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STUDENTS DIFFICULTY IN SOLVING MATHEMATICAL PROBLEMS

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Abstract: *This study investigates the difficulties experienced by the third year college students in solving Mathematics problem. A total of twenty students are instructed to solve problems in the form of a questionnaire. The data gathered were analyzed to explore difficulties faced by students when solving problems. The major results of the study showed that the students' difficulties are on the inability to translate problem into mathematical form and inability to use correct mathematics.*

Keywords: *Difficulty, problem solving, mathematics, mathematical problems*

I. INTRODUCTION

Mathematics plays a very important role in our daily living. It is a subject that deals with problems which involve a process of analysis, computation and other mental skills. Historically, learning mathematics and teaching it has been motivated by the belief that a study of mathematics helps individual to learn, to reason and to apply such reasoning to everyday problems. This matter, Mathematics develops the mind to think critically and analytically. It is more than counting, measuring, and computing. It is an eye opener to all sciences. As far as Mathematics instruction is concerned, the major goal is the involvement of the students in the process of discovering mathematical ideas and formulating process.

One of the interesting concerns about learning Mathematics is the fact that it develops the mind to solve problems that need higher order thinking skills. These problems and puzzles induced the curiosity and challenge the ingenuity of individuals. Introducing problem solving into the classroom improves students' skills and their ability to think creatively, logically and carefully.

Hugar (2011), pointed out the types of things we might think about a mathematics classroom are equations, procedures, and word problems, but in learning them, a student needs to master to solve problem. Thus, over the last couple of decades there has been a move to approach the teaching of mathematics through problem-solving.

Problem-solving as defined in the dictionary is the thought processes involved in solving a problem and it is also the area of cognitive psychology that studies the processes involved in solving problems.

The article on *Problem Solving in Mathematics: a Tool for Cognitive Development* from the University of New York, states that problem solving is, "the process wherein students encounter a problem – a question for which they have no immediately apparent resolution, nor an algorithm that they can directly apply to get an answer. They must then read the problem carefully, analyze it for whatever information it has, and examine their own mathematical knowledge to see if they can come up with a strategy that will help them find a solution. The process forces the reorganization of existing ideas and the emergence of new ones as students work on problems with the help of a teacher who acts as a facilitator by asking questions that help students to review their knowledge and construct new connections. As the new knowledge is embedded into existing cognitive frameworks, the result is an enrichment of the network of ideas through understanding." I think this in depth look at what problem-solving is, is a great framework for what the process entails and how the students benefit from learning mathematics this way.

Yeo (2004), states that problem solving in Mathematics can also be explained as "thinking and working mathematically" but the converse is not true. It is an intricate process which calls for problem solver who is engaged in mathematical task to organize and deal with the domain general pieces of knowledge.

Bandong (2000) of the University of the Philippines Baguio, stated that as long as a student is patient and sets his mind into it, he can learn everything. All he needs is the understanding of the four fundamental operations of arithmetic – addition, subtraction, multiplication and division. Teachers and students believe that Mathematics needs patience in analyzing and solving every problem. The heart determination is needed to make the subject interesting and easy.

In spite of the importance of Mathematics, there seems to be growing reluctance of the student to go into subject. Many students, despite a good understanding of mathematical concepts are inconsistent at analyzing and computing. They make errors because they misread or carry numbers incorrectly or may write numerical clearly enough or in the correct column. These students often struggle, where basic computation and "right answers" are stressed. Often they end up with remedial classes, even though they might have a high level of potential for higher level mathematical thinking.

According to Polya (1981), solving a routine problem did not contribute to the mental development of the student. He believed that to provide an opportunity for students to develop higher-order thinking in the process of understanding, analysis, exploration and application of mathematical concepts, non-routine problems should be employed. However, students generally fear the idea of solving non-routine problems because these problems are usually non-standard, involving unexpected and unfamiliar solutions. Besides, students are also apprehensive, anxious and extremely uncomfortable because they are not able to recall and apply learned procedures in a straightforward way.

In the study conducted by Yeo (2004) on mathematical problem solving of secondary students in Singapore, showed that students performed poorly on solving word problems. Difficulties in solving problems in Mathematics are evident inside the classroom. Some students were impeded in their progress in solving the problem as they did not comprehend the problem at all. Several students also committed erroneous solutions owing to careless computations. Students sometimes identify an appropriate operations or sequences of operating but do not know the procedures necessary to carry out these operations accurately. Their problem particularly in solving is confounded by the difficult terminology. These students have difficulty understanding written or verbal directions or explanations and find word problems especially difficult to translate into mathematical form and inability to use the correct mathematics.

The foregoing gave the interest to the researcher to conduct the present study due to the difficulties of the students in problem solving.

Statement of the Problem/ Research Question

The study aimed to determine the difficulties of the students in solving Mathematical problems.

II. SIGNIFICANCE OF THE STUDY

Investigating written solutions of students provide a valuable insight and analysis into the difficulties experienced when solving mathematical problems. The four-step process in problem solving which was developed by George Polya was used as basis for determining the problem –solving difficulties of the respondents in Mathematics in terms of their a) understanding the problem, b) devising a plan c) carrying –out the plan and d) looking back. Once the causes of difficulties are discovered, then it is probable to conclude and decide the

remedy. The findings of this study provide greater insights into students' thinking and difficulties as problem solvers. Difficulties are not problems to be overcome or evils to be eradicated but they are simply a part of the mathematical learning process. Thus, no one can achieve competence in any problem solving without experiencing difficulties.

III. LITERATURE REVIEW

Krulik (1987), states that a problem is situation, quantitative or otherwise that confronts an individual or groups of individuals, which requires resolution, and for which the individual sees no apparent path to the solution.

Various definitions of Problem Solving have been presented by experts. Basically these definitions contain the same meaning while the differences lie only on the ways they formulate them. Two definitions of problem solving are given here. First, according to Schoenfeld (1994), problem solving, as used in mathematics education literature, refers to the process wherein students encounter a problem – a question for which they have no immediately apparent resolution, nor an algorithm that they can directly apply to get an answer. They must then read the problem carefully, analyze it for whatever information it has, and examine their own mathematical knowledge to see if they can come up with a strategy that will help them find a solution. The process forces the reorganization of existing ideas and the emergence of new ones as students work on problems with the help of a teacher who acts as a facilitator by asking questions that help students to review their knowledge and construct new connections.

Second, by Cai (2005), problem solving in Mathematics can be explained as critically and a cognitive process. Creative thinking and problem solving are frequently seen as a task for an individual but an individual can only build these skills from what he/she experience or learned. Problem solving combined experimental and correlations method to investigate the effects of problem solving effectiveness.

In the research study of Hugar (2011), Problem solving is the back bone for mathematical instruction. This emergence has come to be established due to the idea that studying math through problem solving improves one's ability to think, to reason, and to solve problems that are confronted with in the real world. There seems to be three themes characterized by the role of problem solving in school mathematics curriculum: 1) Problem solving as content; the idea that problems and the solving of them are a means to achieve other

valuable ends. 2) Problem solving as skill; this is the idea that it is a skill to be taught and not necessarily a unitary skill, but is a clear skill orientation. 3) Problem solving as art; this is the idea that learning math through problem solving is an art of discovery for its methods and rules.

Lester (1994) stated that successful problem solving involves coordinating previous experiences, knowledge, familiar representations and patterns of inference, and intuition in an effort to generate new representations and related patterns of inference that resolve the tension or ambiguity (i.e., lack of meaningful representations and supportive inferential moves) that prompted the original problem-solving activity.

Yeo (2004), also explained problem-solving processes as using different forms of knowledge leading to the goal of solving the problem. The types of knowledge applied in problem solving consisted of: linguistic and factual knowledge – about how to encode statements, schema knowledge – about relations among problem types, algorithmic knowledge – about how to present distinct procedures, and strategic knowledge – about how to approach problems. In fact, according to Newman (1983), difficulty in problem solving may occur at one of the following phases, namely reading, comprehension, strategy know-how, transformation, process skill and solution.

In the research study of Schoenfeld (1985) suggested four aspects that contributed to problem-solving performance. These are the problem solver's: (1) mathematical knowledge, (2) knowledge of heuristics, (3) affective factors which affect the way the problem solver views problem solving, and (4) managerial skills connected with selecting and carrying out appropriate strategies. In their study of the problem-solving research literature, Kroll and Miller (1993) identified three major cognitive and affective factors; namely, knowledge, control (metacognition) and beliefs and affect that contributed to students' difficulties in problem solving. Further Lester (1994) expressed that difficulties experienced during problem solving could also be caused by the problem solver's characteristics such as: traits – such as spatial visualization ability and ability to attend to the structural features of problems, dispositions – such as beliefs and attitudes, and experiential background – such as instructional history and familiarity with types of problems.

As reflected in the study of Cai (2005) on *Mathematical problem solving: What we know and where we are going,* states that there are three specific goals for Problem Solving: (1) to examine the understanding of the complex cognitive processes involved in problem solving;

(2) to explore the actual mechanisms by which students learn and make sense of mathematics through problem solving, and how this can be supported by teachers; and (3) to identify future directions of problem-solving research, including the use of information technology.

Thus, if problem solving be successfully used and taught in the classroom, the students will also be successful in applying them in real life situation. This enables the students to internalize the theories learned from school through application which makes the lessons become meaningful to them.

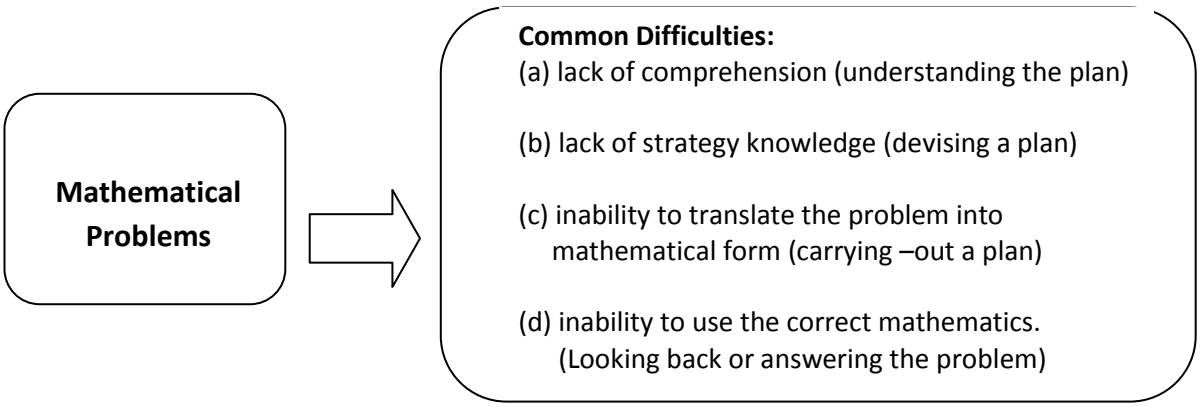

Figure 1: The schema of the conceptual framework.

IV. METHODS

Participants of the Study

The participants were twenty (20) randomly selected third year students of the BSED (Bachelor of Science in Education) major in Mathematics of Cagayan State University-Andrews Campus.

Instrument and Procedure

The problem–solving type of test was administered in the study to determine the difficulties of the students in solving Mathematical problems.

The test was given during their Mathematics class. Students were given an allotted time in solving within 40 minutes.

Data Analysis

The researcher used the frequency of occurrence in determining the difficulties of the students in solving mathematical problems. Each committed errors were tabulated and classified accordingly.

V. RESULTS AND ANALYSIS

As identified from the participants' answers to the five-item test in the form of a questionnaire, the common difficulties committed by the third year college students are presented on Table 1. The table indicates at which stage the students were unable to proceed with the solution to a problem. It gives the breakdown of the occurrences at the various stages for this group of 20 students of 3rd year BSED Mathematics.

Table 1. Problem –Solving Difficulties on Mathematical Problems

	Incorrect			
	Understanding the Plan (Lack of comprehension)	Devising a Plan (Lack of strategy knowledge)	Carrying-out the Plan (Inability to translate the problem to mathematical form)	Looking Back or Answering the Problem (Inability to use correct mathematics)
Problems	Frequency (F)	Frequency (F)	Frequency (F)	Frequency (F)
Age	**0**	**6**	**11**	**12**
Time	5	16	16	17
Motion	**0**	**6**	**19**	**20**
Number	**4**	**18**	**19**	**19**
Geometry	**10**	**16**	**16**	**16**
Total	**19**	**62**	**81**	**84**

The results of the study show that the major difficulties of the students in problems solving are inability to translate the problem to mathematical form (81) and the inability to use correct mathematics or answering the problem (84).

VI. DISCUSSION

It can be noted that students' major difficulty in solving mathematical problems are carrying-out-the plan and looking back. A total of eighty four (84) incorrect solutions were committed on looking back (getting the correct answer), this reveals that the students have the inability to use correct mathematics and that students' mathematical problem solving skills is poor. This last phase of Math problem solving skills is on output difficulty. A student with problems in output is unable to recall basic math facts, procedures, rules, or formulas, very slow to retrieve facts or pursue procedures, have difficulty maintaining precision during mathematical work, have difficulty with handwriting that slow down written work or make it hard to read later, have difficulty remembering previously encountered patterns and forget

what he or she is doing in the middle of a math problem leading to incorrect answers or solutions. Thus, the students made a highest proportion of errors on this Process Skills followed by errors on the following order: Carrying-out the plan (Transformation), Comprehension, Carelessness, Reading and Encoding (Newman, 1983).

Eighty one on the carrying –out the plan this means that the students have the inability to translate problem into mathematical forms (equations or open sentences). Teachers across all academic disciplines, even at the college level, must deal with incorrect problem solving strategies. The incorrect mathematical concepts, equations, and formulas are the most prevalent and irremediable difficulties found in mathematical worded problem test. Some students seem to have absolute difficultly managing and/or merging task in worded problems. They find it difficult to switch between multiple demands in a complex math problem and to tell when tasks can be grouped or merged and when they must be separated in a multi-step math problem and cannot manage all the demands of a complex problem, such as a word problem, even thought he or she may know component facts and procedures.

Kroll & Miller (1993), states that students must possess relevant knowledge and be able to coordinate their use of appropriate skills to solve problems. Furthermore, knowledge factors such as algorithmic knowledge, linguistic knowledge, conceptual knowledge, schematic knowledge and strategic knowledge are vital traits of problem-solving ability. For mathematics teachers to assist their students develop their problem-solving ability, it is essential that they are aware of their difficulties first.

Mathematics problems often present difficulties for many people especially for the young learners. Mastery of the basic rules in problem solving takes time. Despite of the resources made available for exposure of the problems intended, errors or mistakes are still bound to happen. However such instances are not a clear indication of failure to mathematical problem solving but learning should be constant and must seek other tools for improvement.

VII. CONCLUSION AND RECOMMENDATIONS

The main difficulties committed by the participants of the study are on inability to translate problems into mathematical equations and inability to use correct mathematics. These forms of difficulties imply a need for mastering mathematical concepts and formulas on the

part of the mathematics learners to lessen errors in solving mathematical problems and in constructing mathematical equations in a well developed manner to come up with the correct solution.

The findings of the study suggest a focus on teaching mathematical concepts and formulas to students and a need to expose them with a variety of math problem types which will require them to think analytically by trying different problem solving strategies that are appropriate to solve problems. The findings of the study will also be a reference for further research on problems solving difficulties in a larger scope where possible as a help to improve course syllabus in Mathematics and develop instructional materials where students are provided with the processes and strategies that make math problem solving easy to learn and they become successful and efficient problem solvers.

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Appendix A- PROBLEM SOLVING TEST QUESTIONNAIRE

Name:_____Sex:_____

Direction: Analyze and solve each problem carefully. Answer the questions that follow before each item. Show your complete and organized solution on the space provided on each problem.

1. *Age problem*. Peter is three times as old as Carlo. Carlo is four years older than Jay. In twenty years, Peter will be twice as old as Jay. How old are Jay, Carlo and Peter now?

1.1. What is/are given?

What is/are asked?

1.2. Represent the unkown/s in the problem.

Mathematical Equation/s.

1.3. Show your solution.

1.4. State your final answer in a statement.

2. *Time Problem.* Miss Lee arrived at the concert hall 15 minutes before a concert began. However, due to some technical problems, the concert started 10 minutes later. The whole concert lasted for 2 hours 25 minutes. It was 10:30 pm when Miss Lee left the concert hall. At what time did Miss Lee arrive at the concert hall?

2.1. What is/are given?

What is/are asked?

2.2. Represent the unkown/s in the problem.

Mathematical Equation/s.

2.3. Show your solution.

2.4. State your final answer in a statement.

3. *Motion Problem*. Mr. Cruz drives his car from Town A to Town B in 5 hours. If he will drive 14 kilometers per hour faster than he used to, the trip will take him one hour less. How far is Town B from Town A?

3.1. What is/are given?

What is/are asked?

3.2. Represent the unkown/s in the problem.

Mathematical Equation/s.

3.3. Show your solution.

3.4. State your final answer in a statement.

4. *Number Problem*. Mrs. Reyes buys numerals to put on the doors of each apartment in a 99-unit apartment building. The apartments are numbered 1 to 99. How many of each digit should Mrs. Reyes buy?

4.1. What is/are given?

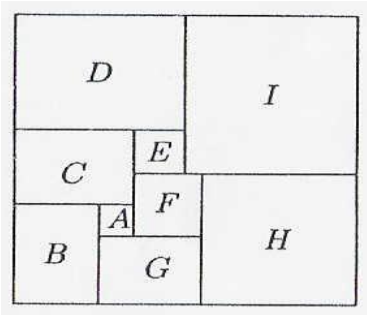
What is/are asked?

4.2. Represent the unkown/s in the problem.

Mathematical Equation/s.

4.3. Show your solution.

4.4. State your final answer in a statement.



5. Geometry Problem: Nine squares are arranged as shown. If square *A* has area 1 cm^2 and square *B* has area 81 cm^2 then what is the area of square *I* in square centimeters?

5.1. What is/are given?

What is/are asked?

5.2. Represent the unkown/s in the problem.

Mathematical Equation/s.

5.3. Show your solution.

5.4. State your final answer in a statement.