

Reflective Thinking Skills toward Problem Solving of Students in Ilocos Sur Polytechnic State College

Maria Teresa T. Garcia

Ilocos Sur Polytechnic State College, San Nicolas, Candon City. Ilocos Sur, www.ispsc.edu.ph | op@ispsc.edu.ph. mttg1979@gmail.com

HOW TO CITE:

Maria Teresa T. Garcia (2026).
Reflective Thinking Skills toward
Problem Solving of Students in
Ilocos Sur Polytechnic State
College.
International Journal of Special
Education, 41(9s), 815-829

ABSTRACT:

As the demands of the 21st century continue to evolve, students are expected not only to acquire knowledge but also to develop higher-order thinking skills essential for effective problem-solving. Among these skills, reflective thinking plays a vital role by enabling learners to examine their thought processes, evaluate their actions, and generate meaningful solutions to complex challenges. This study aims to understand how reflective thinking influences academic achievement by investigating the reflective thinking skills of second-year Bachelor of Science in Office Administration students enrolled in the Statistics of Research course at Ilocos Sur Polytechnic State College, Main Campus. Specifically, it assesses the students' level of reflective thinking and its relationship to their profiles and mathematics performance. Utilizing a descriptive-correlational research design, data were collected through a structured questionnaire and analyzed using frequency counts, percentages, means, and correlation techniques.

Findings revealed that the majority of the respondents were female and came from rural areas. In terms of mathematics performance, most students obtained a "Good" rating, indicating a satisfactory level of understanding of statistical concepts. The results further showed that students demonstrated a high level of reflective thinking across the three domains. However, certain indicators, particularly those involving higher-order questioning, strategy modification, and knowledge transfer, were only at an average level.

Correlation analysis indicated no significant relationship between the respondents' profile and their level of reflective thinking. Similarly, no significant relationship was found between reflective thinking and mathematics performance. These findings suggest that although students possess reflective thinking skills, these are not fully utilized in enhancing their academic performance.

The study concludes that reflective thinking must be more intentionally integrated into instructional practices to improve students' problem-solving abilities. It is recommended that educators adopt strategies that promote deeper reflection and critical thinking in mathematics learning.

Keywords: reflective thinking, problem solving, mathematics performance, statistics education, higher-order thinking skills.

COPYRIGHT STATEMENT:

Copyright: © 2026 Authors.

Open access publication under the
terms and conditions
of the Creative Commons Attribution
(CC BY)
license (<http://creativecommons.org/licenses/by/4.0/>).

Introduction

Mathematics problem-solving is a central goal of both secondary and higher education because it nurtures analytical reasoning, creativity, and the application of quantitative thinking across disciplines and real-life situations. To improve the quality of education and achieve curriculum goals—particularly in mathematics—it is essential for students to understand mathematical concepts, explain the relationships among these concepts, and apply them effectively to solve problems. This perspective aligns with Bruner's view that meaningful learning in mathematics depends on recognizing conceptual connections and utilizing them in problem-solving contexts.

Dewey (1933) emphasizes that identifying and defining relationships between concepts during problem-solving is a core component of reflective thinking. This view is supported by contemporary literature, which describes reflective thinking as a deliberate process involving analysis, evaluation, motivation, and the construction of deeper meaning through appropriate learning strategies. Through reflection, students connect new information with prior knowledge, enabling them to address unfamiliar or complex problems more effectively.

Given this, reflective thinking in mathematics is indispensable for achieving learning objectives. However, students' performance often does not fully reflect the importance of these skills. Various challenges in mathematics education continue to hinder the development of reflective thinking, resulting in suboptimal learning outcomes. Problem solving inherently requires reflective thinking because it involves identifying what is already known, modifying existing understanding, and applying insights to different situations. Therefore, strengthening students' reflective thinking skills is crucial for improving their mathematical proficiency (Noer et al., 2020).

Dewey (1933) further defined reflective thinking as "active, persistent, and careful consideration of any belief or knowledge, in light of the grounds that support it and the conclusions to which it leads." This definition reinforces the idea that

reflective thinking encompasses examining assumptions, evaluating evidence, and understanding the implications of one's conclusions. It also involves cognitive processes that help learners identify factors contributing to conflicts or difficulties in diverse situations, making reflective thinking a critical element of meaningful learning.

Reflective thinking plays an essential role in mathematical problem-solving, particularly for students who are preparing to become educators. As learners engage with mathematical tasks, they are expected to develop reflective habits that support their analytical abilities. Mastery of reflective mathematical thinking is closely associated with improved problem-solving performance, and it can be further strengthened through structured and conceptual reflection (Yasin et al., 2020). Beyond refining reflective thinking, students are encouraged to enhance their mathematical problem-solving skills as part of their professional and academic development. Strong reflective thinking equips learners with the knowledge and skills necessary to address challenges in both educational and community settings (Yatha et al., 2021).

Today, reflective thinking is widely recognized as a key component of effective learning and higher-order cognitive performance in mathematics. It allows learners to analyze problems deeply, clarify their assumptions, evaluate various solution strategies, and construct logical arguments. At the college level, where students encounter complex, non-routine, and conceptually demanding mathematical tasks, reflective thinking becomes even more essential for academic success.

Globally, mathematics educators have increasingly emphasized the development of reflective thinking as a way to strengthen students' metacognitive abilities. Reflective thinkers are better able to detect errors, revise their approaches, and make informed decisions throughout the problem-solving process. These competencies are considered core 21st-century skills that are vital for academic achievement, professional growth, and daily decision-making.

In the Philippine context, national assessments continue to reveal gaps in students' mathematical reasoning and problem-solving performance. Research suggests that student characteristics such as sex, geographic location, and prior academic achievement may influence their reflective thinking and metacognitive skills. Despite this, reflective thinking remains an underexplored construct in local higher education research, especially within multi-campus state universities like Ilocos Sur Polytechnic State College (ISPSC).

Given the diverse student population across ISPSC's campuses and geographical locations, examining how students' profiles relate to their reflective thinking skills is both relevant and timely. The study also aligns with Sustainable Development Goal 4: Quality Education by promoting inclusive and equitable learning opportunities through the development of a more supportive academic environment. Insights from such research can guide targeted interventions, inform instructional improvements, and support data-driven curriculum development aimed at enhancing students' mathematical problem-solving competencies.

STATEMENT OF THE PROBLEM

The purpose of this study is to assess the reflective thinking skills of college students at Ilocos Sur Polytechnic State College (ISPSC) in relation to their mathematical problem-solving performance.

Specifically, it aims to answer the following questions:

1. What is the profile of the respondents in terms of:
 - a. sex, and
 - b. location of residence?
2. What is the level of performance of the students in their previous mathematics subject?
3. What is the level of students' reflective thinking toward problem solving in terms of:
 - a. questioning,
 - b. evaluation, and
 - c. reasoning?

4. Is there a significant relationship between the students' profile and their reflective thinking skills?

5. Is there a significant relationship between students' reflective thinking skills and level of performance?

Review of Related Literature

Reflective thinking has long been regarded as a central component of deep learning and effective problem solving. Its classic definition traces back to John Dewey (1933), who described reflective thinking as the active, persistent, and careful consideration of beliefs or knowledge in light of evidence and logical reasoning, with the goal of reaching well-supported conclusions (Yatha et al., 2021). Dewey's conception highlights reflection as an intentional and structured cognitive activity rather than a passive mental process.

In mathematics education, reflective thinking is understood as a metacognitive and self-regulatory process. Rather than merely following procedures, learners monitor, evaluate, and regulate their thinking as they engage with mathematical tasks—selecting strategies, examining their steps, and verifying their results (Tabuyo, 2024). Thus, reflection allows students to become aware of their thought processes and make purposeful adjustments that improve their problem-solving performance.

Empirical and theoretical studies often describe reflective thinking as consisting of several components or phases. For instance, one influential framework identifies components such as technique usage, monitoring, insight, and conceptualization. In a study on prospective mathematics teachers, individuals classified as "proficient reflective thinkers" showed consistency and completeness across these aspects when solving geometric problems (Sa'dijah et al., 2020). Another widely used model outlines stages of reflective thinking during problem solving: reacting (initial response), elaborating/comparing (analyzing and evaluating information), and contemplating (reconsidering, reconstructing, and drawing conclusions) (Utomo et al., 2021). More recent research on

mathematical problem solving demonstrates that reflective thinking occurs continuously throughout the entire process—from initial understanding and planning, through execution, and finally to evaluation and verification (Sumen, 2023). These frameworks collectively emphasize that reflective thinking is not a single moment of “looking back” but a continuous cognitive and metacognitive activity integrated into every phase of problem solving.

Reflective thinking is also closely linked to problem-solving competence in mathematics. Researchers such as Schoenfeld (1992), Kwon and Lee (2019), and Chen and Wang (2022) consistently highlight that students who reflect on their assumptions, strategies, and conclusions tend to perform better in analytical and complex tasks. Reflective thinkers typically ask clarifying questions, review and evaluate their steps, justify their reasoning with evidence, detect errors early, and adjust strategies when necessary. These behaviors align with the three core constructs examined in this study: questioning, evaluation, and reasoning.

Questioning involves the student’s ability to ask meaningful questions before, during, and after problem solving. Effective questioning enhances students’ ability to interpret problems, identify essential information, and select suitable strategies. Studies show that learners who can formulate relevant questions demonstrate deeper conceptual understanding and rely less on rote procedures (Temur, 2020).

Evaluation, on the other hand, refers to students’ capacity to assess the effectiveness and correctness of their solutions. It enables students to judge the appropriateness and correctness of strategies and results. Classic and contemporary research—from Pólya’s early problem-solving stages (1945) to Zhang and Wang’s (2021) recent findings—identifies evaluation as a critical step in successful mathematical problem solving. Students who lack this skill often fail to detect errors even when they understand the underlying procedures. According to Wang et al. (2020), evaluative reflection allows learners to judge outcomes critically and improve future

performance. In mathematical contexts, evaluation enables students to verify answers and compare alternative solution methods.

Reasoning, meanwhile, allows learners to provide logical explanations and evidence-based conclusions. It involves logical thinking and justification of solutions. Mathematical reasoning is essential for explaining processes and validation of conclusions. Noor et al. (2025) emphasized that reflective reasoning promotes creative and analytical thinking, leading to improved problem solving competence. On the other hand, the National Council of Teachers of Mathematics (NCTM, 2020) describes reasoning as a fundamental mathematical practice, and studies have shown strong correlations between reasoning ability and students’ overall mathematics performance (Adu-Gyamfi, 2021).

Meanwhile, students’ demographic profile, such as sex and location of residence, may influence reflective thinking skills. Several studies have explored gender differences in reflective thinking and mathematical skills, although findings remain inconsistent. Some research suggests that female students tend to exhibit stronger self-regulation and reflective tendencies (Goller et al., 2024), whereas other studies report no significant gender differences (Santos & Caballero, 2020). These conflicting findings underscore the need for further examination, particularly within specific institutional contexts such as ISPSC.

Students’ location or learning environment may also shape their metacognitive development due to variations in access to learning resources, instructional practices, technology exposure, and academic support systems. Studies by Lumoto et al. (2024), as well as Indonesian scholars such as Sari (2021), reported that urban students often demonstrate stronger metacognitive awareness, while rural students may exhibit greater perseverance. This is seconded by Rivers et al., 2021, which indicates that students from urban areas often have greater exposure to technology-enhanced and inquiry-based instruction, which can foster reflective thinking. However, differences in reflective thinking across campus settings—especially in Philippine higher

education—remain insufficiently explored. Nevertheless, effective teaching strategies can mitigate disparities and promote reflective thinking across diverse student populations.

Academic performance in mathematics is closely linked to reflective thinking skills. A strong academic background in mathematics is frequently associated with higher reflective and analytical ability. Students who engage in reflective practices tend to demonstrate higher achievement because they actively regulate their learning and problem solving strategies. Research indicates that students with higher mathematics grades often possess deeper conceptual understanding, better strategy selection, and stronger reasoning skills (Lumoto et al., 2024). Rivers et al. (2021) also emphasized that reflective learners are more capable of identifying errors, adapting strategies, and improving academic performance. Recent studies have found significant correlations between reflective thinking and mathematics achievement. Hwang et al. (2020) reported that reflective and metacognitive learning activities significantly enhanced students' mathematical problem-solving performance and conceptual understanding. Nonetheless, prior achievement alone does not fully account for reflective skill development, as motivation, instructional quality, and learning mindset also play significant roles. Examining this relationship within ISPSC can therefore provide meaningful insights.

Reflective thinking serves as a strong predictor of academic success, particularly in problem-solving-oriented disciplines. Research in higher education has consistently shown that students with well-developed reflective skills perform better academically because they engage in self-assessment and continuous improvement (Wang & Sperling, 2020). In mathematics education, reflective thinking facilitates transfer of learning and long-term retention of concepts. Students who reflect on their problem-solving processes are more likely to apply learned strategies to new and complex problems, leading to sustained academic performance improvements (Goller et al., 2024).

Instructional interventions such as reflective workbooks, journals, and guided problem-solving activities have been found effective in enhancing reflective thinking skills. These tools provide structured opportunities for students to practice questioning, evaluation, and reasoning. Recent developmental studies highlight the importance of validating instructional materials to ensure effectiveness. Well-designed and validated reflective thinking workbooks have been shown to improve students' engagement, self-regulation, and problem-solving performance in mathematics (Huang & Lajoie, 2021). These findings support the development of an instructional output aimed at improving or sustaining reflective thinking skills among college students.

Overall, the literature consistently affirms that reflective thinking is essential for effective mathematical problem solving. It strengthens students' abilities to understand problems, identify strategies, evaluate outcomes, and justify solutions. While questioning, evaluation, and reasoning are widely recognized as core reflective skills, research on how student profile variables—such as sex and location, relate to reflective thinking remains incomplete and inconsistent, particularly in the Philippine setting. This gap highlights the need for studies that investigate these relationships within diverse educational environments such as ISPSC and for proposing a validated instructional output to improve or sustain students; reflective thinking in problem solving.

Methodology

Research Design

This study will utilize the descriptive-correlational research design. According to Bhandari (2020), quantitative research is the process of gathering and analyzing numerical data. It can be used to discover patterns and averages, to make predictions, to test causal relationships, and to generalize results to larger populations. Pantaleon (2022) defined descriptive research design as a scientific method that involves observing and describing an existing phenomenon. In this study, this method will be

used to determine the students' profile variables and to describe their levels of reflective thinking. On the other hand, correlational method will be used to determine the relationship between the students' profile and their reflective thinking skills toward problem solving. A correlational design is appropriate when the intention is to describe the degree of association between variables without manipulating them (Creswell, 2012). Fraenkel, Wallen, and Hyun (2019) explained that correlational methods help determine how strongly variables are related, serving as a basis for prediction and further inquiry.

Population and Locale of the Study

The population of the study will be the second year Bachelor of Science in Office Administration (BSOA) students who are enrolled in Statistics for Research for the 2025–2026 school year, at the Ilocos Sur Polytechnic State College, Main Campus.

However, in accordance with ethical research standards, informed consent and voluntary participation will be rigorously enforced. All BSOA students who are enrolled in Statistics for Research will be invited to participate in the study but only those who willingly agreed will be included in the actual data collection. Respondents will be informed of the purpose of the study, the nature of their involvement, their right to withdraw at any time without penalty, and the measures taken to protect their confidentiality and data privacy. This approach respects the autonomy of the individuals while aiming for a representation of the population as ethically possible.

Research Instrument

The primary data-gathering tool will be the Reflective Thinking Skills Questionnaire adapted from existing standardized reflective thinking instrument (Kember et al. 2017). The questionnaire is composed of two parts:

Part I of the research instrument will be the profile of the respondents which includes the sex, location of residence, and previous

mathematics grade. Part II will assess the reflective thinking skills toward problem solving of the students in Questioning, Evaluation, and Reasoning.

Data Gathering Procedure

The survey questionnaire will serve as the main instrument for data collection in this study. It will be given to all BSOA students in Statistics for Research of Ilocos Sur Polytechnic State College, Main Campus for the School Year 2025–2026 who are willing to participate. The data-gathering procedure will follow an organized and ethically acceptable approach to assure accuracy, voluntary participation, and protection of participant rights.

Prior to data collection, the researcher will acquire approval from the ISPSC Research office as well as from the REC office. Following this, a formal informed consent process will be carried out. Respondents will be given a permission form that covers the objective of the study, its goals, the procedures involved, potential risks and benefits, and the assurance of voluntary participation. It will also clearly mention that participants have the ability to refuse or withdraw from the study at any moment without any kind of penalty.

The survey will be administered face-to-face, depending on the preference and availability of the respondents. Instructions for answering will be clearly provided to reduce response errors. Respondents will be assured that no personally identifying information will be collected unless necessary, and if so, it will be coded and kept confidential. All data will be maintained securely, accessible only to the researcher, and will be disposed of properly following the study's completion in compliance with data protection protocols.

The researcher understands the ethical considerations that must be taken into account, including:

- Respect for autonomy by promoting voluntary and informed participation.

- Confidentiality and anonymity, where possible, to protect the identity and data of participants.
- Nonviolence, assuring that no harm—physical, emotional, or psychological—will come to participants.
- Integrity and honesty, especially in reporting findings truthfully and without manipulation.

In terms of vulnerabilities and limits, self-reported data through surveys may be prone to social desirability bias, non-response bias, or misreading of questions by some respondents. The researcher will take proactive initiatives to mitigate these risks by pre-testing the instrument, conducting clarifying sessions, and making hard copies.

Through careful preparation, ethical adherence, and sensitivity to the needs and rights of the respondents, the researcher attempt to assure the credibility, reliability, and ethical soundness of the data-gathering process.

Statistical Treatment of Data

The Megastat will be utilized in the statistical analysis and treatment of data to be gathered. Specifically,

Frequency Count and Percentage will be used to analyze the profile of the respondents.

Mean will be used to determine the students' level of reflective thinking skills.

Normality test will be used to determine if the data is distributed normally or not prior to the utilization of parametric or non-parametric statistical treatment.

If the data to be gathered will be distributed normally, the following treatment will be used:

Pearson Product-Moment Correlation Coefficient will be used to determine the significant relationship between the profile of the respondents and their level of knowledge, attitude, and practices in the use of GenAI among the BSBA students.

If the data to be gathered will not be distributed normally, the following treatment will be used:

Spearman Rho Correlation will be used to determine the significant relationship between the profile of the respondents and their level of knowledge, attitude, and practices in the use of GenAI among the BSBA students.

Data Categorization

To determine the level of reflective thinking skills toward problem solving among the BSOA students, the following 5-point Likert scale will be used:

Rating	Statistical Limit	Descriptive Overall	Descriptive Rating
5	4.21-5.00	Strongly Agree (SA)	Very High Reflective Thinking
4	3.41-4.20	Agree (A)	High Reflective Thinking
3	2.61-3.40	Neutral (N)	Average Reflective Thinking
2	1.81-2.60	Disagree (D)	Low Reflective Thinking
1	1.00-1.80	Strongly Disagree (SD)	Very Low Reflective Thinking

Ethical Considerations

This portion provides specifications on the observation of ethical consideration, along with the following:

Conflict of Interest. The researcher is required to reveal any potential conflicts of interest that could compromise the study's integrity. This encompasses financial interests, personal relationships, or affiliations that may affect the research results. The researcher must ensure that her conclusions and interpretations are only derived from the obtained data, free from unrelated influences or personal biases.

Participants/Respondents. Participation in the study must be completely voluntary, free from pressure or improper influence on the BSOA students. Participants must be apprised of their

ability to withdraw from the study at any moment without facing unfavourable consequences.

Privacy and Confidentiality. The researcher must adopt strategies to safeguard the privacy of participants. This entails anonymizing data and guaranteeing that personal identifiers are not associated with the responses. Researcher must implement confidentiality agreements to protect the information supplied by participants, guaranteeing access solely to authorized individuals engaged in the study.

Informed Consent. Respondents must be provided with clear and thorough information regarding the study's objectives, methodologies, potential hazards, and advantages prior to consenting to participate. Written informed permission must be acquired, guaranteeing that respondents comprehend their rights and the nature of their participation in the research.

Benefits. The study intends to help the students to become more independent, strategic, and resilient problem solvers. The findings can guide mathematics instructors in designing reflective prompts, metacognitive activities, and scaffolding strategies tailored to students' needs. Results can also serve as basis for enhancing instructional programs, revising curricula, and developing policies that support reflective and critical thinking.

Community Considerations. The researcher should explore the broader consequences of the study on the educational community and

guarantee that the research contributes positively to the area of education. Engaging with key stakeholders, such as faculty members and educational administrators, can assist match the study's aims with community needs and expectations.

Risks and Remedies. The researchers should do a thorough assessment of any potential risks related with participation in the study, including emotional distress or discomfort related to statistical concepts. If participants experience worries or stress connected to the study, the researchers should provide access to support services, such as counselling or academic assistance, to help offset these risks. In the event that a participant experiences harm as a result of their involvement in the study, the researchers should have a plan in place to address and correct the issue, including offering appropriate assistance and services.

Results and Discussion

The succeeding discussions include the presentation, interpretation, and analysis of significant findings regarding the levels of knowledge, attitudes, and practices (KAP) of BSBA students toward Generative Artificial Intelligence (GenAI), their performance in Mathematics in the Modern World (MMW), and the relationship between these variables.

Profile of the Respondents

The charts below show the profile of the respondents along sex and place of residence.

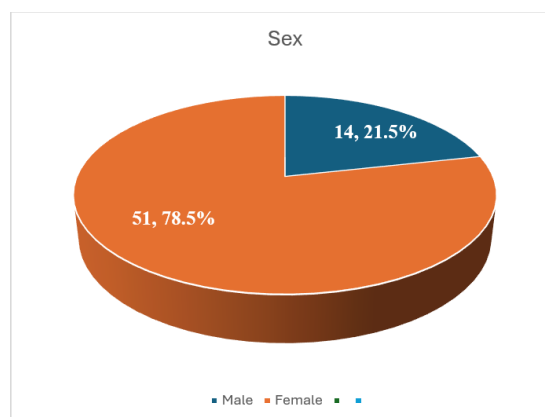


Figure 1. Sex

Figure 1 presents the distribution of respondents according to sex and location of residence.

The data reveal that the majority of the respondents are female, comprising 78.5% or 51, while male respondents account for only 21.5% or 14. This indicates that the population of students enrolled in the program is

predominantly female. This finding is consistent with trends in office administration programs, which typically attract more female students. This result is attested by Garcia and Torres (2021), who found that female students tend to demonstrate stronger reflective learning behaviors

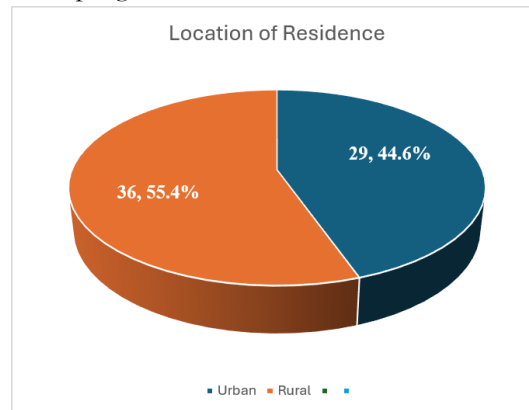


Figure 2. Location of Residence

In terms of location of residence, 55.4% or 36 of the respondents come from rural areas, while 44.6% or 29 are from urban areas. This suggests that the institution caters to a diverse group of students, with a slightly higher representation

from rural communities. Santos and Dela Cruz (2020) emphasized that students from rural areas often develop adaptive problem-solving strategies shaped by their learning environment.

Table 1. Level of Students' Mathematics Performance

Range of Scores	f	Percentage	Descriptive Rating
1.00 – 1.25	4	6.2	Excellent
1.50 – 1.75	14	21.5	Very Good
2.00 – 2.25	34	52.3	Good
2.50 – 2.75	12	18.5	Fair
3.00	1	1.5	Passing

Table 1 presents the level of students' mathematics performance in their previous Mathematics subject, Mathematics in the Modern World (MMW).

The results show that the majority of the respondents 52.3% or 34 fall within the "Good" category. This is followed by 21.5% 14 categorized as "Very Good" and 6.2% or 4 as "Excellent." On the other hand, 18.5% or 12 are rated as "Fair," while only 1.5% or 1) fall under the "Passing" category.

These findings indicate that most students demonstrate a satisfactory level of understanding

of statistical concepts and possess basic problem-solving skills. However, the relatively small percentage of students achieving "Excellent" performance suggests that higher-order thinking skills, particularly reflective thinking, may not yet be fully developed.

This supports the findings of Lopez and Ramos (2022), who argued that reflective thinking significantly contributes to higher levels of mathematical achievement. Students who actively evaluate and regulate their thinking processes tend to perform better than those who rely solely on procedural knowledge. Similarly, Cruz et al.

(2023) emphasized that reflective thinking enables students to move beyond basic comprehension toward deeper conceptual understanding.

Table 2. Level of Students' Reflective Thinking toward Problem Solving in Questioning

Indicators	Mean	DR
1. I ask myself what the problem is really asking before I begin solving it.	4.03	HRT
2. I identify which information in a problem is important and which is not.	3.97	HRT
3. I ask clarifying questions when I do not understand a part of the problem.	3.97	HRT
4. I restate the problem in my own words to make sure I understand it.	3.80	HRT
5. I analyze given data before deciding what solution to use.	4.06	HRT
6. I break down the problem into smaller parts when it seems too difficult.	3.83	HRT
7. I check if I need more information before solving a problem.	4.02	HRT
8. I ask "why" questions to understand the relationships in the problem.	3.15	ART
OVERALL	3.85	HRT

Legend: HRT – High Reflective Thinking

ART – Average Reflective Thinking

The results show an overall mean of 3.85, which is High Reflective Thinking, indicating that students frequently engage in questioning behaviors before and during problem solving. Indicators such as identifying relevant information (3.97), analyzing given data (4.06), and checking the need for additional information (4.02) all fall under high reflective thinking.

However, one indicator—asking "why" questions to understand relationships (3.15)—was rated as Average Reflective Thinking,

suggesting that while students are good at understanding problems at a surface level, they may struggle with deeper conceptual inquiry.

This finding aligns with recent studies emphasizing that questioning is a foundational component of reflective thinking. According to Nguyen and Tran (2021), students who actively engage in self-questioning demonstrate better comprehension and problem-solving performance. However, higher-level questioning (e.g., "why" and "how") is often less developed and requires explicit instructional support.

Table 3. Level of Students' Reflective Thinking toward Problem Solving in Evaluation

Indicators	Mean	DR
1. I check whether my chosen strategy is appropriate for the problem.	3.88	HRT
2. I review each step of my solution to verify accuracy.	4.12	HRT
3. I look for mistakes after solving a mathematical problem.	3.92	HRT
4. I change my strategy when I realize that my first one is not working.	3.32	ART
5. I compare my answer with alternative solutions if available.	3.25	ART
6. I evaluate whether my final answer makes sense.	3.78	HRT
7. I identify what helped me succeed or fail after solving a problem.	3.35	ART
8. I reflect on how I could have solved the problem more efficiently.	3.85	HRT
OVERALL	3.68	HRT

Legend: HRT – High Reflective Thinking

ART – Average Reflective Thinking

The overall mean of 3.68 (High Reflective Thinking) indicates that students generally evaluate their solutions after solving problems.

High ratings were observed in reviewing steps (4.12), checking accuracy (3.92), and verifying whether answers make sense (3.78).

However, some indicators such as changing strategies (3.32), comparing alternative solutions

(3.25), and identifying success or failure factors (3.35) were rated as Average Reflective Thinking. This suggests that while students can check their work, they may not consistently engage in deeper evaluation processes such as strategy modification and comparative analysis.

These findings support the work of Cruz et al. (2023), who noted that students often perform surface-level evaluation (e.g., checking answers) but struggle with deeper reflective evaluation that involves strategic thinking and adaptability. Effective problem solving requires not only verifying answers but also understanding why a solution works or fails.

Table 4. Level of Students' Reflective Thinking toward Problem Solving in Reasoning

Indicators	Mean	DR
1. I justify my steps when explaining my solution to others.	3.77	HRT
2. I provide reasons for why my answer is correct.	3.77	HRT
3. I use mathematical concepts to support my explanations.	3.62	HRT
4. I can explain why I chose a particular strategy.	3.65	HRT
5. I consider different viewpoints or approaches before choosing a solution.	3.66	HRT
6. I connect new problems to similar ones I have solved before.	3.34	ART
7. I organize my solution logically and clearly.	3.77	HRT
8. I can explain my reasoning whether my answer is right or wrong.	3.75	HRT
OVERALL	3.67	HRT

Legend: HRT – High Reflective Thinking
ART – Average Reflective Thinking

The results show an overall mean of 3.67 or High Reflective Thinking, indicating that students are generally capable of explaining and justifying their solutions. High ratings were observed in justifying steps (3.77), explaining answers (3.77), and organizing solutions logically (3.77)

However, the indicator on connecting new problems to previous experiences (3.34) was rated as Average Reflective Thinking, suggesting

that students may have difficulty transferring knowledge across different contexts.

This is consistent with the findings by Dela Peña and Aquino (2022), who emphasized that while students can explain their reasoning, they often struggle with knowledge transfer—a key component of advanced reflective thinking. The ability to connect past and present learning experiences is crucial for developing flexible and adaptive problem-solving skills.

Table 5. Relationship between profile and the level of students' reflective thinking toward problem solving

Profile	Level of Reflective Thinking toward Problem Solving			
	Questioning	Evaluation	Reasoning	Overall
Sex	.156	.029	.005	.069
Location of Residence	.048	.079	-.098	.001

Table 5 presents the relationship between the respondents' profile (sex and location of residence) and their level of reflective thinking across the domains of questioning, evaluation, reasoning, and overall.

The computed correlation values for sex and location of residence indicate very weak relationships across all domains. These values suggest that there is no significant relationship between the respondents' demographic profile

and their level of reflective thinking toward problem solving.

This implies that reflective thinking skills are not strongly influenced by gender or place of residence among the respondents. Regardless of whether students are male or female, or from rural or urban areas, their ability to engage in reflective thinking remains relatively similar.

This finding is supported by recent studies which argue that reflective thinking is more influenced

by instructional strategies and learning experiences rather than demographic factors. According to Reyes and Mendoza (2021), reflective thinking develops through exposure to metacognitive activities rather than inherent personal characteristics. Similarly, Garcia and Torres (2021) noted that while minor differences may exist, these are not always statistically significant in determining reflective thinking ability.

Table 6. Relationship between the levels of students' reflective thinking toward problem solving and the level of Mathematics performance

Mathematics Performance	Level of Reflective Thinking toward Problem Solving			
	Questioning	Evaluation	Reasoning	Overall
	-.242	-.133	.113	-.083

Table 6 presents the relationship between students' level of reflective thinking and their mathematics performance.

The correlation coefficients show weak relationships across questioning, evaluation, reasoning, and overall. These results indicate that there is no significant relationship between reflective thinking and mathematics performance among the respondents.

Interestingly, the negative correlations in questioning and evaluation suggest that higher reflective thinking in these areas does not necessarily correspond to higher mathematics performance. Meanwhile, reasoning shows a slight positive relationship, although still negligible.

These findings suggest that while students demonstrate high reflective thinking, it does not directly translate into higher academic performance in statistics. This may be due to several factors, such as differences in assessment methods, students' study habits, or the possibility that reflective thinking skills are not fully applied during examinations.

This result contrasts with studies such as Lopez and Ramos (2022), which found a positive relationship between reflective thinking and academic performance. However, it supports the

argument of Cruz et al. (2023) that reflective thinking alone is not sufficient to guarantee high performance unless it is effectively integrated into learning and assessment processes.

Conclusions

After analyzing the data, the following statements were concluded :

1. The respondents were predominantly female and slightly more from rural areas.
2. The students demonstrate a satisfactory level of performance in mathematics, indicating adequate understanding of statistical concepts but not a high level of mastery.
3. The respondents exhibit a generally high level of reflective thinking in questioning, evaluation, and reasoning, suggesting that they possess essential problem-solving skills.
4. The findings revealed very weak relationships between the respondents' profile and their level of reflective thinking toward problem solving, indicating that sex and location of residence do not significantly influence students' reflective thinking skills.
5. The results showed weak and negligible relationships between reflective thinking and mathematics performance, suggesting that reflective thinking skills are not consistently

applied in improving students' performance in Statistics in Research.

Recommendations

1. Instructors and school administrators should maintain inclusive learning environments and provide equal opportunities for all students, regardless of sex or location of residence, to actively participate in reflective and problem-solving activities.
2. Instructors should incorporate more engaging and contextualized activities that reinforce the understanding and application of statistical concepts to enhance students' performance in mathematics.
3. Instructors should continue to nurture these abilities through the use of reflective journals, guided questioning, and collaborative problem-solving activities since students already demonstrate strong reflective thinking skills,
4. Instructors should continue implementing inclusive reflective learning activities that cater to all students regardless of demographic background.
5. Instructors should provide activities that directly connect reflective thinking with mathematical problem-solving tasks to help students apply reflective skills more effectively in improving academic performance.

References

- Adu-Gyamfi, K. (2021). Mathematical reasoning and its influence on students' achievement in problem solving. *Journal of Mathematics Education*, 14(2), 55–70.
- Bhandari, P. (2020) What Is Qualitative Research? Methods & Examples. <https://www.scribbr.com/methodology/qualitative-research>
- Chen, L., & Wang, J. (2022). Reflective thinking and problem-solving performance in mathematics: A structural equation modeling analysis. *International Journal of Cognitive Research in Science, Engineering and Education*, 10(2), 133–142.
- Cruz, M. A., Villanueva, R. T., & Perez, J. L. (2023). Reflective thinking and academic performance in mathematics among college students. *Journal of Educational Research and Practice*, 13(2), 45–58.
- Dela Peña, J. R., & Aquino, L. M. (2022). Knowledge transfer and reflective thinking in mathematics learning. *Philippine Journal of Education*, 98(1), 34–49.
- Garcia, P. M., & Torres, A. S. (2021). Gender differences in metacognitive awareness and reflective learning. *International Journal of Learning Studies*, 10(1), 23–35.

6. Development and validation of a Reflective Thinking Workbook is recommended to maintain and further enhance the high level of reflective thinking skills of the respondents.

Limitations and Recommendations of the Study

This study was limited to second-year Bachelor of Science in Office Administration students taking Statistics for Research at Ilocos Sur Polytechnic State College; therefore, the findings may not be generalized to students from other academic programs or institutions. The study focused only on reflective thinking skills in terms of questioning, evaluation, and reasoning and did not consider other factors that may influence problem solving and mathematics performance. Moreover, the study employed a descriptive-correlational design, which only determined the relationships among variables and did not establish causal relationships. The data gathered were based on self-reported responses from the respondents, which may be subject to personal bias and subjectivity.

Acknowledgement

The researcher expresses her indebtedness to Dr. Mario P. Obrero, SUC President III of Ilocos Sur Polytechnic State, and Dr. Jocelyn L. Absolor.

-
- Göller, R., Gildehaus, L., & Lahdenperä, J. (2024). Students' self-regulated learning of university mathematics in different learning environments. *International Journal of Mathematical Education in Science and Technology*. <https://doi.org/10.1080/0020739X.2024.2341035>
- Huang, X., & Lajoie, S. P. (2021). Process analysis of reflective thinking in problem-solving learning environments. *Educational Technology Research and Development*, 69(2), 825–847.
- Hwang, G. J., Wang, S. Y., & Lai, C. L. (2020). Effects of a metacognitive prompting-based learning approach on students' reflective thinking and problem-solving performance. *Computers & Education*, 157, 103988.
- Kember, D., McKay, J., Sinclair, K., & Wong, F. K. Y. (2017). A four-category scheme for coding and assessing reflective thinking. *Assessment & Evaluation in Higher Education*, 42(7), 1133–1149.
- Lopez, D. R., & Ramos, E. F. (2022). Reflective thinking as a predictor of mathematics achievement in higher education. *Asian Journal of Education and Learning*, 7(3), 112–125.
- Lumoto, H. Q. A., Decolas, C. C., Cabalquinto, K. E., & Miranda, A. T. (2024). Exploring students' mathematics performance through self-regulated learning. *Asian Journal of Education and Social Studies*, 50(8), 240–250. <https://doi.org/10.9734/ajess/2024/v50i81525>
- NCTM. (2020). *Principles to actions: Ensuring mathematical success for all*. National Council of Teachers of Mathematics.
- Nguyen, T. H., & Tran, D. P. (2021). The role of self-questioning in enhancing students' problem-solving skills. *Journal of Educational Psychology Research*, 15(2), 89–104.
- Noer, S.H. et al. (2020). Improving students' reflective thinking skills and self-efficacy through scientific learning. *Journal of Physics Conference Series* 1581(1):012036. DOI: 10.1088/1742-6596/1581/1/1/012036
- Noor, N. L., Waluya, S. B., & Widodo, S. A. (2025). Self-regulated learning for solving mathematical problems: A systematic literature review. *Jurnal Riset Pendidikan Matematika*, 12(2). <https://doi.org/10.21831/jrpm.v12i2.89026>
- Pantaleon, A. (2022). Development and Validation of Instructional Material in Basic Calculus. *International Journal of Innovative Science and Research Technology*, ISSN – 2456 – 2165, pp: 228 – 232.
- Reyes, C. J., & Mendoza, L. P. (2021). Instructional strategies for enhancing reflective thinking in problem solving. *Philippine Journal of Educational Psychology*, 9(1), 67–80.
- Rivers, D. J., Nakamura, M., & Vallance, M. (2021). Online self-regulated learning and achievement in the era of change. *Educational Technology Research and Development*, 70(1). <https://doi.org/10.1177/07356331211025108>
- Sa'dijah, C. et al. (2020). Reflective thinking characteristics: A study in the proficient mathematics prospective teachers. *Journal of Mathematics Education*. <https://doi.org/10.22460/infinity.v9i2.p159-172>.
- Santos, H. G., & Dela Cruz, M. N. (2020). Influence of residential background on students' learning experiences and outcomes. *Journal of Social and Educational Studies*, 5(2), 88–102.
- Santos, J., & Caballero, J. (2020). Gender differences in reflective thinking and problem solving among Filipino pre-service teachers. *Philippine Journal of Education*, 96(3), 45–58.
- Sumen, O. (2023). Reflective Thinking in the Problem-solving Process: A Model Proposal. *Sakarya University Journal of Education*. Vol. 13, No. 1, pp. 6-23.
- Tabuyo, A. (2024). Metacognition and Mathematical Problem-solving Performance of Pre-service Teachers. *Pegem Journal of Education and Instruction*, 14(4), 474–480. <https://doi.org/10.47750/pegegog.14.04.46>
- Temur, Ö. (2020). The role of student questioning in developing mathematical understanding. *International Journal of Education in Mathematics, Science and Technology*, 8(3), 214–227.
- Utomo, D. P. et al. (2021). Students' reflective thinking based on their levels of emotional intelligence in mathematical problem-solving. *Beta: Jurnal Tadris Matematika*, 14(1), 69–84. <https://doi.org/10.20414/betajtm.v14i1.399>
-

-
- Wang, Y., & Sperling, R. A. (2020). Characteristics of effective self-regulated learning interventions in mathematics classrooms: A systematic review. *Frontiers in Education*, 5, 58. <https://doi.org/10.3389/educ.2020.00058>
- Yasin, R. M., et al. (2020). Reflective thinking levels of mathematics education students in solving non-routine problems. *Journal on Mathematics Education*, 11(3), 389–402.
- Yatha, Y., Kusuma, A. P., & Huda, N. (2021). Problem-based learning in mathematics learning to improve reflective thinking skills and self-regulated learning. *Al-Jabar: Jurnal Pendidikan Matematika*, 12(2). <https://doi.org/10.24042/ajpm.v12i2.10847>
- Zhang, Y., & Wang, H. (2021). Evaluation as a predictor of students' success in mathematical problem solving. *Journal of Mathematical Behavior*, 61, 100835.

BOOKS

- Bruner, J. S. (1977). *The process of education* (Revised ed.). Harvard University Press.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson.
- Dewey, J. (1933). *How We Think : A Restatement of The Relation of Reflective Thinking to The Educative Process* (Boston : D.C. Heath and Company)
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to design and evaluate research in education* (10th ed.). McGraw-Hill.