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Instructional Exposure of Senior High School Students to Approaches that Promote Critical Thinking and Problem-Solving Skills

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Abstract

This descriptive study assessed students' exposure to activities that promote the acquisition of critical thinking and problem-solving skills. The study involved 150 randomly selected senior high school students. Results reveal that students have a "great extent" of exposure to instruction that promotes the acquisition of the desired mathematics skills, particularly on the content, strategies, assessment, and instructional materials. Students are exposed to a "great extent" to activities that allow them to predict, gather and organize information, derive conclusions, make judgment or decisions, discuss and justify solutions; however, have a "low extent" of exposure to problem posing. Students were exposed to a "very great extent" to the step by step process in dealing with problems. The students have a "great extent" of exposure to problem-solving strategies that promote verbal-logical, visual-spatial, and organizing skills, however, to a low extent in restructuring and rethinking skills. Students' exposure to the use of manipulatives or mathematical models, calculators, creative pictures and diagrams, worksheets, online materials, creative PowerPoint presentations, varied textbooks, and scholarly materials in mathematics problem solving was to a "great extent" but "low" on the use of mathematics software and videos. Along assessment, students have a "great extent" of exposure to assessment on knowledge, comprehension, application, synthesis, and evaluation skills but to a "low extent" on assessment that requires metacognitive and reflective thinking.

Keywords

critical thinking, mathematics, problem-solving, problem-solving strategies

1. Introduction

Rational decision is increasingly becoming a part of everyday life in the modern world. Students need to develop and effectively apply critical thinking skills to their academic studies, the complex problems they will face, and the critical choices they will be forced to make, due to the information explosion and other rapid technological changes. Critical thinking skills are important because they enable students “to deal effectively with social, scientific, and practical problems” (Shakirova, 2007; Chukwuyenum, 2013). Students who can think critically can solve problems efficiently (Atlas, 1995). Merely having knowledge or information is not enough. To be effective in the workplace and their personal lives, students must have acquired the skill to solve problems and think critically (National Research Council, 2012).

Nowadays, schools are responsible for improving the skills of critical thinking (Miri, David, & Uri, 2007; Radulović & Stančić, 2017). It is the expected result of education to produce high critical skills (Branch, 2000). Since education plays a crucial role in developing critical thinking among the young, the educational system needs to require teachers to improve their students’ critical thinking skills. Individuals have to achieve critical thinking skills during their years in school to completely, correctly, meaningfully learn new information by employing prior knowledge and transferring their knowledge to their lives (Caliskan, 2009).

Mathematics instruction is an appropriate venue to teach critical thinking (Peter, 2012). As Rajendran (2010) and Aizikovitsh and Amit (2010) claim, mathematics is one of the subjects that can develop critical thinking skills. As embodied in its 5 five broad goals, mathematics instruction aims to train students to 1) value mathematics, (2) apply mathematics, (3) become a problem solver, (4) communicate mathematics appropriately, and (5) to develop self-confidence. A student needs critical thinking to be able to meet these goals (Crosswhite, 1989). More than just a set of isolated facts and concepts, Mathematics provides “ways of knowing,” thinking, and understanding (Bernardo, 1998). Doing mathematics requires logical thought and trains students to think both critically and creatively. To prepare students for life and further education, Baykul (2003) stressed that mathematics instruction should improve reasoning, critical thinking, and problem-solving skills.

As an offshoot of these claims, as mentioned earlier, efforts for the development of critical thinking skills in mathematics have become the main Agenda in the curriculum of mathematics education worldwide (NCTM, 2000; Mason, Burton, & Stacey, 2010; Butera, Friesen, Palmer, Lieber, Horn, Hanson, & Czaja, 2014; Marcut, I., 2005).

In the Philippines, the Department of Education radically changed the mathematics curriculum to conform to the five broad goals and the K-12 reform. One main feature of the mathematics curriculum is the spiraling of the content. Learners learn all the areas of mathematics starting in kindergarten. The learning is enhanced little by little as the learner goes up the ladder of basic education. The “Spiraling” approach means that the same topics are taught at every grade level but with increasing complexity.

Embodied particularly in the K-12 mathematics framework are two skills, critical thinking and problem-solving, which are considered the "twin" goals of mathematics in the basic education levels (kindergarten to grade 12). These two goals are to be achieved through an organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attitudes, and appropriate tools, taking into account Filipino learners' different contexts.

Critical thinking and problem-solving are intertwined. One cannot exist without the other. Successful problem solving is governed by a series of critical reflections and decisions. By acquiring these two skills, students will manifest reasoning skills, communication skills, skills in making connections and representation, and decision-making skills (Snyder & Snyder, 2008). Critical thinking is a means for successful problem-solving (Leader & Middleton, 2004; Peter, 2012). As a student goes through each phase in solving the problem, they go through reasoning out, making decisions, evaluating, and applying knowledge. On the other hand, problem-solving is a fundamental means of developing critical thinking (Widyatiningtyas, Kusumah, Sumarmo, & Sabandar, 2015; Leader & Middleton, 2004). As students tackle problems from the first and last phases, they develop the ability to think critically.

Together with the spiraling approach is the introduction of innovative approaches to promote critical thinking and problem-solving skills. Among those strategies include contextualization, differentiated instruction, supporting experiential and situated learning, reflective learning, constructivism, cooperative learning, discovery, and inquiry-based learning. Assessment strategies used are more of those that assess students' critical thinking and problem-solving skills, such as performance-based and product-based or project-based assessments. The K-12 mathematics curriculum was first implemented during the academic year 2012-2013 and is already in its 5th year of implementation. The G12 students enrolled in the current year have completed their junior high school mathematics under this new curriculum. As the new mathematics curriculum's pioneer products, it is then expected that these students have acquired the desired mathematics skills as defined in the framework.

As a result of the students' exposure to the K-12 curriculum for almost five years, it is expected that they have acquired critical thinking through problem-solving skills. It is in this context that the study was conceptualized. This study aims to assess the students' extent of exposure to activities that promote critical thinking skills through problem-solving. In this context, problem-solving serves to promote students' critical thinking considering the rigorous process they go through from identifying the given facts, devising a solution, implementing the planned solution, and identifying the final answer.

The investigation will bring about useful information for enhancing instruction at the senior high school level to ensure students' acquisition of critical thinking through problem-solving skills.

1.1 Conceptual Framework

The investigation was based on the following frameworks.

1.1.1 K-12 Mathematics Framework (K-12 Curriculum Guide, 2012)

The twin goals of mathematics in the basic education levels, K-10, are critical thinking and problem-solving. These two goals are to be achieved with organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attitudes, and appropriate tools, taking into account Filipino learners' different contexts. As adopted from the framework prepared by SEI (2010), there are five content areas in the curriculum. These are Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics. The specific skills and processes to be developed are: knowing and understanding, estimating, computing and solving; visualizing and modeling; representing and communicating; conjecturing, reasoning, proving, and decision-making; and applying and connecting. The following values and attitudes are to be honed: accuracy, creativity, objectivity, perseverance, and productivity. It is recognized that the use of appropriate tools is necessary for teaching mathematics. These include manipulative objects, measuring devices, calculators and computers, smartphones and tablet PCs, and the internet. Context is a locale, situation, or set of Filipino learners' conditions that may influence their studies and use of mathematics to develop thinking and problem-solving skills critically. Contexts refer to beliefs, environment, language, and culture that include traditions and practices and the learner's prior knowledge and experiences.

The framework is supported by the following underlying learning principles and theories: experiential learning (Kolb, 1984) and situated learning (Lave, 1991), reflective learning (Tan, 2002), constructivism (Cobb, 1994), cooperative learning (Smith, 1992), and discovery, and inquiry-based learning (Bruner, 1961).

1.1.2 Critical Thinking Framework

Critical thinking is utilized during a learning situation that involves self-regulation, interpretation, analysis, drawing inference, explanation, and evaluation.

1.1.3 Polya's Problem Solving Framework (Polya, 1940)

The See, Plan, Do, and Check which Goerge Polya devised was the core problem-solving process involved in the study.

1.1.4 Framework Problem Solving Strategies (Cooper,1986)

Problem-Solving (PS) strategies are clustered into four as follows:

Cluster A: PS strategies that utilize verbal and logical skills include restating the problem and making a number sentence.

Cluster B: PS strategies that utilize visual and spatial thinking skills, which include act it out, make a model; and draw a diagram.

Cluster C: PS strategies involve restructuring-rethinking strategy with guess and check; work backward; solve a simpler problem, and check for hidden assumptions as sub-strategies.

Cluster D: PS strategies that utilize organizing skills, which include strategies such as looking for a pattern; constructing a table, logical reasoning, making an organized listing, simulation, or experiment.

The paradigm in Figure 1 shows how the theories presented are translated into the study context.

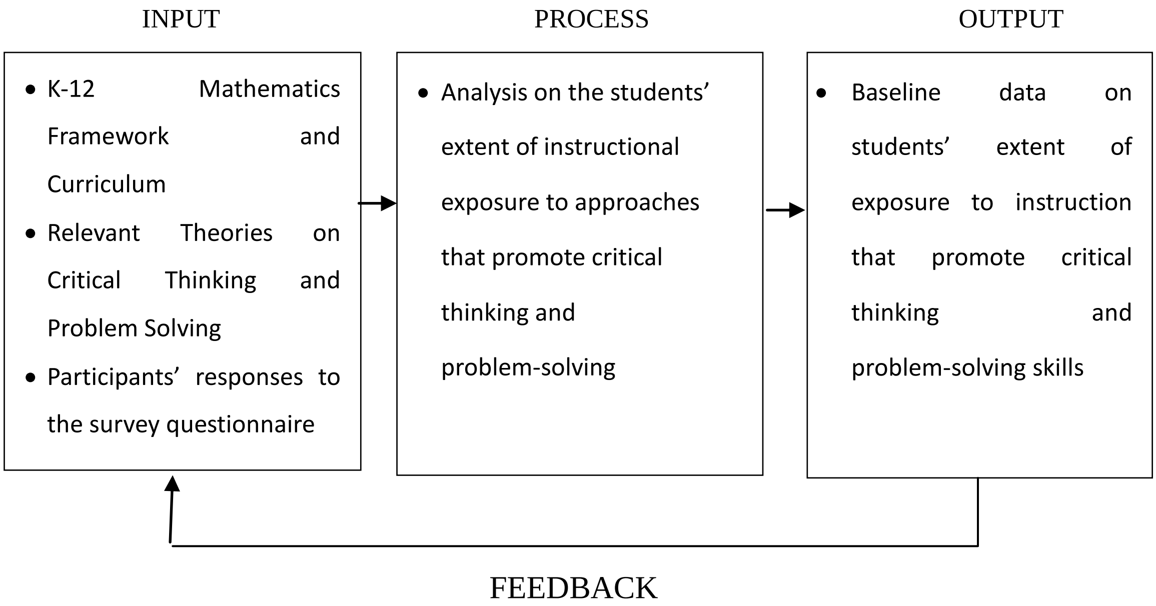

Figure 1. The Paradigm of the Study

As reflected in the paradigm, for attaining the study's objectives, it considered the following inputs: the K-12 mathematics framework, relevant theories on critical thinking and problem-solving skills, K-12 mathematics curriculum, and participants' responses to the questionnaire.

This present investigation endeavored to obtain baseline information on the students' extent of exposure to instruction that promotes critical thinking and problem-solving skills. The study further attempted to develop an Intervention Plan to facilitate critical thinking and problem-solving approaches in the mathematics classroom.

1.2 Statement of the Problem

This study aimed to assess the students' extent of instructional exposure to approaches that promote the acquisition of critical thinking and problem-solving skills among Senior High School students.

More specifically, the study aimed to answer the given problem:

1. To what extent are the defined content in the mathematics courses promote critical thinking and problem-solving?
2. What is the students' extent of exposure to instructional approaches that promote critical thinking and problem-solving along the following areas:
   2.1 Strategies;
      1.2.1 General Strategies
      1.2.2 Polya's Problem Solving Process
      1.2.3 Problem Solving Strategies
   2.2 Assessment; and

2.3 Instructional Materials?

2. Method

2.1 Research Design

This investigation utilized the quantitative approach. Specifically, the descriptive research design was employed since the study aimed to assess students' instructional exposure to the content and teaching approaches that promote critical thinking and problem-solving skills.

2.2 Participants of the Study

The study considered one-hundred fifty (150) randomly selected G12 students at St. Paul University Philippines during the second semester, 2017-2018. Six student-participants were taken from each of the 25 sections of G12 students.

2.3 Instrumentation

The study utilized the *Instructional Exposure Questionnaire* to assess students' exposure to instruction that integrates critical thinking and problem-solving skills. This questionnaire has four sub-categories: content, strategies, practices, and instructional materials, consisting of 10, 31, 14, and 10 items, respectively. The 31 items for the strategies area involved general strategies in problem-solving, Polya's four steps in problem-solving, and problem-solving strategies with 13, 4, and 14 items, respectively.

The Instructional Exposure Questionnaire was subjected to content validation, which was analyzed using the Content Validation Index (CVI) method (Lynn, 1986). Based on the I-CVIs, of the 65 item indicators, 43 were accepted, and 22 were revised. I-CVIs of the revised items that were re-rated indicate that the items are within acceptable levels. The obtained S-CVI of the tool is 0.93.

2.4 Data Gathering Procedure

The researcher, in obtaining the data, undertook the following procedures.

1. Permission was sought permission from the principal of the Basic Education Unit (BEU) and the coordinators of the senior high school students to conduct the study.
2. Before the data collection, the research tools' validity was established, and the study participants' identification was undertaken. Informed consent from these participants was likewise sought to ensure that the study conforms to the research's ethical norms.
3. Upon approval of the principal, the researcher conferred with the SHS coordinators on the data gathering schedule, particularly on administering the questionnaires.
4. The quantitative data that were obtained from the questionnaires were tallied for statistical treatment.

2.5 Data Analysis Tools

The data obtained were tallied and treated using the mean and the following 4-point Likert scale interpret the means:

Table 1. Scale for Interpreting Students' Extent of Instructional Exposure to Activities that Promote Critical Thinking and Problem-Solving Skills

Score Range	Descriptive Interpretation
3.25-4.00	Very Great Extent (VGE)
2.50-3.24	Great Extent (GE)
1.75-2.49	Low Extent (LE)
1.00-1.74	Very Low Extent (VLE)

3. Results

3.1 Students' Extent of Exposure to Instructional Activities that Promote Critical Thinking and Problem- Solving Skills

3.1.1 Content

Table 2. Students' Instructional Exposure to Content That Promotes Critical Thinking through Problem Solving

Indicators	Mean	Descriptive Interpretation
The contents of the mathematics curricula to which I have been exposed:		
1. cover the desired learning content	2.93	Great Extent
2. consider problem-solving as its integral component	2.92	Great Extent
3. involve interesting and challenging problems	2.82	Great Extent
4. show a connection between past and current topics	2.97	Great Extent
5. establish the relationship between existing content and other mathematics topics	2.96	Great Extent
6. integrate existing content with other disciplines	2.81	Great Extent
7. are organized from simple to complex level of difficulty	2.92	Great Extent
8. reflect the same topics across levels but of increasing level of difficulty (spiral approach)	3.13	Great Extent
9. focus on deriving and understanding the mathematical concepts	3.06	Great Extent
10. are centered on the acquisition of higher-order thinking skills	2.82	Great Extent
Category Mean	2.93	Great Extent

The data disclose that students have a “great extent” of exposure to content that promotes critical thinking. The students asserted that they were exposed to a “great extent” to mathematics instruction where the desired learning content was covered, where problem-solving is an integral component of the lessons, and where interesting and challenging problems were explored.

3.1.2 Strategies

Table 3. Summary Table on the Students’ Instructional Exposure to Strategies that Promotes Critical Thinking and Problem Solving

Strategies	Mean	Descriptive Interpretation
A. General Strategies	2.80	Great Extent
B. Polya’s Problem Solving Process	3.19	Great Extent
C. Problem Solving Strategies	2.77	Great Extent
Strategies that Promote Verbal-Logical Skills	3.05	Great Extent
Strategies that Promote Visual-Spatial Skills	2.90	Great Extent
Strategies that Promote Restructuring-Rethinking Skills	2.34	Low Extent
Strategies that Promote Organizing Skills	2.79	Great Extent
Overall Mean	2.92	Great Extent

As shown, students have a “great extent” of exposure to general strategies that promote critical thinking. These strategies involve those activities the allow them to use their higher-order thinking skills such as problem-solving, brainstorming, and critical evaluation of their solutions. The data reveal that students have a “great extent” of exposure to Polya’s Problem Solving Process. The process specifically includes the See-Plan-Do-Check phases in attacking a problem. Furthermore, students have a “great extent” of exposure to varied problem-solving strategies. This is to provide them with varied experiences in dealing with different types of problems. Of the four clusters of problem-solving strategies, students’ exposure to the use of “Verbal-Logical Skills” got the highest mean rating. In contrast, those that use “Restructuring and Rethinking Skills” got the lowest rating.

3.1.3 Assessment

Table 4. Students' Instructional Exposure to Assessment that Promotes Critical Thinking through Problem Solving

In my mathematics subjects, I have been exposed to assessment practices where my teachers:	Mean	Descriptive Interpretation
1. provide problems to test:		
• students' ability to recall mathematics ideas and identify the relationship among these	2.96	Great Extent
• students' ability to apply mathematical concepts in an actual problem situation	2.97	Very Great Extent
• students' ability to deduce specific ideas out of broader mathematical ideas	2.42	Low Extent
• students' ability to analyze a specific set of ideas to establish a trend and generate a conclusion	2.91	Great Extent
• students' ability to evaluate a set of alternatives and make decisions	2.83	Great Extent
2. require students to:		
• solve problems that utilize various mathematics content topics.	3.08	Great Extent
• come up with projects to test students' critical and creative thinking.	2.95	Great Extent
• present organized solutions and justifications to problems.	3.26	Very Great Extent
• write journals to note experiences and learning insights derived from the problem-solving activities.	2.32	Low Extent
• require students to do simple investigations that are related to the topic discussed.	2.29	Low Extent
• solve problems that test varying levels of thinking.	2.32	Very Great Extent
• utilize scoring rubrics to rate students' solutions to problems.	3.49	Very Great Extent
• give problem sets to provide students the opportunity to tackle problems of varying contexts and degrees of difficulty.	3.43	Very Great Extent
• require students to evaluate varied solutions to a problem.	2.75	Great Extent
Overall Mean	3.92	Great Extent

Students are exposed to a "very great extent" on assessments that test students' ability to apply mathematical concepts in an actual problem situation, to present organized solutions and justifications to problems, to solve problems that test varying levels of thinking, and to tackle problems of varying contexts and degrees of difficulty. Also, students have a "very great extent" of exposure to assessments that utilize scoring rubrics to rate students' solutions to problems.

Furthermore, students have a “great extent” of exposure to assessments that test students’ ability to recall mathematics ideas, to analyze a specific set of ideas to establish a trend and generate a conclusion, to evaluate a set of alternatives, and make decisions, to solve problems that utilize various mathematics content topics, to use their critical and creative thinking in problem-solving, and to evaluate varied solutions of students to a problem.

However, students have a “low extent” of exposure to assessments that test their ability to deduce specific ideas out of broader mathematical concepts, reflect on their experiences and generate learning insights from the experience of solving problems. Furthermore, the students also have a “low” extent of exposure to assessment activities that require students to do simple investigations related to the topic discussed.

In general, the students are exposed to a “great extent” to assessment techniques that promote critical thinking within the context of problem-solving.

3.4 Instructional Materials

Table 5. Students’ Instructional Exposure to Instructional Materials that Promote Critical Thinking and Problem Solving

In my mathematics classes, I am exposed to:	Mean	Descriptive Interpretation
1. worded problems that are taken from research-based materials (i.e., journals, mathematics sites)	2.77	Great Extent
2. the use of manipulatives which serve as aids in problem-solving tasks	2.75	Great Extent
3. the use of calculators allows me to focus more on processing my thinking	3.08	Great Extent
4. creative pictures and diagrams to visualize mathematics problems	2.80	Great Extent
5. mathematics software which is used as aids in problem-solving	1.94	Low Extent
6. online materials as sources to enrich students' problem-solving skills	2.57	Great Extent
7. videos that reflect direct applications of mathematics concepts	2.37	Low Extent
8. creative PowerPoint presentations that facilitate my understanding of mathematics concepts and their applications	2.69	Great Extent
9. reading varied textbooks to understand the mathematics concepts and their real-life applications	2.74	Great Extent
10. worksheets that orient students with the processes involved in problem-solving	2.97	Great Extent
Overall Mean	2.73	Great Extent

Pertinent to the use of instructional materials in problem-solving tasks, students were exposed to a "great extent" to the use of manipulatives or mathematical models, calculators, creative pictures and diagrams, worksheets, online materials, videos, creative PowerPoint presentations, varied textbooks, and scholarly materials in mathematics problem-solving.

4. Discussion

4.1 Content

The "great extent" of students' exposure to content that promotes critical thinking indicates that all the mathematics content topics defined in the Curriculum Guide (CG) for G11 Mathematics subjects were discussed in the classroom. Along with the content, topics are the desired competencies directed towards the acquisition of problem-solving and critical thinking skills, the twin goals of mathematics. They were exposed to instruction that integrates other disciplines into mathematics content, to mathematics topics organized from simple to complex level, to topics that focus on the derivation and understanding of mathematical concepts, and those centered on the acquisition of higher-order thinking skills. Aside from merely knowing and understanding mathematical content, the instruction was also focused on applying this content through problem-solving tasks. Furthermore, content that promotes deductive and inductive reasoning was also undertaken.

4.2 Strategies

Students' "great extent" of exposure to teaching strategies that promote critical thinking include their exposure to practice problem situations where the lessons may be derived, exposure to a variety of problem situations that provide a concrete representation of mathematics content, use of questioning techniques to direct students to think critically, students' exposure to problem-solving activities, allowing students to brainstorm, share and consolidate their ideas, train students to make predictions, gather and organize information, derive conclusions and make judgments or decisions, and allow students to discuss the processes involved in solving problems. This finding supports the theory that problem-solving is an integral part of studying mathematics (NCTM, 2000). As postulated by NCTM (2017), problem-solving provide the context in learning mathematics. Problem-solving may serve as a motivational strategy in mathematics, as this may provide a springboard for generating mathematics concepts (Irvine, 2015). Problem-solving must form part of the lesson proper as this provides practice for students in integrating their current topics to the actual real-world application (Brewer, 2010). Problem-solving must also form part of assessing mathematics learning as this allows students to apply the topics in problem-solving tasks (NCTM, 2000; Brewer, 2010). Also, students have a "great extent" of exposure to instructional activities where they are tasked to predict, gather, organize information, derive conclusions, and make judgments or decisions. Students are also exposed to a "great extent" to activities that provide them with opportunities to discuss their solutions and justify their answers. On the contrary, students have a "low extent" of exposure to instructional strategies that allow them to pose problems and solve different online problems. This result means that students were not given enough opportunities to create world problems that illustrate the real-world applications of mathematics concepts.

Students' 'great extent' of exposure to instruction that emphasizes the step by step process in dealing with problems indicate that teachers emphasize that solving mathematics problems follow a logical process. Although there are different strategies in dealing with a specific problem, a common procedure in solving a problem is involved (Polya, 1940). All processes defined by problem-solving experts can be summed up with Polya's problem-solving plan, known as the see-plan-do-check process. When students are exposed to these steps in problem-solving, they are trained to present their solutions in an orderly manner. In this manner, teachers can track students' thinking and can evaluate their solutions. Based on interviews, both teachers and students claim that the logical process of presenting solutions to problems was observed in the classroom. It is believed that an organized solution shapes students' understanding, allows students to monitor their thinking, and enable students to assess their solutions (Gollub, J., Bertenthal, M., Labov, J., & Curtis, P., 2002).

The highest mean rating for students' exposure to strategies that utilize "Verbal-Logical Skills" is traced to the fact that most of the mathematics problems can be deduced to mathematical sentences of equations. Based on the interview, students claim that most of the problems explored in their mathematics classes require translations to mathematical sentences or equations. Students' low rating on their exposure to "Restructuring and Rethinking Skills" implies that they were exposed to a "low extent" to the specific strategies such as guess and check, working backward, generating a simpler problem, and looking for hidden assumptions. For strategies that promote visual-spatial skills, students were exposed to a "very great extent" to problem-solving situations where they were trained to draw pictures, sketches, or diagrams to visualize essential data in the problem. These visualization strategies are the most immediate technique in visualizing the problem as these require paper and pen or pencil (Marcut, 2010). Students are also exposed to a "great extent" to problem-solving activities that train them to act out or show a model to concretize the problem. For problem-solving strategies that promote their ability to restructure and rethink how they are thinking, a "low extent" of exposure was observed. In terms of the specific strategy covered in this cluster, the students have a "great extent" of exposure to the working backward strategy that allow them to look for some hidden information. On the contrary, the students have a "low extent" of exposure to problem-solving activities that train them to use the 'guess and check' strategy and to deduce first a simple problem before obtaining a solution to the entire problem.

For problem-solving strategies that promote students' organizing skills, the data reveal a "great extent" of students' exposure in solving problems that trains them to make an organized list of data either in simple or tabular forms or to use logical and systematic steps to obtain the solution to the problem. However, the students have a "low extent" of exposure to problem-solving activities that require them to generate a set of data needed to solve a problem.

In summary, the students' "great extent" exposure to instructional strategies that promote critical thinking through problem-solving indicates that teachers' teaching strategies in mathematics instruction integrate problem-solving activities that train students to think critically. This finding suggests that students were exposed to situations that may help them deal appropriately with varied types of problems. Exposure of students with different problem strategies allows them to decide on appropriate problem-solving heuristics in dealing with a particular problematic context.

4.3 Assessment

The very great extent of students' exposure to actual situations where mathematical concepts are applied is a commendable teacher's instructional practice. Through this, students can see concretely the actual application of the concepts in real-life situations.

Students' great extent of exposure to assessment that allows them to recall mathematics ideas is an avenue to train them not just to recall these concepts but to let them seethe connections between and among concepts. Furthermore, exposure of students to assessment activities that train them to formulate conclusions, evaluate solutions, and make decisions are rich experiences for promoting critical thinking.

Students' low extent of exposure to assessments that test their ability to deduce, reflect, generate learning insights, and do simple investigations. It is in developing reflective judgment where students' understanding and intellectual growth and critical thinking are honed, thus, the need to improve assessment practice in this area.

4.4 Instructional Materials

Through manipulatives or mathematical models, creative pictures and diagrams, online materials, videos, and creative PowerPoint presentations, visualization of the problem-solving tasks is facilitated. Mathematics, when not concretized, remains to be an abstract idea (Lambert, 2000). Manipulatives are instructional materials in 2-dimensional or 3-dimensional forms to embody mathematics concepts (Clements, 2009). Adequate exposure to these materials implies that they missed the opportunity to see the concrete application of mathematics in real life, the chance to consolidate their ideas, and the opportunity to see accurate representations of mathematical concepts.

Worksheets are prepared to provide various problems showcasing various problem situations where the mathematics concepts are applied. Online materials also offer varied, interesting, and relevant activities for problem-solving. Textbooks and scholarly materials also provide a variety of problems intended for the students' problem-solving tasks. The use of research-based materials is needed to provide students with current updates in the field of Mathematics. Providing students with updated information through these platforms brings in them the challenge of exploring and contributing more to the existing body of knowledge. Concrete examples and problem sets may be derived from these materials making mathematics more relevant.

Calculators are also helpful in problem-solving tasks as these assist students in rigorous computations (Pomerantz, 2007). When calculators are used, students can focus more on the metacognitive processes needed to come up with the most accurate solution to the problem. Mathematics topics in the senior high school curriculum entail complex computations that can be tedious without using calculators. The use of calculators allows students to focus more on processing their thoughts other than bogged down with calculations' complexities.

Students' "low extent" of exposure to the use of mathematics software and videos as aids in problem-solving tasks curtail their ability to do more mathematics explorations, which can be the best setting for the acquisition of critical thinking and problem-solving skills.

5. Conclusion and Recommendations

Based on the findings of the study, the following conclusion was drawn:

Critical thinking is a learned skill that requires instruction and practice. Actively engaging students in problem-solving activities from the motivation phase to the assessment phase encourages students' critical thinking development. Harmonizing the content, strategies, assessment, and instructional materials to develop meaningful problem-solving activities is necessary for mathematics instruction to ensure the students' acquisition of the desired learning skills.

From the results of the investigation, the following recommendations are generated:

1. Teachers handling G11 and G12 students may consider conducting a diagnostic test to assess students' mastery of the number facts and their ability to solve problems.
2. G11 and G12 teachers may conduct remediation sessions for students who had not mastered the basic math facts.
3. Instructional material developers may consider providing teachers with a wide range of instructional materials to embody different mathematical concepts.
4. Mathematics teachers handling G11 and G12 mathematics subjects through the principal's support will consider integrating the suggested activities in the proposed plan to promote critical thinking and problem solving among students.
5. Future researchers may consider replicating the research by including participants on a broader scale.

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