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| RESEARCH ARTICLE

The Influence of Critical Thinking and Computational Skills on the Problem-Solving Skills of Grade 7 Students

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| ABSTRACT
This study evaluated the role of critical thinking and computational skills on problem-solving skills of Grade 7 learners at a National High School in Cebu, Philippines, as a basis for an action plan. Utilizing a descriptive-correlational research design, 142 learners and their parents were selected through random sampling, with data analyzed using frequency counts, weighted mean, percentages, and Pearson's r. Findings revealed that most respondents were 13-year-old female Grade 7 students (60.38%), with 33.02% of mothers having completed high school and 26.89% of fathers having completed high school as well, while 36.32% of families were below the poverty line, earning less than ₱10,957 monthly. Learners demonstrated strong critical thinking skills, very satisfactory computational skills, and satisfactory problem-solving skills. However, correlation analyses indicated negligible relationships between critical thinking and problem-solving skills and between computational and problem-solving skills. Socioeconomic factors, such as parental education and income, were identified as potential influences on skill development. The study concludes with a recommendation to implement the proposed action plan to address identified gaps and support holistic learner development.

| KEYWORDS

Computational thinking skills, critical thinking skills, descriptive-correlational design, Philippines, problem-solving skills, teaching Mathematics

| ARTICLE INFORMATION

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INTRODUCTION

The K to 12 Basic Education Curriculum in the Philippines places a strong emphasis on developing critical thinking and problem-solving skills, recognizing their importance in both academic success and everyday life. Mathematics, as a foundational subject, extends beyond the classroom and is essential for students of all ages, fostering intellectual growth and enhancing computational abilities (Marchy et al., 2022). One of the most compelling reasons to study mathematics is the inherent beauty it possesses. The primary aim of mathematical education is to develop mental discipline and stimulate cognitive processes (Mayani et al., 2022). This discipline is essential, as mathematics significantly influences our daily lives in communities, schools, homes, and workplaces. Engaging with mathematics requires strong critical thinking and computational skills, particularly when solving problems (Mayani et al., 2022).

In our modern era, possessing only conceptual knowledge is insufficient. The ability to apply critical thinking, computational skills, and problem-solving strategies is crucial for meeting the demands of contemporary society (Muhammad et al., 2023). Critical thinking skills, which encompass logical reasoning, interpretation, analysis, and evaluation of information, are vital for making sound decisions in everyday life (Phoong et al., 2022). Recognizing the key aspects of a problem is essential for

achieving success (Mellawaty & Taufan, 2021). Ultimately, cultivating critical thinking skills empowers students to become effective learners and adept problem solvers, enhancing their capacity to tackle challenges in their daily lives (Suharno, 2020).

The success of students in mathematics hinges on their abilities and the development of these skills. Critical thinking, in particular, is essential for deepening mathematical understanding, as computational skills are best nurtured through critical thinking practices (Cottrell, 2023). Problem solving is also a crucial area where students must utilize and combine various mathematical concepts and skills while making decisions.

However, students have been reported to struggle with mathematics problem-solving. Their difficulties stem from a lack of essential mathematical skills. Additional study indicated that students find mathematics challenging because they struggle to understand and recall concepts, formulas, facts, and procedures (Muhammad & Yolanda, 2022).

According to the Trends in International Mathematics and Science Study (2023), the Philippines scored 297 in Mathematics and 249 in Science, the lowest among 58 participating countries. The TIMMS-Advanced mathematics assessment was organized around two dimensions on the subject matter or area to be assessed in mathematics and a cognitive dimension on the thinking processes that students were deemed likely to use as they engaged with the content. The Philippines is the lowest among 58 participating countries (Magas, 2023). Furthermore, in the SEA-PLM 2019 Assessment Framework, they reported that the mean score of Filipino students in the mathematics assessment was 288 points, with only 17% reaching the proficiency level expected at the end of primary education. This indicates that a typical Filipino student can apply number properties and units of measurement in English (DepEd, UNICEF, & SEAMEO, 2021).

Thus, the current performance of Filipino students in mathematics reveals a pressing need for targeted interventions to enhance their critical thinking and problem-solving abilities. The low scores reported in international assessments serve as a wake-up call for educational stakeholders to prioritize the improvement of mathematics instruction. By focusing on developing a robust curriculum that emphasizes practical applications and cognitive skills, the Philippines can work towards elevating its students' proficiency in mathematics. Addressing these educational gaps is essential not only for improving academic outcomes but also for empowering students to navigate complex problems in their everyday lives, ultimately contributing to the nation's overall development and competitiveness on a global scale.

Theoretical Background

This study is anchored on the Cognitive Theory by Jean Piaget (1936) and the Social Learning Theory by Albert Bandura (1977), as well as the legal basis of DepEd Order No. 21, s. 2019 and Republic Act No. 10533.

According to the Cognitive Theory by Jean Piaget, in the context of the article by Cherry (2024), children progress through distinct stages of learning, actively engaging with their environment and integrating new knowledge with their existing understanding. Jean Piaget's theory of cognitive development provides a valuable framework for understanding how students at the Grade 7 level can enhance their problem-solving skills through the cultivation of critical thinking and computational thinking. This active involvement is crucial for developing higher-order thinking skills, such as critical and computational thinking, which are essential for effective problem-solving (Pakpahan & Saragih, 2022).

As Grade 7 students interact with mathematical concepts and real-life scenarios, they resemble Piaget's "little scientists," experimenting and observing to construct their understanding. This procedure is in line with the objectives of the research topic, which is to assess how students' problem-solving capabilities are improved by critical thinking and computational thinking abilities. Understanding that cognitive abilities and intelligence evolve through both qualitative and quantitative changes, this study will investigate how developing these thinking abilities can enhance mathematical problem-solving results. In the end, knowing how Piaget's developmental phases relate to the improvement of critical and computational thinking will help teachers create lessons that will help seventh-grade children learn more deeply.

Another theory that is anchored on this study is Social Learning Theory which posits that which asserts that learning is a cognitive process that occurs in a social context and can still happen just through direct instruction or observation, even in the absence of motor adaptation or immediate reinforcement (Main, P., 2022). This theory explains that cognition, environment, and behavior all mutually affect each other to strengthen the learning process. When grouped, they can result in meaningful learning.

Social Learning Theory emphasizes the value of collaborative learning contexts when assessing how critical thinking and computational thinking skills enhance Grade 7 students' problem-solving ability. Students can exchange ideas, watch how one another solves problems, and have discussions that help them comprehend concepts better when they collaborate (Bouchrika, 2024). Students can acquire critical and computational thinking abilities in a supportive environment thanks to this social interaction, which promotes meaningful learning. This study can offer important insights into successful instructional strategies that improve students' mathematical problem-solving skills by examining the role that social dynamics play in learning.

Problem-solving skills are intricately connected to cognitive theory and play a crucial role in enhancing students' higher-order thinking in mathematics (Siahaan et al., 2023). Siahaan et al. (2023) emphasized that problem-solving is a fundamental aspect of mathematics education, requiring students to apply their knowledge and reasoning to address complex, real-world challenges. They advocated for student-centered learning environments that promote active engagement and collaboration, allowing students to construct their mathematical understanding rather than passively absorb information. Critical thinking skills,

such as analyzing information and drawing logical conclusions, are essential in this process, as are metacognitive skills that involve self-regulating one's problem-solving strategies (Darmayanti, 2022).

Moreover, Arisoy & Aybek (2021) highlight the significant impact of students' beliefs about mathematics and their self-efficacy on their problem-solving performance. Cultivating dispositions such as persistence, flexibility, and a willingness to engage in sense-making is vital for developing robust problem-solving skills. They argue that effective mathematics instruction should address not only the content but also the teaching of problem-solving strategies, fostering metacognitive awareness and nurturing positive attitudes toward mathematics. This comprehensive approach aims to equip students with the skills and mindset needed to tackle future challenges in their educational and professional endeavors.

Cognitive theory emphasizes the development of habitual and automatic thought processes that adapt to the psychological challenges individuals encounter (Pakpahan & Saragih, 2022). This active learning style enhances students' ability to connect new information with existing knowledge, improving memory retention. Monteiro et al. (2020) highlight in their study that critical thinking is essential for effective problem-solving, as it involves analyzing information, interpreting evidence, evaluating arguments, and drawing logical conclusions. Students with strong critical thinking skills are better equipped to identify problems, consider multiple perspectives, and develop innovative solutions.

Similarly, computational skills—such as numerical reasoning, data analysis, and algorithmic thinking—are crucial for breaking down complex problems and applying appropriate mathematical techniques (Sholihah, 2022). The interplay between critical thinking and computational skills is well-documented; students who integrate these skill sets are more adept at addressing multifaceted challenges. Critical thinking helps them understand the problem context and evaluate potential solutions, while computational skills offer the quantitative reasoning necessary for implementation.

On the other hand, critical thinking involves analyzing information, evaluating evidence, and making reasoned judgments (Monrat et al., 2022). Bandura's theory suggests that when students observe their peers or educators engaging in critical thinking processes, they are more likely to adopt similar strategies. For instance, in a mathematics classroom, when a teacher demonstrates how to break down a complex problem into manageable parts, students can observe the critical thinking involved in identifying relevant information and evaluating potential solutions. Research by Indah et al. (2022) reinforces this idea, which indicates that students who see successful models engaging in critical thinking are more motivated to emulate these behaviors, thereby enhancing their own critical thinking skills.

In the Philippine educational landscape, the integration of critical thinking and computational thinking skills has become paramount, which aligns with global educational trends and national development goals (Lapuz & Fulgencio, 2020). The legal foundation for this research rests upon two legal frameworks, namely DepEd Order No. 21, s. 2019 and Republic Act No. 10533, which delves into the pivotal role of enhancing these skills.

The Department of Education (DepEd) Order No. 21, series of 2019, provides the policy guidelines for the K to 12 Basic Education Program, which aims to provide Filipino students with a robust educational foundation by extending the basic education cycle to 13 years, comprising kindergarten and 12 years of basic education. It outlines the goals and standards for various subjects, including Mathematics, and highlights the importance of developing critical thinking and computational skills among students, recognizing these competencies as essential for effective problem-solving and overall academic achievement. The guidelines emphasize a learner-centered approach, ensuring that the curriculum is responsive to the needs of the students and the demands of the 21st century.

Complementing DepEd Order No. 21, s. 2019 is Republic Act No. 10533, commonly known as the Enhanced Basic Education Act of 2013. This act focuses on extending the basic education cycle and aiming to enhance the quality of education in the Philippines by aligning the curriculum with international standards. The MATATAG Curriculum, developed under this act, which will be implemented in phases in the school year 2024-2025, starting with kindergarten, grades 1, 4, and 7 stated in the DepEd Memorandum No. 054, s. 2023. The curriculum is designed to be learner-centered, inclusive, and developmentally appropriate, ensuring that students are well-prepared for the challenges of higher education and the workforce. It focuses on strengthening the foundation of basic education by improving the quality of education and ensuring that graduates are equipped with essential skills and knowledge. Thus, emphasizes critical thinking, problem-solving, and computational skills, aligning with global standards and the demands of the modern world. Both DepEd Order No. 21, s. 2019, and RA 10533 advocates for the holistic development of students. This research shows the interplay between critical thinking, computational skills, and problem-solving skills, providing insights into how these skills can collectively contribute to students' overall development.

Critical Thinking is one of the most important thinking skills that plays a significant role in determining the quality of student learning (Alsaleh, 2020). According to Delamain & Spring (2020), Critical Thinking involves the objective analysis and evaluation of information or issues to reach well-founded conclusions. A critical thinker possesses the capacity to conceptualize, reason logically, strategize, think analytically, make decisions, and synthesize information to effectively resolve complex problems (Rahman, 2019). Similarly, according to the article published by the Government of Ontario that is found in the Education and Training page or section, "Critical thinking and problem solving involve locating, processing, analyzing, and interpreting relevant and reliable information to address complex issues and problems, make informed judgements and decisions, and take effective action." When people have trouble in solving problems, they have trouble in making decisions; thus, critical thinking skills is required if a person wants to make the best decisions possible (Montoya, 2023).

Mathematics is considered a pathway to enhance cognitive skills and shares a common similarity with critical thinking. Critical thinking has been gaining increasing recognition within the educational system, alongside the constructivist approach, and it contributes to nurturing individuals who possess constructive, creative, and productive traits, with qualities such as independent and scientific thinking, and a broad worldview (Arisoy & Aybek, 2021). According to Saputra et al. (2019), such skills can be cultivated universally, notably within the sector of education, which plays an important role in honing students' attitudes, knowledge, and skills.

In the present era, educators are tasked not only with imparting knowledge but also with equipping students with essential skills such as critical thinking skills, enabling students to effectively identify and solve problems while retaining key problem-solving approaches and potential outcomes (Fahmi et al., 2019). High-order thinking skills play a significant role in assessing 21st-century learning due to the need for the advancement of high-level critical thinking skills. Critical thinking skills are essential in the 21st century as they prepare students to effectively address social, scientific, and practical challenges in the future (Miterianifa et al., 2021).

The continuous development of people is required to become effectively competent in using the skills in this era, since trends are evolving in the 21st century. Critical thinking is recognized as a fundamental skill since it helps in the intellectual development of individuals to sustain global welfare; that is why integrating critical thinking into academic content is one of the many strategies employed to cultivate students' critical thinking abilities (Bağ & Gürsoy, 2021). The development of critical thinking skills is a vital component of education that has been a focal point for many educators over the years, with the belief that it can contribute to improved academic performance (D'Alessio et al., 2019). Moreover, critical thinking equips students with the skills to analyze problems, consider it, and draw well-founded conclusions, thereby enhancing their capacity to understand, comprehend, and retain information (Palinussa et al., 2023).

In the twenty-first century, the capacity for computational thought is a critical ability. Using concepts from computer science, Wei et al. (2021) established the idea of computational thinking, which includes behavioral analysis, system design, and problem-solving. Computer scientists' thought processes were the initial focus of the reflection on computational thinking, but it has since developed into a fundamental skill that applies to everyone navigating the technological landscape and successfully solving complex problems (Wei et al., 2021; Huang & Looi, 2021).

Computational thinking involves breaking down complex problems into more manageable components through techniques such as reduction, embedding, transformation, or simulation, as well as employing heuristic reasoning to identify solutions (Palts & Pedaste, 2020). This contrasts with general problem-solving skills, which may not specifically incorporate these computational strategies or the systematic approaches inherent in computer science. In the study conducted by Bati (2022) about the systematic literature review regarding computational thinking skills, he explained that while problem-solving can be applied to a wide range of contexts—including personal, social, and academic challenges—computational thinking focuses on applying specific algorithms and logical processes to efficiently tackle problems, especially those related to technology and data. This distinction highlights the importance of both skill sets in today's increasingly digital world, as computational thinking equips individuals with the tools to navigate and innovate within complex technological environments.

Despite various definitions, computational thinking has come to be recognized as an essential 21st-century talent and is currently being incorporated into curricula in schools all around the world (Bati, 2022; Palts & Pedaste, 2020). Implementing computational thinking as a fundamental skill across the school curriculum will allow students to develop abstract thinking, algorithmic and logical reasoning, and the ability to tackle intricate and open-ended problems (Polat et al., 2021). Among the subjects that require computational thinking skills is mathematics. Mathematics is often described as a tool for critical, logical, and inventive thinking because it is a science that can only be understood by reasoning. As a discipline in education, mathematics is very important because it's a good way to measure how well pupils can learn and reason logically (Angraini et al., 2023). Given that computer science has many roots in mathematics, it is sense to consider whether and how providing students with Computational Thinking activities can impact their understanding of mathematics (Wei et al., 2021).

A study of Salde (2023), which explores the mathematical proficiency of Grade 10 students at a sectarian school in Bacolod City, focusing on their computational thinking, critical thinking, and problem-solving skills across various function types. Results show that both male and female students demonstrate average proficiency in Linear, Polynomial, and Exponential Functions, indicating effective application of computational thinking. Notably, females outperform males in Logarithmic Functions, suggesting a stronger use of critical thinking in problem-solving. However, both genders struggle with Quadratic Functions, highlighting a gap in their problem-solving abilities for more complex concepts. While students from private and public schools exhibit similar proficiency levels, higher-income students perform better in Logarithmic Functions. These findings emphasize the need for targeted instructional strategies to enhance students' computational and critical thinking skills, particularly in challenging areas like Quadratic Functions, to improve overall mathematical proficiency.

A more recent related study, Almulla (2023), empirically investigated the link between students' critical thinking and creativity, which influences their problem-solving skills and, hence, their academic success in Saudi Arabia's higher education. In this study, learning motivation, cooperativity, peer contact, peer engagement, and a smart classroom environment were found to be favorably associated with students' critical thinking and creativity. Furthermore, pupils' critical thinking and creativity were favourably associated with problem-solving skills and academic success. As a result, the findings of this study show that lecturers

should consider students' learning motivation, cooperativity, peer interaction, and peer engagement in the smart classroom setting to encourage critical thinking and creativity. While the current study has substantial implications, it is not without flaws. It should be mentioned that, using a structural equation modelling approach, this research has only looked at seven critical aspects that impact students' problem-solving and academic performance. In addition, the context was limited to a single topic area in a smart classroom setting. Other topic areas and associated qualities, such as students' learning styles and approaches to studying, as well as teaching procedures and tactics, should be included in future research.

Furthermore, Suryana & Yulia (2021) investigated the relationship between computational thinking skills and creative problem-solving abilities among secondary school students during the 2018-2019 academic year, involving a sample of 1,098 pupils from grades 5 to 8. The findings revealed that students demonstrated strong average scores in both numerical thinking and creative problem-solving skills, with girls outperforming boys in these areas. Significant differences in computational thinking scores emerged as students progressed through grade levels. The study concluded that there is a substantial correlation between thinking skills, creative problem-solving abilities, and the capacity to adapt to technological advancements. Additionally, a positive and significant relationship was found between computational thinking skills and creative problem-solving skills, with the latter being a strong predictor of the former.

In general, this study underscores the integral connection between critical thinking, computational thinking, and problem-solving skills in enhancing the mathematical proficiency of Grade 7 students. Grounded in Piaget's Cognitive Theory and Bandura's Social Learning Theory, the research highlights the importance of active learning and social interaction in developing these essential skills. The findings emphasize that both critical and computational thinking are vital for effective problem-solving, particularly as students encounter increasingly complex mathematical concepts. Recommendations suggest implementing targeted instructional strategies that foster these skills, especially for students struggling with specific topics like Quadratic Functions. By aligning educational practices with the frameworks established by DepEd Order No. 21, s. 2019, and Republic Act No. 10533, educators can create a more supportive and enriched learning environment that prepares students for the challenges of the 21st century. Overall, enhancing these thinking skills will not only improve academic performance but also equip students with the necessary competencies to navigate future educational and professional landscapes.

OBJECTIVES OF THE STUDY

This research assessed the critical thinking skills, computational skills, and problem-solving skills of the Grade 7 students at the identified public high schools in (name of the division) for the school year 2024-2025 as a basis for proposed action plans. Specifically, this study sought to answer the following queries:

1. What is the profile of respondents in terms of age and gender, parents' highest educational attainment, and combined family monthly income?
2. What is the level of critical thinking skills of the respondents?
3. What is the level of computational thinking skills of the respondents in terms of creativity, algorithmic thinking, cooperativity, critical thinking, and problem-solving?
4. What is the level of problem-solving skills of the respondents?
5. Is there a significant relationship between the respondents' critical thinking and their problem-solving skills, and the respondents' computational thinking and their problem-solving skills?
6. Based on the findings, what action plans may be proposed?

Statement of the Null Hypothesis

Based on the objectives of the study, the following null hypothesis was tested at a 0.05 level of significance:

Ho1: There is no significant relationship between the respondents' critical thinking and their problem-solving skills.

Ho2: There is no significant relationship between the respondents' computational thinking and their problem-solving skills.

METHODOLOGY

Research Design

This study adopted a descriptive correlational research design. Referring to John W. Creswell, as quoted in the correlational study of Creswell et al. (2021), correlation research is defined as a statistical test to determine the tendency or pattern for two even (or more variables or two sets of data to vary consistently. Then Gay, as stated in the study of Li et al. (2022), explained that correlation research involves collecting data to determine, and to what degree, a relationship exists between two or more quantifiable variables.

The aim is to describe the variables within the student population and examine their correlations without implying causation. Through data collection and analysis, this design aimed to provide insights into the patterns and relationships among critical thinking skills, problem-solving skills, and academic performance.

The Input-Process-Output (IPO) model guided this scientific investigation towards achieving the study's objectives regarding critical thinking skills, problem-solving skills, and academic performance.

Input: The study focuses on assessing students' difficulties in critical thinking and problem-solving which aims to understand the challenges in these areas and their impact on academic success. *Process:* The methodological steps, including participant selection, data collection, and statistical analysis, are outlined. The progression from questionnaire administration to data analysis is detailed. *Output:* The anticipated outcomes of the research, such as potential educational interventions to enhance critical thinking skills, problem-solving abilities, and academic performance among high school students, will be highlighted.

Environment

The study was conducted in a National High School, located in Cebu Province within the Central Visayas region of the Philippines, and is positioned near the St. Francis of Assisi Parish Church and the Dumanjug Municipal Council office. Officially recognized as a first-class municipality, Dumanjug is home to this distinguished institution, which serves as the flagship high school of the area. Established in 2002 as "Bitoon National Vocational High School – Poblacion Extension," its origins can be traced to the former Dumanjug Municipal Hall, now part of the Dumanjug Executive Building.

The school is managed by a head administrator supported by a dedicated team of 30 teaching staff and 3 non-teaching staff, all of whom contribute essential services to the school community. The National High School features 32 vibrant classrooms that accommodate Junior High School students from Grades 7 to 10, as well as facilities for Senior High School students. Additionally, the school offers various resources to meet student needs, including a library, technological laboratory, computer laboratory, activity center, and guidance office.

For many years, this institution has played a vital role in Dumanjug's educational landscape, providing a foundation for both academic and personal development among local youth. The diverse student body, with varying levels of mathematical proficiency, creates a rich environment for exploring the enhancement of computational thinking and problem-solving skills.

Respondents

The research respondents were from the National High School, Cebu, Philippines that has garnered huge enrollment since the beginning of admissions for the school year 2024 – 2025. The total number of student enrollees for the school year in the National High School is 601. All grade 7 students are the respondents of the study where numeracy skills were tested through a numeracy skills test tool. Total enumeration was used. The distribution of respondents by the school is shown in Table 1.

Table 1. Distribution of the Respondents

Gender	f	%
Male	79	55.63
Female	63	44.37
Total	142	100.00

The total number of Grade 7 enrollees is 142. All these students were the respondents of the study which can be considered as population data. Population data is generally considered to be better than sample data because it is more accurate, representative, generalizable, and precise. However, there are situations where collecting data from the entire population may not be feasible or practical, in which case sampling may be necessary. In the case of the study, population data can be obtained, hence, all of the grade 7 students of these identified schools are chosen as respondents.

Instrument

This research utilized the Numeracy Skill Test given by the Department of Education – City of Naga Division, Cebu, Philippines. This was used to measure the level of numeracy skills of the students in Grade 7 during the first quarter. The most essential learning competencies (MELCS) being tested in this tool was to perform fundamental operations on integers (M7NS-Ic-d-1). The questions were further classified into three levels of difficulty to check the level of understanding of the students such that 25 items out of 50 or 60 percent of the questions belongs to the easy level, 18 questions out of 50 or 30 percent belongs to the average level, and seven (7) questions out of 50 or 10 percent belongs to the difficult level. From here, data of their level in the operations on integers, strong points, and weak areas were interpreted using descriptive statistics.

The students in this study took a 50- item Multiple Choice Test on Addition and Subtraction of Integers. This test was comprised of two parts: 25-item question on Addition of Integers and 25-item question on Subtraction of Integers. The students answered the test for one hour by solving the questions and encircling the letter of the correct answer. For every section, there is one teacher that administers the test. The time duration was based on the section's Math class schedule.

Gathering Procedure

There are three parts in the implementation of this study which include the preliminary, data gathering, and post data gathering stages. This is vital to have a systematic way of conducting the research. The careful planning and implementation of the study could lead to more reliable and ethically motivated results.

Preliminary Stage. In the gathering of data, the researcher asked permission from the Department of Education – School's Division Superintendent through a request or transmittal letter to conduct a study among junior high school students in the selected public schools in DepEd. Another letter of request to conduct the study were given to the designated Principal. Once consent is granted, the researcher asked the designated personnel to retrieve the schools for their approval.

During Data Gathering Stage. Once the consent was granted, the researcher asked the designated personnel in retrieving the data of the numeracy skills test scores of the students for the first to third quarter of the school year 2023 - 2024. To ensure a better and more accurate outcome, the data mining was personally conducted by the researchers themselves. The researcher further informed the schools and other key personnel that the data obtained were kept with at most confidentiality.

Post Data Gathering Stage. After the data were collected, they were tabulated, collated, analyzed, and interpreted using the appropriate statistical treatment. The results were the basis for the study's interpretation, implication, generalization, and conclusion. It is also important to keep the confidentiality of the data by using codes or disposing of data after use.

Statistical Treatment

Statistical treatment of data is an imperative part of studying any field. It is an effective and essential way out for using the data in the right form. The use of the treatment provided the researcher with the right information as basis for implication, generalization, or analysis. The responses of the participants in this study were subjected to the following statistical treatment:

The profile of the respondents was measured using frequencies, percentages for the nominal and ordinal data (gender; parents' occupation; and parents' highest educational attainment); means and standard deviations for interval data (age and final grade in the 1st quarter in Math).

In determining the level of students' numeracy level, DepEd's Grading System was employed with the numerical rating, descriptive rating, and verbal interpretation. The numerical rating was evenly distributed and was also categorized into five categories as students to be Outstanding, Very Satisfactory, Satisfactory, Fairly Satisfactory and Did Not Meet Expectations in the test tool.

Means and standard deviations were also be employed to determine the level of numeracy skills of the respondents in Mathematics in the following areas: addition of integers, and subtraction of integers.

The Multiple Regression R was employed to determine the significance of the relationship between the profile and the level of numeracy skills of the students. Likewise, the Wilcoxon Signed Rank Test was used to test the significance of the difference among the numeracy skill levels of the respondents by area with the Kolmogorov-Smirnov Test of Normality used to verify normality of data.

Ethical Considerations

It was made clear to the respondents that their participation in this study is voluntary, and they are not compelled to participate should they believe it is detrimental to their interest. Furthermore, the participants will be informed that the research is conducted solely for academic purposes and the data gathered from them will be exclusively used for such purpose.

Data Privacy. The researcher ensured the confidentiality of the data gathered relative to the respondents' personal information and would not be disclosed to the public at any cause. These were guaranteed by performing the activities such as, the names of the respondents are replaced by codes, the sheet containing the name of the respondents is removed and kept or destroyed when no longer needed for the research, the researcher would have the sole access to the code's master list, and files containing research data were password protected and encrypted to keep the data safe.

RESULTS AND DISCUSSION

Profile of the Respondents

The profile of the respondents as to age and gender, final grade in the 1st quarter in Math, parents' occupation, parents' highest educational attainment are herein presented.

Age and Gender

Age and gender are considered essential variables that need to be determined in this study, which could help in explaining the results. Table 2 presents the age and gender of the respondents in the National High School.

Table 2. Age and Gender of the Respondents

Variable	f	%
Age (in years)		
Above 15 years old	5	3.52
14 - 15 years old	8	5.63
Below 14 years old	129	90.85
Mean: 12.67		
SD:0.94		
Gender		
Male	79	55.63
Female	63	44.37
Total	**142**	**100.00**

As shown in Table 2, 129 out of 142 respondents, or 90.85 percent are in the age bracket of below 14 years old. Moreover, 8, or 5.63 percent are aged 14-15 years old, and 5, or 3.52 percent are in the age bracket above 15 years old. With regards to the gender of the respondents, 79 out of 142 or 55.63 percent are males while 63 out of 142 or 44.37 percent are females.

The results indicate that the majority of the respondents are under the age bracket of 14 years old and below and male respondents dominated the class. Based on the structure of the K-12 Basic Education of the Department of Education, the methods of assessment should be appropriate to each Grade level at each stage. The Junior High School is for students aged 12 to 15 years old. The data imply that the age of the respondents is appropriate for Grade 7 level.

Final Grade of Math in the 1st Quarter

Table 3 presents the final grade in the first quarter in Math. As shown in Table 3, 50 out of 142 respondents, or 35.21 percent were rated Satisfactory in their final grade in Mathematics during the first quarter. These were followed by 43 or 30.28 percent who were rated Fairly Satisfactory. Next, 38, or 26.76 percent rated Very Satisfactory, eight (8), or 5.63 percent were Outstanding, and only three (3) or 2.11 percent did not meet expectations.

Table 3. 1st Quarter Final Grade

Final Grade Descriptor (Grading Scale)	f	%
Outstanding (90-100)	8	5.63
Very Satisfactory (85-89)	38	26.76
Satisfactory (80-84)	50	35.21
Fairly Satisfactory (75-79)	43	30.28
Did Not Meet Expectations (Below 75)	3	2.11
Total	**142**	**100.00**

Mean: 81.85
SD: 4.8

The data indicate that the majority of the respondents performed poorly in Mathematics during the first quarter. This result aligns with the PISA 2022 results showing that the results in mathematics did not change significantly when compared to the 2018 results. (OECD, 2023)

Parents' Occupation

The distribution of the respondents by the occupation of the parents are presented in Table 4. As shown in Table 4, 46 out of 142 father respondents, or 32.39 percent work in building and construction. They were followed by 14 or 9.86 who work in transportation, 7 or 4.93 percent who work as peace officers, 4, or 2.82 who work for banking and business as well as food, and 3 or 2.11 who are OFW workers. There were 64 or 45.07 percent of the respondents whose occupation is not classified. Regarding the occupation of the mothers, the data showed that 54 out of the 142 mother respondents, or 38.03 percent were housewives followed by 12 or 8.45 percent who work in banking and business. Next were caregiver and production with 11 or 7.75 percent, OFW with five (5) or 3.52 percent, and caregiver and teacher with four (4) or 2.82 percent. The last was named others with 41 or 28.87 percent.

Table 4. Parent-Respondents' Occupation

Occupation	f	%
Father		
banking and business	4	2.82
building and construction	46	32.39
food	4	2.82
peace officer	7	4.93
transportation	14	9.86
OFW	3	2.11
others	64	45.07
Mother		
banking and business	12	8.45
caregiver	11	7.75
food	4	2.82
housewife	54	38.03
production	11	7.75
OFW	5	3.52
teacher	4	2.82
others	41	28.87

The result shows that most of the parent respondents had low or middle occupation levels. According to a study occupation of parents affects students' performance in their academics (Odoh et al, 2017). Parent's occupation has an impact on the academic motivation of learners' success. Students from parents with high occupation levels performed poorly compared to those students from parents with low and middle occupation levels (Walter, 2018).

Parents' Highest Educational Attainment

Table 5 presents the data gathered about the highest educational attainment of parents.

Parents' Highest Educational Attainment	frequency			%
	Father	Mother	Total	
College Graduate	12	13	25	8.80
College Level	11	12	23	8.10
HS Graduate	26	31	57	20.07
HS level	22	27	49	17.25
Elem Graduate	11	8	19	6.69
Elem Level	12	7	19	6.69
None	48	44	92	32.39
Total	**142**	**142**	**284**	**100.00**

Table 5. Parents' Highest Educational Attainment

As presented in Table 5, 57 out of 284 parent respondents, or 20.07 percent were High School Graduate. This was followed by 49 or 17.25 percent who were HS level. There were 25 or 8.80 percent were college graduate while 23 or 8.10 were college level. Next were 19 or 6.69 percent who were Elementary graduate and elementary level. A considerable number of 92 or 32.39 percent of the respondents did not signify their educational attainment.

Level of Numeracy Skills of the Respondents in Mathematics

The level of numeracy skills of the respondents in Mathematics in addition of integers and subtraction of integers are herein discussed. **Are**

Addition of Integers

Table 6 presents the data gathered about the level of numeracy skills of the respondents in Mathematics about the addition of integers.

Table 6. Level of Numeracy Skills of the Respondents in Addition of Integers

Level of Numeracy Skills	f	%
Outstanding (90-100)	8	5.63
Very Satisfactory (85-89)	2	1.41
Satisfactory (80-84)	4	2.82
Fairly Satisfactory (75-79)	4	2.82
Did Not Meet Expectations (Below 75)	124	87.32
Total	**142**	**100.00**

Mean = 44.51
SD = 22.03

The data revealed in Table 6, shows that 124 out of 142 respondents, or 87.32 percent Did Not Meet Expectations, were graded below 75 in addition to integers. This was followed by eight (8) or 5.63 percent Outstanding, four (4) were Satisfactory and Fairly Satisfactory, and lastly, two (2) were Very Satisfactory. It has a mean of 11.13 and a standard deviation of 5.51.

The results indicate that the respondents performed poorly in adding integers with higher number of students who *Did Not Meet Expectations* or whose grade is below 75. Mathematics has a vital part in the lives of the students. It offers students job choices across many content areas of sciences, technologies, engineering and mathematics. It helps to promote critical thinking and address student difficulties. This makes them successful in the future in various ways. According to (Layug, 2021), the Philippines' low level of numeracy skills as reflected in the results of PISA in the last two years prompted teachers to employ different interventions for students who are performing poorly in mathematics. In their study, they found out that the commonly used by the Grade 7 mathematics teachers at Baguio City National High is conference with the parent and student. However, the most effective intervention is a one-on-one tutorial. Teachers are continuing to employ these interventions to improve students' numeracy skills.

Students who struggle with adding integers face significant implications that extend beyond the immediate difficulty with a specific mathematical concept. Weakness in adding integers can hinder their ability to advance to more complex mathematical topics, limiting their overall mathematical proficiency. This foundational skill is essential for problem-solving across various contexts and a lack of understanding may erode students' confidence in their mathematical abilities.

Subtraction of Integers

The data gathered on the level of numeracy skills of the respondents in Mathematics on the subtraction of integers are presented in Table 7. As reflected in Table 7, the data showed that 141 out of 142 respondents or 99.30 percent or its majority Did Not Meet Expectations, one (1) or 0.70 percent, none got a grade of Fairly Satisfactory, Satisfactory and Outstanding.

Table 7. Level of Numeracy Skills of the Respondents in Subtraction of Integers

Level of Numeracy Skills	f	%
Outstanding (90-100)	0	0.00
Very Satisfactory (85-89)	1	0.70
Satisfactory (80-84)	0	0.00
Fairly Satisfactory (75-79)	0	0.00
Did Not Meet Expectations (Below 75)	141	99.30
Total	**142**	**100.00**

Mean = 30.25
SD = 13.75

This data indicate that students have difficulty in subtracting integers. Similar to the numeracy skills of the respondents in adding integers, the result showed that they Did Not Meet Expectations. The data imply immediate intervention like remedial classes for the failed competencies (subtraction of integers) before introducing the next competencies like the multiplication and division of integers.

A study of (Inganah et al., 2023) about the 6C (critical thinking, creativity, collaboration, communication, computational and compassion) integration of 21st century education in to learning mathematics emphasized that integrating 6C into integrated math skills is one of the evolutions in educational practice that meets the needs of the 21st century. They noted that in the process

of integrating the 6C into math skills, teachers face several problems. The problems faced by the teachers are influenced by students and teachers themselves. Their study summarizes some of the solutions teachers found to overcome the problem of integrating 6C into their integrated math skills. This includes providing videos, group work. Providing private discussion rooms, providing short material summaries with narration so that the language is easy for students to understand, using timers to set a time, and ask for referrals and exchanges.

Students who lack proficiency in subtracting integers may face several implications that can impact their overall mathematical competence and academic success. Subtraction of integers is a fundamental skill that extends beyond isolated arithmetic operations.

Areas Where the Students' Numeracy Skills are Weak

The numeracy skills of the respondents in terms of adding and subtracting integers highlighting the weak areas are herein discussed.

Addition of Integers

Table 8 presents the numeracy skills of the respondents in addition of integers. The data revealed that item no. 4 (with the question [10 + (-4)]) ranked first (36, 25.35) got the highest number of respondents who answered the question incorrectly. This was followed by item no.12 ([-5 + 19]) ranked 2nd (39, 27.46), item no. 10 [-18 + 43] and item no. 16 [15 + (-10) + (-6)] ranked 3rd (42, 29.58), and item no. 9 ([- 26 + (-17)]) ranked 5th (44, 30.99).

Table 8. Addition of Integers (Weak Areas)

Item #	Number of Correct Responses	% correct	Rank*
1	134	94.37	24
2	58	40.85	15
3	87	61.27	22
4	36	25.35	1
5	65	45.77	18
6	53	37.32	11
7	51	35.92	9
8	58	40.85	15
9	44	30.99	5
10	42	29.58	3
11	56	39.44	12
12	39	27.46	2
13	57	40.14	14
14	105	73.94	23
15	49	34.51	7
16	42	29.58	3
17	67	47.18	20
18	52	36.62	10
19	47	33.10	6
20	50	35.21	8
21	69	48.59	21
22	56	39.44	12
23	65	45.77	18
24	58	40.85	15
25	52	36.62	10

** with 1 as the least number of responses*

It can be noted that the items where the students failed to answer the questions are those items that uses parenthesis around negative numbers. Parentheses around negative numbers do not mean that one needs to multiply; they are just used to avoid confusion in the use of negatives with subtraction.

The data indicate that students have the difficulty in understanding the concept of adding integers. One problem that students are facing when dealing with integers is that they are confused with signs and operation of the integers which make them struggle in computing the integers. A study of (Sahat et al., 2018) revealed that students faced problems in understanding the concept of adding and subtracting integers. A lack of foundation in mathematics, which includes the computations of integers caused secondary students unable to solve algebraic equations.

Subtraction of Integers

Table 9 presents the weak areas of students' numeracy skills in subtraction of integers.

Table 9. Subtraction of Integers (Weak Areas)

Item #	Correct Number of Responses	% correct	Rank*
1	90	63.38	25
2	42	29.58	17
3	29	20.42	10
4	24	16.90	4
5	44	30.99	18
6	31	21.83	11
7	26	18.31	6
8	18	12.68	1
9	27	19.01	8
10	24	16.90	4
11	19	13.38	2
12	23	16.20	3
13	77	54.23	23
14	33	23.24	12
15	44	30.99	18
16	80	56.34	24
17	54	38.03	22
18	40	28.17	16
19	26	18.31	6
20	28	19.72	9
21	51	35.92	20
22	34	23.94	14
23	33	23.24	12
24	51	35.92	20
25	38	26.76	15

** with 1 as the least number of responses*

As presented in Table 9, the data revealed that item no. 8 [-9-22] ranked first (18, 12.68) got the highest number of students who answered the question incorrectly. This was followed by item no. 11 [8-(-27)] ranked 2nd (19, 13.38), item no. 12 [-3-13] ranked 3rd (23, 16.20), items no. 4 [-8-5] and item no. 10 [15-(-7)] ranked 4th (4, 16.90).

The result indicates that developing comprehension of rational numbers in preparation for formal algebra is a significant part of the lower years. Significantly, the concepts and skills learned in the lower years form the foundation for generalizing algebraic mathematical ideas in more sophisticated ways. Hence, the students are required to build a strong foundation in rational numbers, including integers that contribute to the foundation for Algebra.

According to Lamb et al. (2018), understanding the conceptual aspects and demonstrating the ability to work successfully with integer operations is a foundation for algebra. Knowing that integers are signed numbers using the "-" symbol, one can conceptual characteristic of integers is that students must understand the meaning of the sign to interpret it accurately. However, this symbol can represent more than a negative number.

Areas Where the Students' Numeracy Skills are Strong

The numeracy skills of the respondents in terms of adding and subtracting integers highlighting the strong areas are discussed here. Tables 10 and 11 presents the results.

Addition of Integers

Table 10 presents the strong areas of the students' numeracy skills in adding integers.

Table 10. Addition of Integers (Strong Areas)

Item #	Number of Correct Responses	% correct	Rank*
1	134	94.37	**24**
2	58	40.85	15
3	87	61.27	**22**
4	36	25.35	1
5	65	45.77	18
6	53	37.32	11
7	51	35.92	9
8	58	40.85	15
9	44	30.99	5
10	42	29.58	3
11	56	39.44	12
12	39	27.46	2
13	57	40.14	14
14	105	73.94	**23**
15	49	34.51	7
16	42	29.58	3
17	67	47.18	**20**
18	52	36.62	10
19	47	33.10	6
20	50	35.21	8
21	69	48.59	**2**1
22	56	39.44	12
23	65	45.77	18
24	58	40.85	15
25	52	36.62	10

** with 1 as the least number of responses*

As presented in Table 10, the data revealed that item no.1[2+14] ranked first (134, 94.37) where majority of the students got the answers correctly. Item no. 14 [11+5+13] ranked second (105, 73.94, item no. 3 [-8+(-11)] ranked third (87, 61.27), item no. 21 [13+9+(-12)] ranked fourth (69, 48.59) and item no. 17 [23+10+(-8)] ranked fifth (67, 47.18). It can be observed that students perform better in adding integers with the same sign and without a parenthesis around numbers (e.g. 2+14=16).

Utilizing number line representations, students skillfully navigate the addition process, accurately moving to the right for positive numbers and to the left for negative numbers. Moreover, they can confidently apply rules governing the addition of integers, such as the principles of like signs resulting in a sum with the same sign and unlike signs leading to subtraction either the sign of the larger absolute value. The data imply the need to help students build a strong foundation in solving integers.

According to Alfarisi et al. (2022), an integer is a significant element that needs to be prepared to establish a strong foundation for students' mastery of algebra. They added that students have difficulty interpreting negative numbers and conducting operations that involve negative numbers.

Subtraction of Integers

Table 11 presents the strong areas of the students' numeracy skills in subtracting integers.

Table 11. Subtraction of Integers (Strong Areas)

Item #	Correct Number of Responses	% correct	Rank*
1	90	63.38	25
2	42	29.58	17
3	29	20.42	10
4	24	16.90	4
5	44	30.99	18
6	31	21.83	11
7	26	18.31	6
8	18	12.68	1
9	27	19.01	8
10	24	16.90	4
11	19	13.38	2
12	23	16.20	3
13	77	54.23	23
14	33	23.24	12
15	44	30.99	18
16	80	56.34	24
17	54	38.03	22
18	40	28.17	16
19	26	18.31	6
20	28	19.72	9
21	51	35.92	20
22	34	23.94	14
23	33	23.24	12
24	51	35.92	20
25	38	26.76	15

** with 1 as the least number of responses*

As presented in Table 11, item no. 1 ([15-8]) got the highest number of students who answered the questions correctly (90, 63.38). This was followed by item no. 16 [8-2-5] or (80, 56.34), item no. 13 [-14-6-24] or (77, 54.23), item no. 17[2-(-15)-3] or (54, 38.03), item no. 21 [-6-7-12] and item no. 24[-12-(-3)-20] or (51, 35.92).

The result indicates that students can subtract integers having the same sign. In connection to their level of numeracy skills in subtraction of integers that denote did not meet expectations, this could imply that teachers must do something in making learning mathematics particularly in solving integers easy.

Significance of the Relationship Between the Profile of the Respondents and their Level of Numeracy in Mathematics

This section discusses the test of significant relationship between the profile of the respondents and their level of numeracy in mathematics. The hypothesized that there is no significant relationship between the profile of the respondents and the level of the numeracy skills. Table 12 presents the result.

Table 12. Test of the Significance of the Relationship between the Profile Variables and the Level of Numeracy (N=142)

Profile Variables Paired with Level of Numeracy	Multiple R	R Square	p-value	Significance
Age	0.41821	0.17489	0.34508	Not significant
Gender			0.01847*	Significant
Parents' educational attainment			0.07642	Not significant
Occupation (Father)			0.31788	Not significant
Occupation (Mother)			0.45692	Not significant

First Quarter Grades	0.0000*	Significant

** Significant at α = 0.05*

As shown in Table 12, the obtained Multiple R value is 0.41821 which signifies a low positive correlation between the profile variables and the level of numeracy skills. The data revealed that the profile variable such as the gender and the first quarter grades of the respondents have the significant relationship with the level of numeracy with the p value of 0.01847 and 0.000, respectively, lesser than 0.05 level of significance. On the other hand, the other profile variables such as the age, parents' educational attainment, and occupation of both parents showed no significant relationship with the level of numeracy having the p value of greater than ▪ = 0.05.

The results are supported with the study of (Mejía-Rodríguez et al., 2021) pointed out that gender differences in students' self-concept in mathematics are significant in most countries, usually in favour of boys as early as in fourth grade. Although gender differences in academic performance has received considerable attention over the years, the study of (Mozahem et al., 2021) investigates gender differences in the sources of information that lead to perceived self-efficacy in math and whether the information changes with age. They found that older girls are more likely to receive negative information leading them to develop lower levels of perceived self-efficacy in math. Another study from (Rodriguez et al., 2020) indicate that tended to exhibit less positive attitudes about mathematics than their male classmates, in particular lower motivation, worse perception of competence, and higher rates of anxiety.

Significance of the Difference among the Numeracy Skill Levels of the Respondents by Area

This study hypothesized that there is no significant difference among the numeracy skill levels of the respondents in addition and subtraction of integers. The Wilcoxon Signed Rank Test was used considering the data for addition was not normally distributed. Table 13 presents the results.

Table 13. Test of the Significance of the Difference of the Numeracy Skill Levels by Area (N=142)

AREA	Mean	SD	Wilcoxon W	Z	p-value	Significance
Addition	11.13	5.51	982.5	-7.4805	0.0000*	Significant
Subtraction	7.56	3.44				

** Significant at α = 0.05, two-tails*

The study reveals that the numeracy skill levels of the respondents in addition and subtraction of integers has a significant relationship by area. The computed p-value of 0.0000 is significantly lower than 0.05. The data signify that the numeracy skills in addition differed with the numeracy skills in subtraction with addition obtaining a higher mean of 11.13.

The results support the notion that addition and subtraction are complimentary in nature as they are considered inverse operations. Addition involves combining two or more numbers to find their total while subtraction entails separating one from another to determine the difference. These operations are interconnected in such a way that they can be seen as undoing each other's effects. The interdependence of addition and subtraction forms a foundational aspect of arithmetic and algebra (Utami & Prabawanto, 2023), allowing for comprehensive understanding of mathematical concepts and their practical applications (SMITH, 2021).

CONCLUSION AND RECOMMEND ATIONS

Based on the findings of the study, it is concluded that respondents had very poor numeracy skills that was being indicated in not meeting the competencies in adding and solving integers. Poor numeracy skills in adding and subtracting integers may indicate gap in understanding the foundational principles of arithmetic, potentially affecting problem-solving abilities and overall mathematical confidence.

From the findings and conclusion arrived in the study, it is imperative to provide targeted support and interventions such as additional practice, focused tutoring, or interactive learning resources, to address these challenges and help the students build a stronger mathematical foundation. Hence, the adoption and implementation of the intervention plan are hereby recommended.

The following are recommended: Teachers and schools should recognize students who are susceptible to underperforming in math early at the beginning of school year. Continue and step-up government efforts, organizations and businesses that offer gadgets and telecom businesses in growing affordable and fast internet for public schools. Administrators,

guidance coordinators and teachers should create activities in school that would help students to strive for higher academic achievements which require stronger mathematical proficiency. Mathematics teachers need to be upskilled and reskilled in order to work with students who are at risk of failing so they can design activities that would motivate students the students to learn and value of mathematics in higher occupational aspirations. Schools should continue engaging parents as parents in reminding the students to be persistent in difficult subjects like mathematics, appreciating higher occupational goals for the students.

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