

# Connecting Logic and Language: An Assessment of Students' Mathematical Logical Reasoning Skills and Grammatical Proficiency

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DOI: <https://doi.org/10.51244/IJRSI.2026.1306000220>

Received: 12 June 2026; Accepted: 17 June 2026; Published: 01 July 2026

## ABSTRACT

This study was conducted to determine the Mathematical Logical Reasoning Skills and Grammatical Proficiency among second year college students in the College of Teacher Education at Guimaras State University. A descriptive correlational research design was used in study. The results revealed that the overall mathematical-logical reasoning skills of students were satisfactory, with variations based on sex and program. Students major in Filipino, Social Studies, General Education, and Home Economics showed satisfactory skills, while those major in English, Mathematics, and Science demonstrated very satisfactory skills. The students' grammatical proficiency when taken as a whole and when categorized according to sex was satisfactory. In terms of program, students enrolled in BSED and BEED demonstrated satisfactory grammatical proficiency, whereas those in BTLED exhibited only a fair level. With respect to specialization, students major in Social Studies, General Education, English, Mathematics, and Science showed satisfactory grammatical proficiency. In contrast, students major in Filipino and Home Economics demonstrated a fair level of grammatical proficiency. The students' mathematical-logical reasoning skills did not differ significantly when grouped according to sex; however, significant differences were observed when they were categorized according to program and specialization. Similarly, no significant difference was found in the students' grammatical proficiency when grouped according to sex. However, significant differences existed in their grammatical proficiency when categorized according to program and specialization. Furthermore, a significant relationship was found between the students' mathematical-logical reasoning skills and their grammatical proficiency.

**Keywords:** grammar, proficiency, logical, mathematical, skill

## INTRODUCTION

College students should exhibit high levels of grammar proficiency and logical reasoning since these are crucial for academic success and professional competence. Grammar proficiency enables clear and effective communication, while logical reasoning supports critical thinking and problem-solving abilities. These skills are essential for academic writing, participating in debates, and engaging in complex analyses. Educational institutions, therefore, aim to integrate comprehensive language and reasoning programs into their curricula to enhance these competencies (Smith, 2021).

However, many college students face challenges in mastering grammar and applying logical reasoning effectively. Research indicates that despite having access to various educational resources, students often struggle with grammar issues such as sentence structure, punctuation, and word choice (Jones & Taylor, 2023). Additionally, students often underdevelop logical reasoning skills, which are fundamental for higher-order thinking, resulting in difficulties in academic and professional contexts (Lee, 2022). These deficiencies may be attributed to inadequate instructional methods, lack of targeted practice, and insufficient feedback mechanisms (Martin & Roberts, 2024).

Given these scenarios, it is the researchers' belief that there is a need for a deeper understanding of the factors contributing to inadequate grammar proficiency and logical reasoning among college students. However, while existing research focuses on various aspects of language learning and cognitive development, there is a lack of comprehensive studies that explore the interplay between grammar proficiency and logical reasoning

specifically within the college context (Williams, 2023). Moreover, few studies have investigated how these skills can be effectively improved through targeted interventions and instructional strategies.

Addressing this gap is crucial for developing effective educational strategies and interventions aimed at enhancing mathematical logical skills and grammar proficiency among college students. By investigating the underlying causes of deficiencies in these areas, educators and policymakers can create more tailored and effective teaching approaches. This research contributes to educational development by showing how stronger grammar and logical reasoning skills can improve students' academic success and better prepare them for future careers. Understanding these dynamics can lead to the implementation of evidence-based practices that better support students' success.

### **Objectives of the Study**

The following were the specific objectives of the study. Specifically, this study aimed to determine the:

1. level of students' mathematical logical reasoning skills when taken as a whole and when categorized according to sex, program, and specialization;
2. level of students' grammatical proficiency when taken as a whole and when categorized according to sex, program, and specialization;
3. significant differences in the level of students' mathematical logical reasoning skills when categorized according to sex, program, and specialization;
4. significant differences in the level of students' grammatical proficiency when categorized according to sex, program, and specialization; and
5. relationship between the levels of mathematical logical reasoning skills and grammatical proficiency of students.

### **Materials and Methods**

The researchers employed a descriptive-correlational research design to determine the Mathematical Logical Reasoning Skills and Grammatical Proficiency among CTE randomly selected second-year college students at Guimaras State University-Salvador Campus for Academic Year 2024-2025 shown in (Table 1).

**Table 1. Distribution Of The Respondents**

<b>Program &amp; Specialization</b>	<b>Population (N)</b>	<b>Sample (n)</b>	<b>Percentage (%)</b>
<b>BSED</b>	158	101	70.63%
English	38	24	16.78%
Math	26	17	11.89%
Science	34	22	15.38%
Filipino	30	19	13.29%
Social Studies	30	19	13.29%
<b>BEED</b>	35	23	16.08%
<b>BTLED</b>	29	19	13.29%
<b>Total</b>	<b>222</b>	<b>143</b>	<b>100%</b>

A researcher-made test was utilized to gather data on the students' mathematical-logical reasoning skills and grammatical proficiency. Part I of the research instrument consisted of the respondents' profile. Part II

contained the mathematical-logical reasoning test, while Part III focused on the grammatical proficiency test. To ensure the validity of the research instrument, the questionnaire underwent a thorough review by a panel of validators. They evaluated each item to determine its relevance, clarity, and appropriateness in measuring the intended constructs. To establish the reliability of the instrument, a pilot test was conducted among 30 second-year students who were not included in the actual study sample. The data were subjected to Cronbach’s Alpha reliability analysis, a statistical method used to measure internal consistency. The reliability result for Mathematical Logical Reasoning Skills was 0.869 and for the Grammatical Proficiency was 0.845. The data were gathered, analyzed and evaluated using the appropriate statistical tools. The study utilized both descriptive and inferential statistics such as frequency, percentage, mean, mann-whitney U-test, kruskal-wallis H-test and spearman’s rho correlation coefficient.

To determine the level of the Mathematical Logical Reasoning Skills and Grammatical Proficiency among second year CTE students, the following scale was used shown in (Table 2)

**Table 2. Scale of Means and Qualitative Description**

Scale of Means	Description
25-30	Outstanding
19-24	Very Satisfactory
13-18	Satisfactory
7-12	Fair
0-6	Poor

## RESULTS

Table 3 presents the students’ mathematical logical reasoning skills when taken as a whole and when categorized according to sex, program and specialization. The results revealed that students had satisfactory mathematical logical reasoning skills when taken as a whole (M=17.79). As to sex, both male (M=17.18) and female (M=17.87) students had satisfactory mathematical logical reasoning skills. As to programs, BSED (M=18.59), BEED (M=16.35), and BTLED (M=15.26) had satisfactory mathematical logical reasoning skills. This means that, among the programs, BSED students obtained the highest mean, indicating a stronger performance compared to BEED, BTLED and BTLED. As to specialization, English (M=20.00), Math (M=20.29), and Science (M=20.45) had very satisfactory mathematical logical reasoning skills; however, Filipino (M=14.37), Social Studies (M=17.37), General Education (M=16.35) and Home Economics (M=15.26) had satisfactory mathematical logical reasoning skills. This means that students major in English, Mathematics, and Science showed higher performance, while those in Filipino, Social Studies, General Education, and Home Economics demonstrated satisfactory performance, with Filipino having the lowest mean score.

**Table 3. Students’ mathematical logical reasoning skills when taken as a whole and when categorized according to sex, program and specialization**

Variable	Mean	Description
<b>Sex</b>		
Male	17.18	Satisfactory
Female	17.87	Satisfactory
Total	17.79	Satisfactory
<b>Program</b>		

BSED	18.59	Satisfactory
BEED	16.35	Satisfactory
BTLED	15.26	Satisfactory
Total	17.79	Satisfactory
<b>Specialization</b>		
English	20.00	Very Satisfactory
Math	20.29	Very Satisfactory
Science	20.45	Very Satisfactory
Filipino	14.37	Satisfactory
Social Studies	17.37	Satisfactory
General Education	16.35	Satisfactory
Home Economics	15.26	Satisfactory
Total	17.79	Satisfactory

Scale of means: 25-30 Outstanding; 19-24 Very Satisfactory; 13-18 Satisfactory; 7-12 Fair; 0-6 Poor

Table 4 presents the students' grammatical proficiency when taken as a whole and when categorized according to sex, program and specialization.

Results revealed that students had satisfactory grammatical proficiency when taken as a whole (M=14.67).

As to sex, male (M=12.71) and female (M=14.94) students had satisfactory grammatical proficiency.

As to program, BSED (M=15.51) and BEED (M=14.22) had satisfactory grammatical proficiency, while BTLED (M=10.74) had a fair grammatical proficiency. This means that students enrolled in the BSED and BEED programs demonstrated a stronger command of grammar compared to students in the BTLED, suggesting that BTLED program may need additional support or interventions to improve their grammar skills.

As to specialization, English (M=17.79), Math (M=17.41), and Science (M=18.05), Social Studies (M=13.21), and General Education (M=14.22) had satisfactory grammatical proficiency. However, Filipino (M=10.32) and Home Economics (M=10.74) showed fair grammatical proficiency. This means that grammatical proficiency is not the same across all majors. Students in Filipino and Home Economics need more improvement than those in other majors.

**Table 4. Students' Grammatical Proficiency when taken as a whole and when categorized according to sex, program, and specialization**

Variable	Mean	Description
<b>Sex</b>		
Male	12.71	Satisfactory
Female	14.94	Satisfactory
Total	14.67	Satisfactory

<b>Program</b>		
BSED	15.51	Satisfactory
BEED	14.22	Satisfactory
BTLED	10.74	Fair
Total	14.67	Satisfactory
<b>Specialization</b>		
English	17.79	Satisfactory
Math	17.41	Satisfactory
Science	18.05	Satisfactory
Filipino	10.32	Fair
Social Studies	13.21	Satisfactory
General Education	14.22	Satisfactory
Home Economics	10.74	Fair
Total	14.67	Satisfactory

Scale of means: 25-30 Outstanding; 19-24 Very Satisfactory; 13-18 Satisfactory; 7-12 Fair; 0-6 Poor

Table 5 presents the differences in the Students’ mathematical logical reasoning skills when categorized according to sex using the Mann-Whitney U test. The results revealed that there was no significant difference in the students’ mathematical logical reasoning skills when categorized according to sex. The p-value was .538, which was higher than the 0.05 level of significance. Thus, the hypothesis that states that “there was no significant difference in the students’ mathematical logical reasoning skills when categorized according to sex” was not rejected. This means that male and female learners had the same level of mathematical logical reasoning skills.

**Table 5. Differences in the Students’ Mathematical Logical Reasoning Skills when categorized according to sex**

Variable	N	Mean Rank	Sum of Ranks	U-value	p-value	Remarks
<b>Sex</b>						
Male	17	66.21	1125.50	-.616	.538	Not Significant
Female	126	72.78	9170.50			

Table 6 presents the differences in the students’ mathematical logical reasoning skills when categorized according to program and specialization using the Kruskal-Wallis H test. The results revealed that there was a significant difference in the students’ mathematical logical reasoning skills when categorized according to program and specialization. The p-values for program (.006) and specialization (.000) were lower than the 0.05 level of significance. Thus, the hypothesis that states that “there was no significant difference in the students’ mathematical logical reasoning skills when categorized according to program and specialization” was rejected. This means that students from different programs and specializations do not perform the same in mathematical logical reasoning.

Table 6. Differences in the Students' Mathematical Logical Reasoning Skills when categorized according to program and specialization

Variable	N	Mean Rank	Df	H-value	P-value	Remarks
Program	101	78.93	2	10.305	.006	Significant
BSED	23	60.00				
BEED	19	49.71				
BTLED						
Specialization						
English	24	88.96	6	32.218	.000	Significant
Math	17	95.38				
Science	22	94.07				
Filipino	19	43.71				
Social Studies	19	69.21				
Gen. Ed	23	60.00				
Home Economics	19	49.71				

Table 7 presents the differences in the students' grammatical proficiency when categorized according to sex using the Mann-Whitney U test. The result revealed that there was no significant difference in the students' grammatical proficiency when categorized according to sex. The p-value was .133, which was higher than the 0.05 level of significance. Thus, the hypothesis that states that there was no significant difference in the students' grammatical proficiency when categorized according to sex was not rejected. This means that male and female learners had the same level of grammatical proficiency.

Table 7. Differences in the Students' Grammatical Proficiency when categorized according to sex

Variable	N	Mean Rank	Sum of Ranks	U-value	p-value	Remarks
<b>Sex</b>	17	57.85	983.50	-1.502	.133	Not Significant
Male	126	73.91	9312.50			
Female						

Table 8 presents the differences in students' grammatical proficiency when grouped according to program and specialization using the Kruskal-Wallis H-test. The results revealed statistically significant differences in students' grammatical proficiency across both program and specialization. The p-values for program (.004) and specialization (.000) were lower than the 0.05 level of significance. Thus, the null hypothesis stating that there was no significant difference in grammatical proficiency when categorized according to program and specialization was rejected. This indicates that students from different programs and specializations exhibit varying levels of grammatical proficiency.

Table 8. Differences in the Students' Grammatical Proficiency when categorized according to program and specialization

Variable	N	Mean Rank	Df	H-value	P-value	Remarks
Program						
BSED	101	77.68	2	11.158	.004	Significant

BEED	23	70.89				
BTLED	19	43.16				
Specialization						
English	24	95.06	6	45.482	.000	Significant
Math	17	92.53				
Science	22	97.82				
Filipino	19	35.61				
SocStud	19	61.18				
Gen. Ed	23	70.89				
Home Economics	19	43.16				

Table 9 presents the relationship between students’ mathematical logical reasoning skills and grammatical proficiency. The results revealed that there was a strong positive correlation between mathematical logical reasoning skills and grammatical proficiency

( $r_s = 0.601$ ). This indicates that students with higher mathematical logical reasoning skills tend to have higher grammatical proficiency, and vice versa. Correlation coefficients above 0.60 are generally considered strong positive relationships. The p-value (Sig. 2-tailed) = 0.000 is less than the significance level of 0.05, indicating that the relationship is statistically significant. Therefore, the null hypothesis of no significant relationship between the two variables was rejected.

Table 9. Relationship between Students’ Mathematical Logical Reasoning Skills and Grammatical Proficiency

	Mathematical Logical Reasoning Skills	Grammatical Proficiency	Remarks
Spearman Correlation	.601**	.601**	
Sig. (2-tailed)	.000	.000	Significant Strong Positive Relationship
N	143	143	

## FINDINGS

The following are the key findings of the study based on the analyzed data:

**Mathematical Logical Reasoning Skills:** The students’ mathematical logical reasoning skills, when taken as a whole and when categorized according to sex and program, were **satisfactory**. Regarding specialization, students majoring in Filipino, Social Studies, General Education, and Home Economics demonstrated **satisfactory** skills. In contrast, students majoring in English, Mathematics, and Science exhibited **very satisfactory** mathematical logical reasoning skills.

**Grammatical Proficiency:** The students’ grammatical proficiency, when taken as a whole and when categorized according to sex, was **satisfactory**. In terms of program, students enrolled in BSED and BEED demonstrated **satisfactory** proficiency, whereas those in BTLED exhibited a **fair** level. With respect to specialization, students majoring in Social Studies, General Education, English, Mathematics, and Science showed **satisfactory** proficiency, while those majoring in Filipino and Home Economics demonstrated **fair** grammatical proficiency.

**Differences in Reasoning Skills:** There was **no significant difference** in mathematical logical reasoning skills when categorized according to sex ( $p > .05$ ). In contrast, a

**significant difference** existed when students were categorized according to program and specialization ( $p < .05$ ).

**Differences in Grammatical Proficiency:** No **significant difference** was found in grammatical proficiency when categorized according to sex. However, a **significant difference** was observed when categorized according to program and specialization.

**Relationship between Variables:** There was a **significant relationship** ( $rs = .601, p < .01$ ) between the students' mathematical logical reasoning skills and their grammatical proficiency, indicating a strong positive correlation.

## CONCLUSIONS AND RECOMMENDATIONS

*Based on the findings of the study, the following conclusions were drawn:*

1. The majority of students possess satisfactory mathematical reasoning skills, indicating a clear need to further develop higher-order thinking and advanced problem-solving abilities.
2. Students exhibit both satisfactory and fair levels of grammatical proficiency. This variation across programs and specializations suggests that targeted reinforcement is necessary for specific groups to achieve a higher level of linguistic competency.
3. While sex does not influence mathematical logical reasoning skills, the specific academic program and area of specialization play a significant role in shaping these cognitive abilities.
4. Similarly, sex does not affect grammatical proficiency; however, a student's program and specialization have a significant impact on their level of grammatical competence.
5. The significant association between mathematical logical reasoning and grammatical proficiency suggests that stronger analytical reasoning abilities are intrinsically linked to higher grammatical competence.

*Based on the foregoing findings and conclusions, the researchers propose the following recommendations:*

1. **For Mathematics Educators:** Teachers should design complex problem sets, reasoning tasks, and real-life applications specifically aimed at challenging students to move beyond basic proficiency toward advanced higher-order thinking.
2. **For English Educators:** Teachers should employ differentiated instruction, interactive drills, and communicative practices to support students, particularly those in programs demonstrating lower grammar competency.
3. **Instructional Development:** Educators are encouraged to develop contextualized instructional materials—such as workbooks, modules, and enhanced syllabi—and adopt innovative teaching strategies to bridge the gap in both English and Mathematics.
4. **Interdisciplinary Integration:** It is recommended to incorporate language skills into mathematics instruction (and vice versa). This can be achieved by using mathematical word problems for grammar practice and requiring students to articulate mathematical logic in complete, grammatically correct sentences.
5. **Future Research:** Further studies should be conducted to investigate the underlying socio-demographic or psychological factors that influence the differences observed in reasoning and grammatical proficiency.

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