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A Correlational Study on Critical Thinking Skills and Math Problem-Solving Performance Among Grade 11 Students of Talavera Senior High School

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Abstract — This study examined the relationship between critical thinking skills and math problem-solving performance among Grade 11 students of Talavera Senior High School. Specifically, it described the respondents' profile in terms of age and sex, assessed their level of critical thinking skills, determined their problem-solving skills, and identified whether a significant relationship exists between the two variables. The study utilized a correlational research design. A total of 310 Grade 11 students were selected through stratified random sampling from the total population of 1,850 students. Data were gathered using a survey questionnaire and analyzed using frequency, percentage, weighted mean, and Spearman's rank correlation coefficient.

Findings revealed that most respondents were 16 years old and female. The respondents demonstrated a sufficient level of critical thinking skills with an overall weighted mean of 2.86. Their problem-solving skills were rated agree, with an overall weighted mean of 2.68, indicating a generally positive level of mathematical problem-solving ability. Results further showed that sex had no significant relationship with critical thinking and problem-solving skills, while age had a weak significant relationship with critical thinking skills. Most importantly, a moderate positive correlation was found between critical thinking skills and problem-solving skills ($r = 0.508$, $p = 0.000$), indicating that students with higher critical thinking skills tend to perform better in solving mathematical problems.

The study concluded that critical thinking skills significantly influence students' mathematical problem-solving performance. Therefore, mathematics teachers are encouraged to integrate higher-order thinking activities and real-life problem-solving tasks to further enhance students' critical thinking and problem-solving abilities.

I. Introduction

This chapter presents the background of the study, including the review of related literature, theoretical framework, research paradigm, statement of the problem, scope and delimitations, significance of the study, and definition of terms.

Many students experience difficulty in solving mathematical problems, particularly those requiring structured and systematic thinking. Critical thinking refers to the ability to analyze, interpret, and evaluate information in order to make sound judgments and decisions. In mathematics, it is an essential skill that enables students to examine problems carefully, justify solutions, and develop logical arguments. Researchers emphasize that all students can improve

their critical thinking skills through continuous exposure to mathematical tasks that require reasoning and evaluation.

Critical thinking includes several important components such as analytical thinking, problem-solving, and logical reasoning. Analytical thinking allows learners to examine information carefully, while problem-solving enables them to identify challenges and apply effective solutions. These skills are considered vital 21st-century competencies and are necessary not only in mathematics but also in science and everyday life. Studies also show that active involvement in solving problems enhances learning across disciplines.

Mathematics is not limited to formulas or computations; it develops creativity, discipline, and rational thinking that can be applied in real-life situations. A strong mathematical foundation helps students succeed academically and perform daily tasks effectively. It also supports learning in other subjects such as science, social studies, music, and art. Because of this, schools are encouraged to integrate and assess critical thinking skills within the teaching and learning process.

However, some students with moderate mathematical ability still struggle to understand problems and provide organized solutions. This highlights the need to evaluate students' critical thinking abilities to identify weaknesses and improve instruction. Since mathematics remains a challenging subject for many learners, assessing critical thinking has become increasingly important. Therefore, this study aimed to assess the critical thinking skills of Grade 11 students at Talavera Senior High School in solving mathematics problems.

The K to 12 Basic Education Program under RA 10533 emphasizes the development of critical thinking and problem-solving skills, highlighting the need for higher-order thinking in education. Mathematics is strongly linked to critical thinking, as it develops students' ability to

reason and solve problems effectively (Hwa & Stephens, 2011). Chukwuyenum (2013) also found that critical thinking improves students' understanding of mathematical concepts.

Learning mathematics involves more than memorization; it requires analysis, reasoning, and logical decision-making. Firdaus et al. (2015) noted that critical thinking helps students apply problem-solving skills in both academic and real-life situations. Similarly, Paul and Elder (2016) and McPeck (2017) explained that critical thinking involves identifying problems, analyzing information, and drawing logical conclusions.

However, Hanegem (2017) noted that there is still a challenge in effectively developing critical thinking skills in classroom practice, especially in problem-solving instruction. This highlights the need for improved teaching strategies in mathematics education.

Critical thinking can be assessed through complex problem-solving tasks, where students analyze information and formulate solutions (Aktaş & Ünlü, 2013; Nurmayani, 2020). Widyastuti and Pujiastuti (2014) further stressed that logical thinking improves learning outcomes, while

Widiyastuti (2018) described analytical thinking as breaking down and connecting problem elements.

Firdaus et al. (2017) emphasized the importance of integrating thinking skills in education, while Arisoy and Aybek (2021) concluded that mathematics naturally develops critical thinking through logical reasoning and problem-solving. Overall, the literature confirms that critical thinking is essential in improving students' mathematical problem-solving skills.

Theoretical Framework

This study is anchored on Metacognition Theory, which explains how learners regulate their thinking during learning and problem-solving. Metacognition involves planning, monitoring, evaluating, and controlling one's cognitive processes (Flavell, 1987). Brown (1987) stated that learners who understand their thinking can better identify their strengths and weaknesses in solving mathematical problems.

In mathematics, metacognitive awareness helps students organize strategies, monitor progress, and evaluate solutions. It also promotes self-regulated learning, enabling students to adjust strategies and improve performance (Schraw & Dennison, 1994).

For Grade 11 students at Talavera Senior High School, metacognitive awareness can enhance critical thinking by helping them plan solutions, identify errors, and persist in difficult tasks. Overall, the theory shows that critical thinking in mathematics develops through self-awareness, reflection, and strategic thinking.

Research Paradigm

This part is presented in figure form as the model of the research study. The figure shows the interrelationships of the variables of the study: Input – Process – Output (IPO).

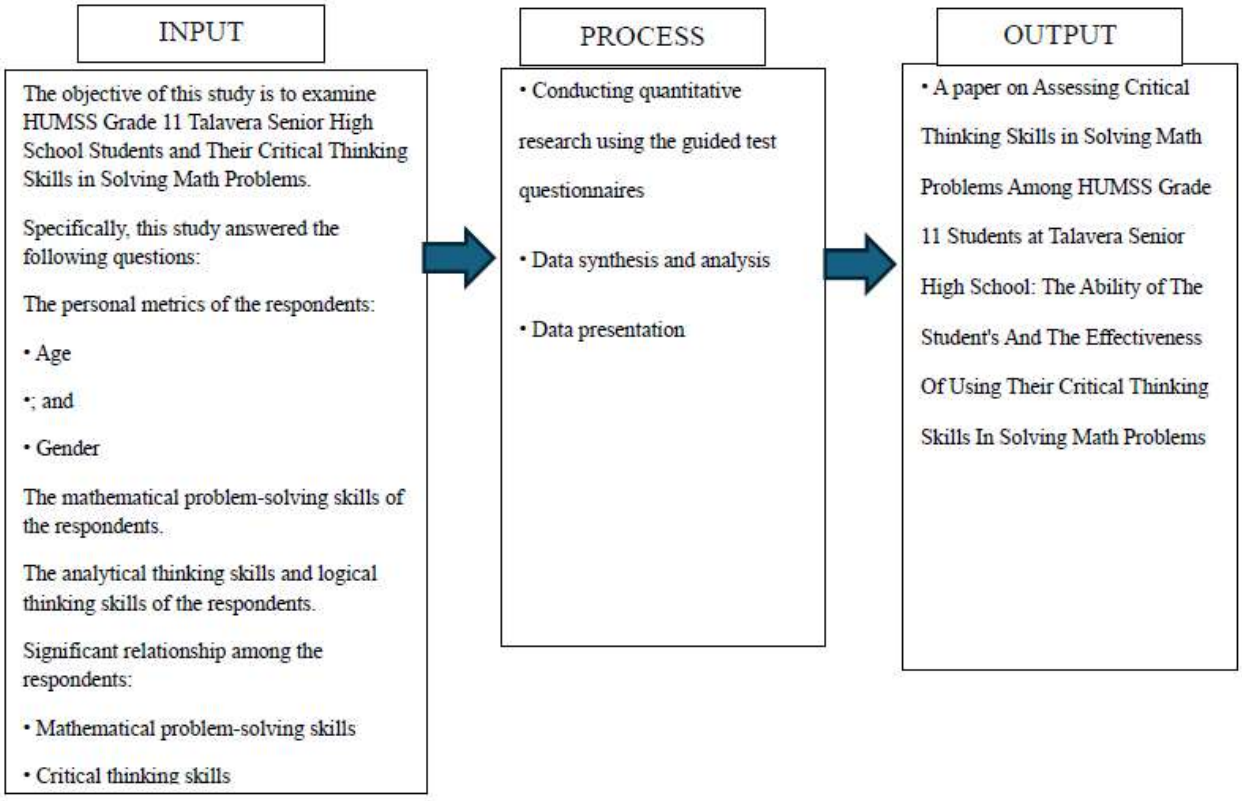

Figure 1. *Research Paradigm using the I.P.O. Model*

Statement of the Problem

This study examined Grade 11 TSHS Students and Their Critical Thinking Skills In Solving Math Problems.

Specifically, this study answered the following questions:

1. How may the personal metrics of the respondents be described in terms of:

    1.1 Age; and

    1.2 Sex?

2. How may the critical thinking skills of the respondents be described?

3. How may the Mathematical problem-solving skills of respondents be described?

4. Is there any significant relationship with their critical thinking skills and mathematical problem solving skills?

Scope and Delimitation

This study and the survey with grade 11 students are conducted in their very own respective classrooms at Talavera Senior High School. It was conducted in the second semester of the school year 2024-2025. This study is generally intended to know the critical thinking skills of Grade 11 students in solving Mathematical problems. This study identified the significant capabilities of students in terms of solving math problems.

Significance of the Study

This study assessed the critical thinking skills of Grade 11 students at Talavera Senior High School in solving mathematical problems. The findings may benefit the following:

- **Curriculum Developers** – to improve mathematics curricula and learning materials that develop critical thinking and problem-solving skills.
- **Students** – to help them recognize their strengths and weaknesses in reasoning and problem-solving.
- **Teachers** – to improve teaching strategies that enhance critical thinking skills.
- **Researchers** – to serve as reference for future studies related to critical thinking and mathematics performance.

Definition of Terms

- **Analytical Thinking Skills** – using a systematic approach to solve problems and make decisions.
- **Critical Thinking Skills** – the ability to think deeply and evaluate information beyond simple recall.
- **Learning Process** – methods and activities used in gaining knowledge and skills.
- **Logical Thinking Skills** – using reason to analyze situations and find solutions.
- **Metacognition** – awareness and regulation of one's own thinking and learning.
- **Problem-Solving Skills** – the ability to identify problems, analyze options, and apply the best solution.

II. Methodology

This chapter discussed the research design, research locale, where the study was conducted, the population, and the sampling technique. The instrument that was used for data collection, the method of data collection, and the statistical analysis were also described.

Research Design

This study used a correlational research design. The correlational research design is used to investigate relationships between variables without the researcher controlling or manipulating any of them. A correlation reflects the strength and or direction of the relationship between two or more variables (Pritha Bhandari, 2023). This method of approach is used to determine whether there is any significant relationship between the critical thinking skills of grade 11 students in terms of solving mathematical problems.

Research Locale

This study conducted and implemented at Talavera Senior High School (TSHS), situated at Highway 1, Villa Rufina Subdivision, Pag-asa District, Talavera, Nueva Ecija. The research conducted during the 2nd semester of the academic year 2024-2025.

Population and Sampling Procedures

The respondents for this study were the Grade 11 Students of Talavera Senior High School with a total population of 1,850 which consists of the ALS-SHS, ABM, GAS, HUMSS, STEM and TVL strand. Stratified sampling was used to determine the specific number of the respondents per strand from the 310 total number of sample respondents.

Table 1.

Distribution of respondents in every strand or strata

STRAND	Population (N)	Sample Size (n)	Percentage (%)
ALS-SHS	153	21	14%
ABM	206	32	16%
HUMSS	727	145	25%
GAS	172	25	15%
STEM	261	41	16%
TVL	331	46	14%
TOTAL:	**1,850**	**310**	**100%**

The recommended sample size was determined using Raosoft Sample Size Calculator with a 95% confidence level, 5% margin of error, and 50% response distribution. The total sample size

was proportionally allocated to each strand by computing the percentage share of each strand in the total population and multiplying it by the overall sample size. This ensured fair representation of all groups.

Sampling Technique The study used probability sampling methods. Simple random sampling gave each student an equal chance of selection, stratified sampling ensured representation from different strands, and cluster sampling selected sections or classes for efficient data collection.

Research Instrument The researchers used a survey questionnaire to gather data. It included respondents' demographic profile (age, gender, strand) and questions measuring critical thinking, analytical thinking, and logical thinking skills. Responses were rated using a 4-point scale: 4–Always, 3–Often, 2–Sometimes, and 1–Almost Never.

Table 2.
Logical Thinking Skills

Scale	Range	Interpretation
4	3.25 – 4.00	Strongly Agree
3	2.50 – 3.24	Agree
2	1.75 – 2.49	Disagree
1	1.00 – 1.74	Strongly Disagree

Table 3.
Problem-Solving Skills

Scale	Range	Interpretation
4	3.25 – 4.00	Strongly Agree
3	2.50 – 3.24	Agree
2	1.75 – 2.49	Disagree
1	1.00 – 1.74	Strongly Disagree

Data Analysis

The responses from the questionnaire were carefully tallied, tabulated, and organized to ensure accuracy and reliability of the study results. The study employed statistical tools such as frequency, percentage, mean, and Spearman's rank correlation coefficient (Spearman's rho) for data analysis.

For SOP 1, frequency and percentage were used to describe the respondents' profile. Frequency refers to the number of occurrences of a data value, while percentage shows the proportion of each category relative to the total population.

For SOP 2, weighted mean and a 4-point Likert Scale were used to determine the respondents' mathematical problem-solving skills by computing the average responses for each indicator.

For SOP 3, Spearman's rho was used to determine the relationship between critical thinking skills and mathematical problem-solving skills. This non-parametric test measures the strength and direction of association between two variables.

For SOP 4, Spearman's rho was also applied to test the significant relationship between respondents' critical thinking skills and their mathematical problem-solving abilities.

Ethical Considerations

This study ensured strict ethical standards throughout its conduct. The confidentiality of respondents' answers was maintained, and no deception or misrepresentation of the study's aims was made. The researchers avoided bias and ensured that data were reported accurately and honestly. Participants' safety and rights were also protected at all times. In addition, proper citation and acknowledgment of all sources were observed to prevent plagiarism and respect intellectual property.

III. Results and Discussion

This chapter presents the findings, analysis, and interpretation of data. Tabular presentation was used for a clearer data presentation. All findings and data gathered from the study were presented and analyzed based on the specific research questions previously stated

1. Respondents' Profile

Table 5 shows the frequency distribution and percentage of the respondents' profiles when grouped according to their age and biological sex.

Table 3.

Table of analysis of the respondents' profile.

PROFILE	INDICATOR	FREQUENCY	PERCENTAGE (%)
Age	15 years old	1	0.4
	16 years old	151	54.5
	17 years old	90	32.5
	18 years old	16	5.8
	19 years old	8	2.9
	20 years old	6	2.2
	21 years old	2	0.7
	23 years old	1	0.4
	25 years old	1	0.4
	33 years old	1	0.4
Mean	16.77		
Sex	Male	132	42.7
	Female	173	56.0
Mean	1.57 (Female)		

Age and Sex Profile of Respondents

As shown in Table 5, most respondents are 16 years old with 151 students (54.5%), followed by 17 years old with 90 students (32.5%). Other ages include 18 years old (5.8%), 19 years old (2.9%), 20 years old (2.2%), and smaller percentages from ages 15, 21, 23, 25, and 33 (0.4% each). Studies suggest that age has little to no significant effect on students' critical thinking skills (Noor et al., 2021).

In terms of sex, 132 respondents (42.7%) are male and 173 respondents (56.3%) are female, showing a slightly higher number of females. Research indicates that there is no significant difference in critical

thinking skills between male and female students (Marnı et al., 2020). Critical thinking is developed through experience and learning rather than gender differences (Bagheri & Ghanizadah, 2016).

1. Respondents' Critical Thinking

Table 4.

Statements	Mean	Verbal Description
When I encounter a matter, I consider it with prejudice without thinking.	2.68	Sufficient
When I encounter a matter, I realize whether the subject is from first hand or second-hand.	2.82	Sufficient
I deduce regarding the explained matter and I can evaluate the reasons of these deductions.	2.87	Sufficient
I can understand pale in the matter and obscurities from explanations regarding the matter.	2.85	Sufficient
I can detect the problems in a matter, explain and define them.	2.88	Sufficient
When I encounter a problem, I can solve it, and make deductions.	2.95	Sufficient
While a matter is explained, I can analyze it by thinking the datas regarding that matter.	2.78	Sufficient
By means of my thoughts regarding a matter, I can improve hypothesis regarding the matter.	2.88	Sufficient
I can pass an accurate judgement on the matter, and I can come to a conclusion with my thoughts.	2.86	Sufficient
When I read a matter, I can understand the main idea and intention of the writer.	2.94	Sufficient
By means of my thoughts, I can make comments and can judge the matters.	2.84	Sufficient
When I encounter a matter, I can express my thoughts regarding matter and I can defend my opinions.	2.87	Sufficient
I can explain my thoughts regarding a matter convincingly and logically.	2.89	Sufficient
By means of explanations regarding a matter, I can predict the ideas unexplained.	2.86	Sufficient
From the explanations regarding a matter, I can find the contradiction between reason and result.	2.99	Sufficient
While a matter is explained, I can concentrate on the matter together with my thoughts.	2.89	Sufficient
By means of explanations regarding a matter, I can establish striking connections regarding the matter.	2.86	Sufficient
When I encounter a matter, I can think critically, reasoningly and analytically.	2.89	Sufficient
When I encounter a matter, I can visualize it and can feel as the main character of the matter.	2.87	Sufficient
When I encounter a matter, I can be more elaborative thanks to my thoughts.	2.85	Sufficient
When I encounter a matter or an action, my thoughts do not misguide me.	2.74	Sufficient
General Weighed Mean:	2.86	Sufficient
Legend/ Range: 3.25 – 4.00 Always 2.50 – 3.24 Sufficient 1.75 – 2.49 Occasional 1.00 – 1.74 Infrequent		

As shown in the table, the respondents' level of critical thinking skills generally falls under a "Sufficient" level, with an overall weighted mean of 2.86. This indicates that students demonstrate an average level of critical thinking in solving problems.

Among the indicators, Statement 15 obtained the highest mean of 2.99, showing that respondents are capable of identifying contradictions between ideas and conclusions in a given problem. This aligns with Watson, Arp, and King (2024), who emphasized that critical thinking involves evaluating arguments and evidence to form reasonable judgments.

On the other hand, Statement 1 recorded the lowest mean of 2.68, suggesting that some respondents tend to approach problems with preconceived ideas or bias. This supports Zaphir (2020), who noted that individuals often rely on prior experiences rather than purely logical reasoning when facing complex issues.

Overall, these findings highlight that while students show adequate critical thinking skills, there is still a need to further enhance their ability to analyze situations objectively. Developing these skills is essential, as Geng (2021) emphasized that critical thinking is crucial for handling complex challenges in academic and real-world contexts.

1. **Respondents' Problem-Solving Skills**

Table 5 presents the verbal interpretation and mean of the problem solving skills of the student respondents of this study.

Table 5.

STATEMENTS	MEAN	VERBAL INTERPRETATION
I am able to be patient as I deal with day-by-day issues and problems in my school	3.13	Agree
I am able to choose the best alternative to solve issues and problems in my school	3.08	Agree
I am able to face job-related issues and problems in my school	3.02	Agree
I am able to list down alternatives to solve issues and problems in my school	3.01	Agree
I am able to see school-related issues and problems before they arise	2.89	Agree
I am able to solve issues and problems on behalf of my school administration	3.05	Agree
I am able to understand why school-related issues and problems arise in the school	3.02	Agree
General Weighed Mean:	2.68	Agree
Legend/ Range: 3.25 – 4.00 Advanced 2.50 – 3.24 Agree 1.75 – 2.49 Disagree 1.00 – 1.74 Strongly Disagree		

From the table, the respondents' problem-solving skills generally fall under an "Agree" level with an overall weighted mean of 2.68, indicating a positive perception of their mathematical problem-solving abilities.

Statement 1 obtained the highest mean of 3.13, showing that respondents are patient when dealing with daily school-related problems. This supports Özreçberoğlu and Çağanağa (2018), who stated that problem-solving skills help individuals handle everyday challenges effectively.

Meanwhile, Statement 5 had the lowest mean of 2.89, indicating that students are less confident in anticipating school-related problems before they occur. This aligns with Abdullah, Julius, and Ali (2022), who found that students' attitudes toward mathematics are closely linked to their problem-solving behavior.

Overall, the findings suggest that respondents demonstrate generally positive problem-solving skills in mathematics and in daily life situations.

4. The repondents' profile and the two main variables in the study.

Table 6 shows the relationship of the respondents' profile and their critical thinking skills and problem-solving skills of this study.

	PEARSONS'S RHO	CRITICAL THINKING SKILLS	PROBLEM-SOLVING SKILLS
SEX	Correlation Coefficient	-0.029	-0.025
	Sig. (2-tailed)	0.614	0.668
AGE	Correlation Coefficient	-.135*	0.060
	Sig. (2-tailed)	0.025	0.324

*. Correlation is significant at the 0.05 level (2-tailed).

According to Sex

As shown in Table 6, sex has no significant relationship with both critical thinking skills ($r = -0.029$, $p = 0.614$) and problem-solving skills ($r = -0.025$, $p = 0.668$), since both p-values are above 0.05. This means that sex is not a determining factor in students' critical thinking and problem-solving abilities. The results suggest that other factors such as education, training, and cognitive development are more influential. This supports Halpern (2013), who stated that gender differences do not significantly affect critical thinking or problem-solving performance.

According to Age

Table 6 shows that age has a significant negative relationship with critical thinking skills ($r = -0.135$, $p = 0.025$), indicating that as age increases, critical thinking slightly decreases. This may be linked to reduced cognitive flexibility in older individuals (Salthouse, 2019). However, age shows no significant relationship with problem-solving skills ($r = 0.060$, $p = 0.324$), suggesting that these skills remain stable across age groups. Baltes and Staudinger (2000) explain that although cognitive speed may decline, experience and knowledge help maintain problem-solving ability.

5. The Respondents' Critical Thinking Skills and Problem-Solving Skills

Table 8 shows the relationship of the respondents' critical thinking skills and problem-solving skills

Table 7.

Significant relationship between the critical thinking skills and problem-solving skills in solving math problems of the respondents.

Problem-solving Skills		
	Pearson Correlation	.508**
Critical Thinking Skills	Sig. (2-tailed)	0.000
	N	309
**. Correlation is significant at the 0.01 level (2-tailed).		

As shown in Table 7, there is a moderate positive correlation between critical thinking skills and problem-solving skills ($r = 0.508$, $p = 0.000$), indicating a highly significant relationship. This means that as students' critical thinking skills increase, their problem-solving skills also increase, and vice versa. It implies that students who frequently apply critical thinking are more likely to demonstrate stronger problem-solving abilities. Therefore, the null hypothesis is rejected.

This finding is supported by Ardiansyah et al. (2022), who stated that mathematical problem situations help reveal students' critical thinking dispositions. Likewise, problem-based tasks encourage learners to analyze, reflect, and apply both declarative and procedural knowledge. Belecina et al. (2018) also emphasized that such problem situations enhance students' metacognitive and reflective thinking, improving their overall critical thinking and problem-solving performance.

IV. Summary, Conclusions, and Recommendations

This chapter presents the summary of findings, conclusions, and recommendations.

Summary of Findings

Based on the analyzed data for *Assessing Critical Thinking Skills in Solving Math Problems Among Grade 11 Students at Talavera Senior High School*, most respondents are 16 years old, and the majority are female.

The respondents showed a "Sufficient" level of critical thinking with an overall positive performance in identifying contradictions and evaluating mathematical problems. They also

demonstrated an "Agree" level of problem-solving skills, particularly in showing patience in handling school-related tasks, although some areas such as anticipating problems still need improvement.

In terms of relationships, age showed a significant but weak negative correlation with critical thinking skills ($r = -0.135$, $p = 0.025$), while no significant relationship was found between age and problem-solving skills. Meanwhile, sex had no significant relationship with both critical thinking and problem-solving skills.

Most importantly, there is a significant positive relationship between critical thinking and problem-solving skills ($r = 0.508$, $p = 0.000$), indicating that students with higher critical thinking skills also perform better in solving mathematical problems.

Conclusions

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

1. Most respondents are 16 years old and predominantly female.
2. The respondents demonstrate a "Sufficient" level of critical thinking skills.
3. Overall, respondents "Agree" to "Strongly Agree" on indicators of critical thinking and problem-solving skills.
4. There is a significant relationship between critical thinking skills and problem-solving skills; thus, the null hypothesis is rejected. Age also shows a significant relationship with critical thinking skills but not with problem-solving skills.
5. Overall, critical thinking skills are significantly related to problem-solving skills among Grade 11 students at Talavera Senior High School.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Future researchers should further explore methods of measuring critical thinking skills in solving math problems among Grade 11 students.
2. Studies may focus on the effects of different teaching strategies on students' problem-solving and critical thinking skills in mathematics.

1. A wider range of student demographics should be included, such as academic background, learning styles, and problem-solving approaches.
2. Future research may examine the use of technology and digital tools in developing critical thinking and problem-solving skills.
3. Mathematics teachers are encouraged to integrate real-life and higher-order thinking problem-solving activities in lessons.
4. Schools should conduct training and workshops for teachers on strategies that promote critical thinking and problem-solving.
5. Curriculum developers should include more logical reasoning and structured problem-solving tasks in the math curriculum.
6. Future studies may investigate the relationship between students' confidence and their critical thinking abilities in mathematics.
7. Teachers and administrators should promote active learning strategies such as discussions and collaborative activities.
8. Ongoing assessments, such as formative and reflective evaluations, should be used to continuously improve students' critical thinking and problem-solving skills.

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