academic performance and mathematics achievement (r = 0.465), critical thinking (r = 0.415), and student engagement (r = 0.454), all significant at the 0.01 level. Significant differences emerged in critical thinking by sex and mathematics achievement across schools, while age-related differences were insignificant. The findings indicate that strong engagement does not necessarily correspond to equally developed mathematical reasoning and achievement. Teachers and school administrators should strengthen problem-solving instruction, critical thinking activities, and targeted learning support while sustaining student engagement. The study's geographic scope, self-reported measures, and correlational design limit broader generalization and causal interpretation. Nevertheless, the findings provide district-specific evidence to inform instructional improvement, equitable learning support, and school-level educational planning.

**Keywords:** *Academic Performance, Correlational Research, Critical Thinking, Grade 10 Students, Mathematics Achievement, Student Engagement*

## 1. INTRODUCTION

Mathematics is a fundamental subject that develops logical reasoning, problem-solving abilities, and critical thinking skills essential for academic success. Despite its importance, mathematics remains challenging for many Filipino learners, as reflected in international assessments such as the Programme for International Student Assessment (PISA). This concern is also evident in the North District of Isabela City Schools Division, where students demonstrate classroom participation and interest but continue to experience difficulties in mathematical reasoning, problem-solving, and academic achievement. Mathematics achievement, critical thinking, and student engagement are interconnected aspects of learning. Mathematics achievement reflects students' understanding and application of mathematical concepts, while critical thinking involves analyzing problems, evaluating solutions, and justifying conclusions. Student engagement encompasses motivation, interest, and active participation in learning activities. Understanding how these factors relate to academic performance is essential for identifying appropriate instructional strategies and strengthening mathematics education. This study examines the relationships among mathematics achievement, critical thinking, student engagement, and academic performance of Grade 10 students in the North District of Isabela City Schools Division. It seeks to provide evidence that may guide teachers, school administrators, and parents in supporting meaningful learning experiences and improving educational outcomes.

**Research Problem**

The continuing difficulty of Filipino students in mathematics highlights the need to strengthen mathematical understanding, critical thinking, and academic performance. In the North District of Isabela City Schools Division, teachers observe that students actively participate in classroom activities but often demonstrate only average performance in assessments and problem-solving tasks. Students also experience difficulties explaining mathematical reasoning, evaluating assumptions, and applying learned concepts to unfamiliar situations. These challenges indicate that classroom engagement alone may not ensure stronger academic performance. Costa et al. (2024) emphasized the importance of critical thinking and problem-solving in mathematics achievement, while OECD (2023) noted that students may recognize the practical value of mathematics yet remain at average achievement levels when learning focuses primarily on routine exercises. Similarly, Wang and Abdullah (2024) emphasized the importance of providing students with opportunities to analyze, evaluate, and solve challenging mathematical problems to develop their critical thinking skills. Student engagement is another important consideration. Wong et al. (2024) highlighted the relationship of student engagement with motivation, learning persistence, and academic performance. However, engagement must be accompanied by meaningful cognitive development and effective learning strategies to support stronger educational outcomes. Consequently, the central research problem concerns the relationship of mathematics achievement, critical thinking, and student engagement with the academic performance of Grade 10 students. The study also examines whether these learning factors differ according to students' sex, age, and school, providing a basis for identifying educational needs within the district. Additional scholarship provides a broader rationale for examining mathematical learning beyond routine performance. Schoenfeld (1992) described mathematical problem-solving as involving reasoning, metacognition, and sense-making, while the National Research Council (2000) emphasized the interplay of prior knowledge, understanding, and learning environments. Research on mathematics attitudes also offers a basis for considering students' dispositions toward the subject (Tapia & Marsh, 2004). More recently, Khasawneh et al. (2023) compared inquiry-based and traditional lecture-based instruction in college algebra;

although conducted in higher education, this work illustrates the relevance of instructional approaches to mathematics achievement.

**Assumptions of the Study**

The study is guided by the assumption that mathematics achievement, critical thinking, and student engagement are relevant factors associated with students' academic performance. Students who demonstrate stronger mathematical understanding, analytical reasoning, and active participation are expected to exhibit more favorable academic outcomes. The study further assumes that meaningful learning requires more than memorization and routine classroom participation. Costa et al. (2024) emphasized the importance of effective learning strategies, while Wang and Abdullah (2024) underscored the role of analytical and evaluative activities in developing critical thinking. Wong et al. (2024) also highlighted the importance of student motivation and engagement in sustaining learning. Additionally, the study considers that students' learning experiences may vary according to their educational environments. Costa et al. (2024) identified teaching strategies, educational resources, school environments, and instructional approaches as important factors associated with differences in students' academic performance. These assumptions provide a basis for examining the relationships among the study variables without presuming that the relationships necessarily establish causation.

**Objectives of the Study**

The general objective of this study is to determine the relationships among mathematics achievement, critical thinking, student engagement, and academic performance of Grade 10 students in the North District of Isabela City Schools Division. Specifically, the study aims to assess students' levels of mathematics achievement, critical thinking, and engagement; determine their academic performance in mathematics; examine significant differences in these learning factors when students are grouped according to sex, age, and school; and establish whether mathematics achievement, critical thinking, and student engagement have significant relationships with academic performance. Through these objectives, the study seeks to provide a basis for improving instructional practices, strengthening students' mathematical reasoning, and developing appropriate educational support programs.

**Conceptual and Theoretical Framework**

The study is anchored in four complementary learning theories that explain the relationships among mathematics achievement, critical thinking, student engagement, and academic performance. Piaget’s (1952) Constructivist Theory emphasizes that learners actively construct knowledge through experience and interaction with their environment. This perspective supports the development of mathematical understanding through exploration, reasoning, and problem-solving. Vygotsky’s (1978) Sociocultural Theory highlights the importance of social interaction, teacher guidance, and peer collaboration in developing higher-order thinking skills. Self-Determination Theory (Deci & Ryan, 2000) explains how motivation, autonomy, and students' involvement in learning contribute to engagement and academic performance. Similarly, Cognitive Load Theory (Sweller, 1988) emphasizes the importance of presenting instructional materials in manageable ways that support understanding without overwhelming learners' cognitive capacities. These theoretical perspectives establish the conceptual relationship among the study variables. Mathematics achievement represents students' understanding and application of mathematical concepts, critical thinking reflects their ability to analyze and evaluate mathematical problems, and student engagement describes their motivation and active participation. Academic performance serves as the outcome variable, measured through students' mathematics grades. Collectively, these theories suggest that meaningful

mathematics learning depends on the interaction of cognitive development, motivation, instructional support, and active participation. The framework therefore provides a basis for examining how mathematics achievement, critical thinking, and student engagement are associated with students' academic performance. The framework can also be understood through complementary perspectives on learning and motivation. Bandura's (1977) social learning theory emphasizes learning in social contexts, while his later account of self-efficacy highlights beliefs about one's capability to act successfully (Bandura, 1997). Dewey (1938) stressed the educational significance of experience, and Brown et al. (1989) situated knowledge and learning within authentic activity and social practice. Biggs and Collis (1982) provided the SOLO taxonomy as a way of describing increasing complexity in learning outcomes. These perspectives help contextualize the roles of classroom experiences, confidence, and depth of mathematical understanding without treating them as additional variables measured in the present study. Critical thinking and engagement also have established conceptual foundations. Ennis (1987) classified critical-thinking dispositions and abilities, while Facione (1990) articulated a consensus-based account of critical thinking for educational assessment. Lipman (1991) connected thinking with educational inquiry, and Halpern (2014) discussed the development and application of critical-thinking skills. Flavell (1979) introduced metacognitive monitoring as an important aspect of cognition. In the motivational domain, Hidi and Renninger (2006) presented a model of interest development, and Dweck (2006) examined how beliefs about ability can shape responses to learning challenges. These works inform interpretation of the study's constructs; they were not used as direct measures of the respondents.

**Sustainable Development Goal and Multidisciplinary Sustainability Relevance**

The study primarily aligns with Sustainable Development Goal 4 (Quality Education), which promotes inclusive, equitable, and quality education and lifelong learning opportunities. By examining mathematics achievement, critical thinking, student engagement, and academic performance, the research addresses the need to improve learning outcomes and strengthen students' essential academic competencies. The study contributes to educational sustainability by providing evidence that may guide teachers in developing effective instructional strategies, strengthening mathematical reasoning, and promoting meaningful classroom participation. Its findings may also assist school administrators in identifying learning difficulties and developing appropriate enrichment and remedial programs to support students with varying academic needs. The research also has relevance to Sustainable Development Goal 10 (Reduced Inequalities) through its examination of differences in learning outcomes according to sex, age, and school. Identifying such differences may help educational institutions recognize disparities and develop more responsive learning support strategies, contributing to equitable educational opportunities. Furthermore, the study supports aspects of Sustainable Development Goal 17 (Partnerships for the Goals) by recognizing the importance of collaboration among teachers, school administrators, parents, and educational institutions in improving mathematics education. Cooperation in instructional improvement, learner support, and sharing effective educational practices may contribute to sustained academic development. Overall, the study emphasizes educational, institutional, and community sustainability by supporting improved teaching practices, equitable learning opportunities, and collaborative efforts to strengthen mathematics education among Grade 10 students in the North District of Isabela City Schools Division.

## 2. METHODOLOGY

### Research Design

The study utilized a quantitative correlational research design to determine the relationships among mathematics achievement, critical thinking, student engagement, and academic performance. This design enabled the researchers to assess the students' levels of achievement, critical thinking, and engagement, examine differences according to demographic characteristics, and determine significant relationships between the identified variables and academic performance.

### Research Locale or Study Setting

The study was conducted in four public secondary schools in the North District of Isabela City Schools Division, namely Baluno National High School, Begang National High School, Calvario Peak National High School, and Tandung Ahas National High School. These schools served as the research settings for examining the mathematics learning experiences and academic performance of Grade 10 students.

### Participants or Data Sources

The respondents consisted of 181 Grade 10 students selected through stratified random sampling to ensure representation from the four participating schools. The study gathered information on students' demographic profiles, mathematics achievement, critical thinking skills, and student engagement. Their final mathematics grades were also obtained to determine academic performance.

### Research Instruments or Materials

The primary research instrument was a structured survey questionnaire consisting of four components: demographic profile, mathematics achievement, critical thinking, and student engagement. The questionnaire employed a five-point Likert scale to assess students' responses. Students' final mathematics grades served as the measure of academic performance. The instrument underwent expert validation and pilot testing, yielding a Cronbach's Alpha coefficient of 0.888, indicating high reliability.

### Data Gathering Procedure

Data collection was conducted during regular class hours in the participating schools. Following the necessary ethical clearance and consent from students and their parents, the validated questionnaires were administered to the selected Grade 10 respondents. Students' final mathematics grades were also collected to assess academic performance. The gathered information was subsequently prepared for statistical analysis.

### Data Analysis

The collected data were analyzed using descriptive and inferential statistical techniques. Frequency distributions were used to summarize relevant student information, while means and standard deviations were employed to describe mathematics achievement, critical thinking, student engagement, and academic performance. Analysis of Variance (ANOVA) was used to examine differences among student groups, while Pearson correlation analysis determined the strength and direction of the relationships between mathematics achievement, critical thinking, student engagement, and academic performance.

### Ethical Consideration

Ethical clearance was secured before conducting the study. Consent was obtained from the participating students and their parents before data collection. The questionnaires were administered during regular class hours following the required ethical procedures.

## 3. RESULTS AND DISCUSSION

### 3.1 Mathematics Achievement, Critical Thinking, and Student Engagement

#### 3.1.1 Mathematics Achievement

The Grade 10 students demonstrated an average level of mathematics achievement, with a grand mean of 3.44. Students reported relatively higher ability to apply mathematical concepts to real-life situations (3.64) and perceived their grades as reflecting their understanding of lessons (3.59). However, their confidence in solving mathematical problems (3.33) and ability to engage in critical mathematical thinking (3.27) remained average. These findings indicate that students possess basic mathematical understanding but require further development in problem-solving and higher-order thinking. Costa et al. (2024) emphasized that mathematics achievement depends on opportunities to practice critical thinking and problem-solving. Similarly, OECD (2023) noted that students recognize the practical relevance of mathematics, although achievement may remain average when instruction emphasizes routine exercises. This interpretation is consistent with a systematic review by Aba-Oli et al. (2025), which examined problem-based learning interventions designed to develop higher-order thinking in secondary mathematics. The review suggests that problem-centered instruction can support reasoning and problem-solving, although implementation quality and classroom context require attention.

#### 3.1.2 Critical Thinking Skills

The students exhibited an average level of critical thinking, with a grand mean of 3.37. Their strongest area was asking questions and seeking assistance when needed (3.53), while evaluating assumptions and previously solved mathematical problems received the lowest mean (3.27). Their abilities to explain reasoning, evaluate solutions, and apply analytical thinking to mathematical problems also remained average. The results suggest that students are willing to seek clarification but still need to strengthen independent reasoning and evaluation skills. Wang and Abdullah (2024) emphasized that critical thinking develops through exposure to challenging and open-ended problems that encourage students to analyze and evaluate information, thereby strengthening their higher-order thinking abilities. Metacognitive processes may be particularly relevant to the students' difficulty evaluating assumptions and explaining solutions. Xie et al. (2024) reported a positive association between metacognition and mathematics achievement across educational levels. This external evidence offers a possible instructional direction but does not establish that metacognition caused the present study's results.

#### 3.1.3 Student Engagement

Student engagement was rated high, with a grand mean of 3.54. Students reported positive participation in mathematics learning, particularly in using different learning methods provided by teachers (3.61), finding mathematics engaging and enjoyable (3.59), and recognizing its relevance to their interests and goals (3.55). However, enjoyment of classroom mathematics activities received an average rating of 3.48. These findings indicate that students demonstrate motivation and active involvement despite their average mathematics achievement and critical thinking skills. Wong et al. (2024) emphasized that student engagement is associated with

learning persistence and improved academic performance. Nevertheless, engagement must be supported by effective learning strategies and cognitive development to strengthen academic outcomes.

#### 3.1.4 Overall Level of Mathematics Learning Factors

The combined assessment of mathematics achievement, critical thinking, and student engagement yielded an overall grand mean of 3.45, interpreted as average. Student engagement recorded the highest mean (3.54), followed by mathematics achievement (3.44) and critical thinking (3.37). The findings indicate that students' motivation and classroom participation are stronger than their demonstrated mathematical understanding and reasoning abilities. Wong et al. (2024) explained that engagement alone does not guarantee high achievement without sufficient cognitive development. Costa et al. (2024) similarly emphasized that motivation must be accompanied by effective instructional and learning strategies.

### 3.2 Academic Performance of Grade 10 Students

The students' academic performance was generally satisfactory, with a mean mathematics grade of 82.25 and a standard deviation of 5.76. Of the 181 respondents, 37.0% obtained fairly satisfactory grades of 75–79, while 34.8% achieved satisfactory grades of 80–84. Meanwhile, 13.8% reached the very satisfactory level, and 14.4% attained outstanding performance. No students received grades below 75. These findings suggest that most students attained the expected minimum competencies in mathematics, although fewer achieved higher performance levels. OECD (2023) observed that Filipino students commonly demonstrate satisfactory mathematics performance while experiencing difficulty attaining mastery. Costa et al. (2024) likewise emphasized that higher achievement requires deeper conceptual understanding and sustained critical thinking practice.

### 3.3 Differences in Mathematics Achievement, Critical Thinking, and Student Engagement According to Demographic Profile

#### 3.3.1 Differences According to Sex

The findings revealed no significant differences between male and female students in mathematics achievement ($p = 0.138$) and student engagement ($p = 0.144$). However, a significant difference was observed in critical thinking ($p = 0.035$), with female students obtaining a higher mean of 3.48 than male students (3.25). The overall difference between sexes was not statistically significant ($p = 0.068$). The findings indicate that mathematics achievement and engagement were comparable between male and female students, although female students demonstrated stronger critical thinking skills. Wang and Abdullah (2024) highlighted the importance of classroom practices that promote reflective reasoning and critical thinking skills among both male and female students.

#### 3.3.2 Differences According to School

Significant differences were found among the participating schools in mathematics achievement ($p = 0.027$) and overall learning factors ($p = 0.048$). Tandung Ahas National High School recorded the highest mathematics achievement mean of 3.84, while Begang National High School obtained a lower mean of 3.32. However, differences in critical thinking ($p = 0.082$) and student engagement ($p = 0.069$) were not statistically significant. These findings suggest that mathematics achievement varies across schools, potentially reflecting differences in

instructional practices and learning environments. Costa et al. (2024) emphasized that differences in academic performance may be associated with teaching strategies, educational resources, school environments, school culture, and teacher effectiveness.

#### 3.3.3 Differences According to Age

No significant differences were observed in mathematics achievement ($p = 0.288$), critical thinking ($p = 0.324$), and student engagement ($p = 0.137$) when respondents were grouped according to age. Although students aged 18 years and above obtained higher mean scores across the three variables, these differences were not statistically significant. The overall comparison likewise showed no significant difference ($p = 0.190$). The findings indicate that age was not a significant factor in the students' mathematics achievement, critical thinking, and engagement. Piaget (1952) explained that adolescents generally develop formal operational thinking, which supports logical reasoning and problem-solving. Similarly, Costa et al. (2024) emphasized that instructional approaches and learning environments are more influential than age in shaping academic outcomes.

### 3.4 Relationship Between Mathematics Achievement, Critical Thinking, Student Engagement, and Academic Performance

The findings revealed significant moderate positive correlations between academic performance and mathematics achievement ($r = 0.465$), critical thinking ($r = 0.415$), and student engagement ($r = 0.454$). The combined learning factors also demonstrated a moderate positive correlation with academic performance ($r = 0.486$). All reported relationships were statistically significant at the 0.01 level, with reported p-values of 0.000. These findings indicate that students with higher mathematics achievement, stronger critical thinking skills, and greater engagement tend to demonstrate better academic performance. Deci and Ryan's (2000) Self-Determination Theory supports the importance of motivation and independent learning in academic success. Similarly, Papageorgiou et al. (2025) emphasized that combining meaningful engagement with deeper understanding contributes to improved academic outcomes. The results reinforce the importance of developing mathematical competence, analytical reasoning, and active learning participation to support students' academic performance.

## 4. CONCLUSIONS AND RECOMMENDATIONS

The study established that mathematics achievement, critical thinking, and student engagement were significantly associated with the academic performance of 181 Grade 10 students in the North District of Isabela City Schools Division. Although students demonstrated high engagement in mathematics learning, their mathematics achievement and critical thinking remained at average levels, while their academic performance was generally satisfactory. These findings indicate that active classroom participation does not necessarily correspond to equally strong mathematical reasoning and achievement. Significant differences were observed in critical thinking according to sex, with female students obtaining higher scores, and in mathematics achievement across participating schools. However, age did not significantly differentiate the learning factors. The moderate positive correlations among mathematics achievement, critical thinking, student engagement, and academic performance suggest that these factors are interconnected in students' learning outcomes. Overall, the study provides district-specific evidence supporting the importance of strengthening cognitive skills alongside sustained student engagement in mathematics education.

Based on the findings, teachers should prioritize instructional strategies that strengthen mathematical reasoning, critical thinking, and problem-solving while maintaining students' high engagement. Classroom activities should provide more opportunities to evaluate assumptions, justify mathematical solutions, solve challenging problems, and apply mathematical concepts to real-life situations. School administrators should support continuous teacher training focused on developing these competencies and improving instructional effectiveness. Considering the significant differences in mathematics achievement across schools, the Department of Education and school administrators should encourage the sharing of effective teaching practices and provide appropriate enrichment and remedial programs to address learning gaps. Teachers should also ensure that classroom activities provide equitable opportunities for male and female students to develop critical thinking skills. Parents should reinforce positive study habits, encourage regular mathematics practice, and support students' persistence in learning. Collaboration among teachers, administrators, parents, and students should be strengthened to sustain engagement and support improved mathematics performance.

The study was limited to 181 Grade 10 students from four public secondary schools in the North District of Isabela City Schools Division, restricting the applicability of its findings to other educational settings. Its quantitative correlational design established statistical relationships but could not determine causal effects among the variables. Mathematics achievement, critical thinking, and student engagement were assessed through a self-reported questionnaire, while academic performance was measured using final mathematics grades. The analysis focused on the identified learning factors and demographic characteristics. Future studies may include broader school populations and alternative research designs to further examine these relationships.

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