



# LEARNING STYLES AND MATHEMATICAL DISPOSITIONS AS PREDICTORS OF THE CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS

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## ABSTRACT

The primary purpose of this study is to determine whether learning styles and mathematical dispositions predict students' critical thinking skills. This study employed a descriptive and correlational research approach. Using stratified random sampling, 271 grade 10 students were selected as respondents from six public secondary schools in Kapalong East District, Davao del Norte Division during the school year 2022-2023. Furthermore, this study employed two adapted survey questionnaires and one researcher-made questionnaire, all of which were validated to collect data and treated using mean, standard deviation, Spearman's Rank Correlation Coefficient, and regression analysis. The findings showed that the learning styles among the students are high, their mathematical dispositions are moderate, and their critical thinking skills are low. The findings also revealed that learning styles has a positive significant relationship and influence on students' critical thinking skills in mathematics. However, students' mathematical dispositions have an inverse relationship and influence to their critical thinking skills in mathematics. These findings underscore the importance of nurturing critical thinking skills among students. It is recommended that teachers and DepEd officials collaborate to create interventions aimed at enhancing students' critical thinking skills. Furthermore, replication studies across diverse contexts are advised to validate the longevity of these relationships and further advance our comprehension of the subject matter.

**KEYWORDS:** Learning styles, mathematical dispositions, critical thinking skills, grade 10 students, descriptive-correlational approach, regression analysis, Kapalong East District, Davao del Norte.

## BACKGROUND OF THE STUDY

Critical thinking skills of students in solving word problems in mathematics have become a challenge among teachers (Ginanjar et al., 2019). This is because students struggled to comprehend the significance of the presented problem situations, which hindered their ability to generate solutions (Baumanns, 2022). According to Purwanto et al. (2020), the various learning styles of students in a classroom pose a challenge for teachers to stimulate critical thinking skills among their students. Moreover, students with unfavorable dispositions toward mathematics have difficulty answering tasks requiring critical thinking skills (Susilo et al., 2020). This means that students need to improve their ability to think critically before they can solve math problems well (Lestari et al., 2021).

In Indonesia, current teaching and learning in mathematics subjects are still unable to effectively enhance the critical thinking skills of students (Munawaroh et al., 2018). In Semarang, Indonesia, only 21% of elementary students answered critical thinking exercises correctly, indicating insufficient skill development (Lestari et al., 2021).

Additionally, the Trends in International Mathematics and Science Study (TIMSS) 2019 report highlights low critical thinking scores among Pakistani students, suggesting inadequate guidance in applying conceptual understanding to problem-solving (Mullis et al., 2020; Afrida et al., 2019).

In the Philippines, Benedicto and Andrade (2022) pointed out that a contributing factor to the underperformance of the country in mathematics is the insufficient development of critical thinking skills among students. According to TIMSS 2019, the Philippines averaged 297, below the low benchmark score, indicating a lack of ability to apply understanding to critical-thinking-required math problems (Mullis et al., 2020). Students' struggles with critical thinking result in inadequate information processing, leading to incorrect or incomplete problem-solving (Brazel, 2022).

Moreover, in one of the schools of the Division of Davao del Norte, a problem with critical thinking skills in mathematics has been observed among students. According to the School District Consolidated Proficiency Level Report in Mathematics for the school year 2021-2022, the test scores of the Grade 10



students in the school only have a proficiency level of 75.97%, which is considered the lowest among the other subjects. Most of the students cannot solve real-life mathematics applications and problems. Thus, students have poor performance on items that require critical thinking.

Several studies establish links between learning styles and critical thinking skills (Erdoğan, 2020), as well as mathematical disposition and critical thinking (Celik & Ozdemir, 2020). Efforts to enhance critical thinking in students include various approaches like learning devices, interactive questions, problem-based learning, and chronotype variations (Afdareza et al., 2020; Monrat et al., 2022; Amin et al., 2020; Lopez III, 2022). This study aimed to explore connections between learning styles, mathematical dispositions, and critical thinking skills in mathematics, prompted by pandemic-related challenges. It addressed a gap in research, aiming to foster empirical evidence to promote critical thinking skills in mathematics among Grade 10 students in Davao del Norte Division.

The study addresses the pressing issue of students' critical thinking skills in mathematics, exacerbated by the ongoing pandemic. It investigates whether learning styles and mathematical dispositions can predict these skills, aiming to provide the Department of Education with strategies for improvement. Results will be disseminated widely, including through the School and District Congress, the School Learning Action Cell (SLAC), seminars, and publications.

## STATEMENT OF THE PROBLEM

The main purpose of the study is to determine if learning styles and mathematical dispositions significantly predict the critical thinking skills of Grade 10 students in the Kapalong East District.

Specifically, this sought to answer the following questions:

1. What is the level of learning styles of the students in terms of:
  - 1.1. study activities;
  - 1.2. study motives; and
  - 1.3. study views?
2. What is the level of mathematical dispositions of the students in terms of:
  - 2.1. confidence;
  - 2.2. cognitive disposition; and
  - 2.3. affective disposition?
3. What is the level of critical thinking skills of the students in terms of:
  - 3.1. interpretation;
  - 3.2. analysis;
  - 3.3. evaluation; and
  - 3.4. inference?
4. Is there a significant relationship between:
  - 4.1. learning styles and critical thinking skills of students?
  - 4.2. mathematical dispositions and critical thinking skills of students?

5. Do learning styles and mathematical dispositions significantly predict the critical thinking skills of the students?

## METHODOLOGY

### RESEARCH DESIGN

The study utilized a quantitative research design, employing both descriptive and correlational approaches to collect and analyze numerical data. Quantitative research aims to discern trends, predict outcomes, analyze causal relationships, and generalize findings to broader populations by gathering data from specific samples and addressing population sample issues. Descriptive research focuses on methodically describing populations, events, or phenomena, providing an overview of current ideas or behaviors, while correlational research identifies relationships between variables and forecasts future events based on present information, assessing the strength of associations between variables.

In this study, the descriptive design facilitated data collection without altering variables, summarizing students' learning styles, mathematical dispositions, and critical thinking skills, while the correlational design allowed for statistical analysis to determine the strength and direction of relationships between these variables. The study aimed to explain current variable levels, assess statistical linkages, and evaluate whether learning styles and mathematical dispositions predict students' critical thinking skills, making the combination of descriptive and correlational quantitative research approaches suitable for its objectives.

### STATISTICAL TREATMENT OF DATA

The analysis and interpretation employed the following statistical tools:

**Mean.** This was used to determine the students' levels of learning styles, mathematical dispositions, and critical thinking skills.

**Standard Deviation.** This refers to a statistical measurement that quantifies the extent of dispersion within a dataset in relation to its mean value. This method of analysis was employed to ascertain the proximity or distance of the scores from the mean.

**Spearman's Rank Correlation Coefficient.** This was utilized to determine the correlation strength among variables having non-normal distribution of data. This was employed to answer specific research queries.

**Multiple Regression Analysis.** This tool includes a collection of statistical methods used to ascertain the relationships between one or more independent variables and dependent variables. This was employed to ascertain the extent to which independent variables exhibit a statistically significant influence on the dependent variable.

### RESEARCH RESPONDENTS

The study's respondents were the Grade 10 students enrolled in the six public secondary schools in Kapalong East District, Davao del Norte Division, during the 2022–2023 school year.



The total number of grade 10 students was 911, including 580 in School A, 91 in School B, 47 in School C, 65 in School D, 83 in School E, and 45 in School F. Using the Raosoft Sample Size Calculator with a 95% confidence level (Z-Score = 1.96) and a 5% margin of error, a sample size of 271 respondents was determined. The sample consisted of 173 students from School A, 27 students from School B, 14 students from School C, 19 students from School D, 25 students from School E, and 13 students from School F.

Furthermore, respondents were drawn from the strata of the six secondary schools using a stratified random sampling technique. This study also employed simple random sampling to choose respondents from each stratum. The researcher used a Microsoft Excel random name generator to select the respondents from the list of Grade 10 students.

Moreover, the school gatekeepers distributed a printed letter directly to each individual, enlisting them as respondents. Furthermore, the researcher made sure to obtain parental consent for the voluntary involvement of the research respondents in this study.

## RESULTS AND DISCUSSION

The following are the results of the study.

**Table 1**

### *Summary on the Level of Learning Styles in Mathematics*

Indicators	Mean	SD	Description
Study Activities	3.88	0.56	High
Study Motives	3.46	0.72	High
Study Views	3.85	0.64	High
<b>Overall Mean</b>	<b>3.73</b>	<b>0.51</b>	<b>High</b>

The overall mean level of students' learning styles in mathematics is 3.73, signifying a high descriptive equivalent and manifesting their learning styles. With a standard deviation of 0.51 indicating minimal variability, responses suggest coherence, positive experiences, high-level study approaches, and favorable attitudes, likely fostering academic success and deeper engagement with mathematics.

The findings align with Tossavainen et al.'s (2020) proposition, showing students possess a high level of learning styles, indicating positive attitudes and active engagement in studies. Rashidov (2020) suggested students with high levels of learning styles contribute to generating new ideas, enhancing their ability to apply knowledge in mathematics effectively. Mazana et al.'s (2019) study supports prioritizing learning styles in mathematics education to enhance enjoyment and academic performance.

**Table 2**

### *Summary on the Level of Mathematical Dispositions*

Indicators	Mean	SD	Description
Confidence	3.15	0.44	Moderate
Cognitive Disposition	3.38	0.58	Moderate
Affective Disposition	3.17	0.36	Moderate
<b>Overall Mean</b>	<b>3.24</b>	<b>0.33</b>	<b>Moderate</b>

The overall mean score obtained by students in terms of their mathematical dispositions was 3.24. This suggests that their mathematical dispositions are somewhat evident, with a consistent standard deviation of 0.33. Students display moderate confidence, cognitive disposition, and affective disposition, influencing their engagement and problem-solving abilities while maintaining a balanced disposition towards mathematics.

Moreover, Hutajulu, Wijaya, and Hidayat (2019) found that students generally have moderate mathematical dispositions, indicating a willingness to participate in various mathematical tasks and solve simpler problems effectively, but they may face challenges with more complex mathematical applications. Similarly, Yaniawati et al. (2019) observed a moderate level of mathematical disposition among students, who actively seek alternative approaches and engage in reflective thinking about their problem-solving methods. Consequently, it's crucial for educators to cultivate students' mathematical attitudes in the classroom setting.

**Table 3**

### *Level of Critical Thinking Skills of Students*

Indicators	Mean	SD	Description
Interpretation	26.73	22.97	Low
Analysis	27.53	31.35	Low
Evaluation	19.79	23.35	Very Low
Inference	19.26	17.07	Very Low
<b>Overall Mean</b>	<b>23.33</b>	<b>20.15</b>	<b>Low</b>

The overall mean of critical thinking skills among students is 23.33, indicating a low descriptive equivalent. This means that the critical thinking skills of students are fair. The standard deviation of 20.15 suggests variability around this mean. Additionally, students display inconsistency in their responses, facing challenges in interpreting, analyzing, evaluating, and inferring mathematical problems, which can hinder decision-making and problem-solving abilities, potentially impacting academic achievement and proficiency in tackling complex problems.

Moreover, Basri et al. (2019) found junior high students' critical thinking skills were low, resulting in low problem-solving and decision-making abilities. Conversely, Siburian et al. (2019) emphasized the importance of enhancing students' critical thinking within instructional contexts, linking it to proficient problem-solving skills. These findings stress the need for targeted educational interventions to improve critical thinking skills.

**Table 4**

### *Significant Relationship Between Learning Styles and Mathematical Dispositions Towards Critical Thinking Skills of Students*

Independent Variables	$\rho$	p-value	Decision on $H_0$	Decision on Relationship
Learning Styles	0.140	0.021	Reject	Significant
Mathematical Dispositions	-	0.000	Reject	Significant



Table 4 illustrates correlations between students' learning styles, mathematical dispositions, and critical thinking skills. It reveals a significant positive correlation between learning styles and critical thinking skills ( $p < 0.05$ ), rejecting the null hypothesis. Spearman's rank correlation coefficient ( $\rho$ ) of 0.140 supports this, indicating higher learning styles correspond to higher critical thinking skills. Conversely, there's a significant negative relationship between mathematical dispositions and critical thinking skills ( $p < 0.05$ ), with a  $\rho$ -value of -0.227 indicating higher mathematical dispositions are associated with lower critical thinking skills. Addressing learning styles is crucial to enhancing students' critical thinking skills in mathematics.

The findings corroborate Maknun's (2020) study, showing a positive correlation between learning styles and critical thinking skills. Adnan et al. (2023) discovered that diverse learning activities enhance students' critical thinking skills, a sentiment echoed by Hamidah et al. (2019), who emphasized the importance of improving learning styles to enhance mathematical problem-solving abilities. Conversely, Güner and Gökçe (2021) found a negative relationship between students' mathematical dispositions and critical thinking skills, although Widana (2022) contested this, suggesting a positive correlation. Susilo et al. (2020) observed that positive attitudes towards mathematics don't guarantee high-level critical thinking, highlighting the need for tailored educational approaches to nurture both positive attitudes and robust critical thinking skills.

**Table 5**  
**Regression Analysis of the Learning Styles and Mathematical Dispositions Towards Critical Thinking Skills**

Independent Variables	Unstandardized Coefficients	Standardized Coefficients	t	p-value	Remarks
	B	Std. Error			
(Constant)	32.1	10.67	3.01	0.003	Significant
Leaning Styles	7.95	2.28	3.49	0.000	Significant
Mathematical Dispositions	-11.92	2.8	-4.26	0.000	Significant
R = 0.288		R square = 0.083		p= 0.000	

Table 11 shows that the regression analysis delves into the influence of learning styles and mathematical dispositions on critical thinking skills. Data transformation normalized the distribution, validated by a Shapiro-Wilk value of 0.053 surpassing 0.05. The coefficient of determination (R square) at 0.083 suggests the model predicts 8.3% of critical thinking skill variability in Grade 10 students. A high coefficient of alienation (91.7%) implies other factors may explain the remaining variability. The beta coefficient ( $\beta = 7.95$ ) indicates a positive association between learning styles and critical thinking skills, while  $\beta = -11.92$  suggests an inverse relationship between mathematical dispositions and critical thinking skills. Statistical analysis rejects the null hypothesis, affirming that learning styles and mathematical dispositions significantly predict students' critical thinking skills in mathematics.

Arisoy and Aybek's (2021) research underscores the significant positive impact of learning styles on students' critical thinking skills in mathematics. Minarti et al. (2020) also highlighted the pivotal role of mathematical dispositions in shaping students' critical thinking skills and influencing their interpretation and analysis of mathematical problems. Conversely, Güner and Gökçe (2021) and Palavan (2020) reveal inverse relationships between mathematical dispositions and critical thinking skills, necessitating alternative approaches to foster critical thinking proficiency in educational settings.

### RECOMMENDATIONS

The following suggestions are made in light of the data and conclusions presented.

The study's findings and conclusions lead to the following recommendations:

1. Students might participate in a variety of learning activities to enhance their critical thinking skills. Active participation in challenging problem-solving tasks helps develop resilience and a positive attitude towards math. Integrating these methods in teaching and learning enables critical thinking, diverse perspective exploration, and effective problem-solving skills essential for mathematics success.
2. Teachers might promote the development of critical thinking skills in students by first assessing their learning styles and mathematical dispositions through various activities or assessments. Adapting teaching methods to match these styles enhances learning. Establishing a nurturing educational environment focused on personal growth encourages applying critical thinking in practical scenarios and supports interdisciplinary learning to accommodate diverse mathematical attitudes.
3. The Department of Education might implement policies promoting teacher training programs that incorporate modules on diverse learning styles and mathematical dispositions. Additionally, they might support the development of educational materials catering to different learning modalities, fostering a flexible framework for cultivating critical thinking skills across diverse student populations.
4. Future researchers might focus on conducting extensive studies to better understand the complex interplay between learning styles, mathematical dispositions, and critical thinking skills, offering insights into effective strategies for tailored education. They may also





investigate how emerging technologies and innovative teaching methods can personalize learning, cater to individual preferences, and expedite critical thinking skill development.

## CONCLUSIONS

Based on the findings of the study, the subsequent conclusions have been derived:

1. The learning styles of the Grade 10 students are manifested.
2. The mathematical dispositions of the Grade 10 students are somewhat evident.
3. The critical thinking skills of the Grade 10 students is fair.
4. There is a significant relationship between learning styles and critical thinking skills, and mathematical dispositions and critical thinking skills of the students.
5. Learning styles and mathematical dispositions significantly predict the critical thinking skills of the students.

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