

An Analysis of Mathematical Problem Solving Ability of High Capability Students of the Islamic Elementary Schools at Sumedang

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Abstract

We often face problems, such as: tasks, questions, or obstacles which cannot be known how to solve soon; it is difficult to avoid by human being. Mathematical problem solving is an exercise for students to face non routine things and how to try to solve them. One of the programs which was held by the Religion Ministry that has a goal to produce human resources who are capable of solving daily life problems is Kompetisi Sains Madrasah Ibtidaiyah (Islamic Elementary School Science Competition) in level sub district, regency, province, and nation. The skills which were competed in this program were Mathematics and Science.

This research aimed to study the students' skills of KSMI 2014 at Sumedang in answering question items of problem solving. The subject of this research was 57 students of 57 Islamic Elementary Schools who were selected by each school and considered having high mathematical problem solving skills. This competition was held in April 2014. The examined contents were Arithmetics, Geometry, and Data and Measurement.

The result of this analysis of the students' answers informed that generally the students still felt difficult to solve the problems, especially in Geometry.

Keyword: mathematical problem solving, Islamic Elementary School Science Competition

A. Introduction

Mathematics is universal science that is based on the development of modern technology, has important role in various kinds of disciplines of knowledges and bring progress to human thoughts. The growing fast of science and technology at this time has been accompanied human being to the era of global competency in all aspect of human life, including education field of mathematics. Mathematics lesson needs to be given to all students by starting from elementary school to provide them with the capabilities of thinking logically, critically, and creatively, and also the capabilities of working together.

In the Standard of Competency of Mathematics lesson, it is stated that the aims of giving mathematics lesson at Elementary School/Islamic Religious Elementary School are: in order that the students have capabilities, such as, to understand the concept of Mathematics, to explain the relationship among concepts and to apply the concepts or Algorithm gently, accurately, efficiently, and exactly to solve problems; to use common sense for the patterns and traits, to do manipulation (Mathematical manipulation) in making generalization, to arrange evidence, or to explain concepts (ideas) and Mathematical statement; to solve problems including the capabilities to understand the problems, to design mathematical models, to do the mathematical models, and to interpret the solution which is got, to communicate ideas with the symbols, tables, diagrams, or any other media to make clear the condition or problems, to have an attitude to appreciate the usage of Mathematics in daily life, such as, having

high curiosity, more attention, and talent to learn Mathematics, and having perseverance and self-confidence to solve problems (Diknas, 2006).

Based on the aims of Mathematics lesson given above, one of the programs which was held by the Indonesian Ministry of Religion that has aims, such as, to produce human resources who are able to create in solving problems which happens in daily life, was the Islamic Religious Elementary School Science Competition at level of sub district, district, province and nation. The fields which more completed in this competition (KSMI 2014) are Mathematics and Science. In this activity, all the participants were trained and were always used to improve their thoughts, creativity, and critical thinking, and also capable to apply it in the next steps of development.

Facing with something that is not routine and then try to finish it is a typical characteristics of human being who are able to judge. Problem solving is an exercise for students to face with something that is not routine and then try to solve it. Problem solving is a part of the curriculum of Mathematics which is very important, beginning from the Elementary School/Islamic Religious Elementary School, even it is said explicitly in the Standard of Competence and the Basic Competence of the Elementary School/Islamic Religious Elementary School.

1. Mathematical Problems Solving

According to Polya (Gani, 2007), problems solving is as an effort to find ways to overcome a difficulty, to make the goal be reached soon. The solution of the problems involves various contexts which come from the relationship of problems in daily life for the mathematical situation which is come up. (NCTM, 2000). The students are able to solve some problems which are come up to them by the other people. But it is easier for them to formulate their own problems based on their own experiences and their interest.

The process of mathematical problem solving is different from the process of doing to finish mathematical test items. The difference is on the use of terms itself (term of problem and term of item). Doing test item or mathematical tasks is not the same with solving mathematical problems yet. The way to finish doing mathematical tasks can be found soon. The tasks are grouped to unroutine tasks, and it is not problem. A problem for an individual or a student at a level of certain school does not mean a problem yet for individual or student on the higher level (Sumarmo: 2012).

Polya (1985) explained in detail the four steps for solving problems which are presented in order, those are: 1) understanding the problem 2) devising a plan 3) carrying out the plan, and 4) looking back.

Furthermore, Ruseffendi (2006) states the five steps to solve problem, those are: 1) presenting problems in good and clear forms; 2) stating the problems in operational forms (can be solved); 3) arranging alternative hypotheses and procedures which are suitable to be used to solving the problems; 4) testing the hypotheses and doing the job to get the result (collecting the data, analyzing the data, etc.), the result might be more than one; 5) checking again whether the result which is got is correct. It needs to choose the best way to solve it, too.

Problem solving approach is the focus in the teaching of Mathematics which includes closed problems with single solutions, opened problems with non single

solutions, and any kinds of problems with many ways to solve. In improving capabilities to solve problems needs to develop skills of how understand the problems, to make mathematical models, to finish solving the problems, and to interpret the solution, in accordance with one of the aims of Mathematical lesson which is printed in the regulation of Ministry of National Education, number 22 in 2006.

Based on the statements above, to solve problem needs a combination of previous knowledge, such as: the use of steps, rules, and concept. In connected with Mathematics is as one of the basic knowledge which gives great importance to the process rather than the result; it means that the answers should be given by someone in solving mathematical problems, he or she should pay attention to the accuracy of the use of steps, strategies, rules, and concepts. The importance of the use of steps and strategies in solving the problems shows that the answers are not easy to get, but it must pass through any kinds of procedural steps and it should relate those concept which have been got before.

2. The Importance of Solving Mathematical Problems

According to Van De Walle (Ardiyanto, 2013), Mathematics today requires not only computational skills, but also the ability to think and reason mathematically in order to solve the new problems and learn the new ideas that students will face in the future.

It is very important to solve problems. According to Polya (Sumarmo, 2002), the activities in solving problems are as follows:

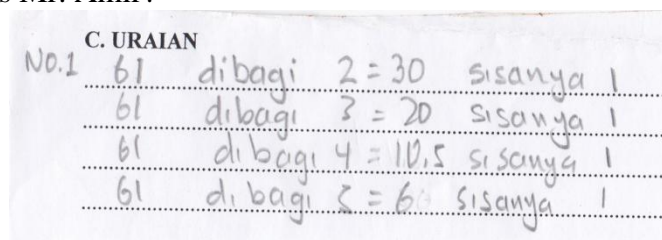
1. Understanding the problems activity. This activity can be identifies through several question: a) What is known and what is questioned?; b) What kind of data is available?; c) How is the condition of the test item? Might the condition be stated in equation form or any other relationship? Is the given condition enough to get what is questioned? Is the condition not enough or more enough or disputed?
2. Planning or designing strategies for solving problems activity. This activity can be identified through several questions: a) Have there ever been questions look alike, or similar in other form before?; b) Which theories are used for the problems?; c) Have similar questions been there? Can experiences and or he old (previous) ways be used for solving the new problems? Should other elements be searched? Back to the definition; d) If the new problems are not able to be solved, try to think the similar questions and finish them.
3. Doing computation activity. This activity includes :do the strategies of solving the problems on number 2 above, and check each step. Check it whether each step of computation is correct. How do we prove or check that the choosen steps are correct?
4. Checking again the truth of the result or solution activity. This activity is identified with: How do we check again the correct results that are gained? Can the contradiction be forwarded? Can the solution be found by using the other ways? Can the results or the ways be used for the other problems.

The importance of problems solving was also stated by Holmes (1995) that: 1) the reason why someone needs to learn how to solve problems is that the fact in the twentieth century people who are able to solve problems live more productive, 2) people are skillful to solve problems will be able to get their needs of life, to become more

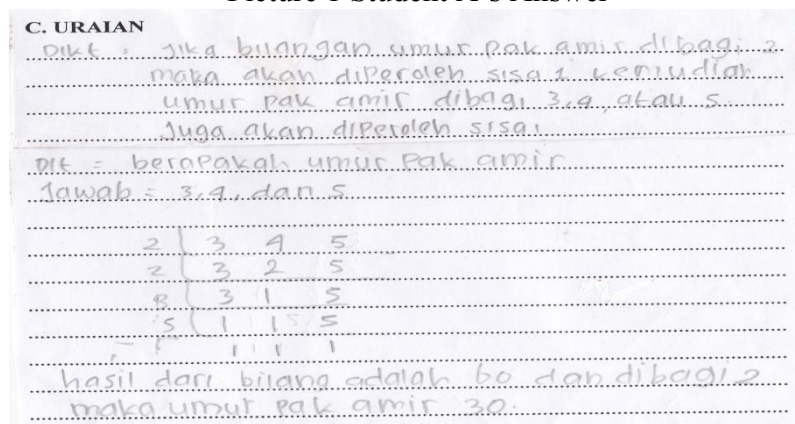
productive workers, and to understand the complex issues related with the global society.

In the Standard of Competence and the Basic Competence of Mathematics lesson for the Elementary School/Islamic (Religious) Elementary School, problems solving which is part of the Mathematics curriculum is very important and explicitly stated. Beginning from the first grade of first semester, at point 1.4, the basic competence is to solve problems which relates to addition and reduction until twenty. It shows that problems solving is given and taught in the early age, even in the early first year of the Elementary School /Islamic Religious Elementary School. And there are still many basic competences in the other points which require the students be able to use mathematical knowledge to solve problems. The scope of Mathematics lesson on Satuan Pendidikan of SD/MI includes the aspects: numbers, Geometry and Measurement, and Data Processing.

The example of problems solving was given to the students of the fifth grade of the Elementary School, its indicator is that the students are able to solve problems on LCM matter, as follows: When seeing Mr. Amir do exercise in the morning, Budi had a riddle for his friends. "If you divide the age of Mr. Amir into 2, you will get left-overs 1. It is said that: "Then, if you divide the age of MR. Amir into 3,4,5, you will also get left overs 1, how old is Mr. Amir?"



Picture 1 Student A's Answer



Picture 2 Student B's Answer

There were who could not do the test item was because of his unskillful to understand the concept of Least Common Multiple (LCM), his lack of right strategies in planning to finish doing computation. The following is the results of the students' works: the student A above shew his knowledge about division, but the concept of LCM was not understood well. He was not perfect yet to communicate what he thought; it

was shown that he only wrote the answer without giving the reason nor enough information. Although the last result pointed the right answer. Then the student B above shew his knowledge about LCM. It was shown that from the process, he finished doing (solving) the problem, but after doing the computation, he was wrong to interpret the problem which was given.

B. Method of Research

The method which was used in this research was descriptive qualitative method, because of his aim was to describe in words and language about a condition or phenomenon in detail. The phenomenon which were described was the students' capabilities of Mathematical problems solving of Islamic (Religious) Elementary School, who have higher level of capabilities at Sumedang district.

Subject in this research was 57 students of the four grade or the fifth grade from 57 Islamic Religious Elementary School and considered having higher capabilities of mathematics as the participants of KSMI 2014. This research was held during the competition for district level, on April 2014.

The data were collected through the written test of doing Mathematics test items of KSMI including mathematical problem solving test items. The items were written in multiple choice, short completion, and essay (description). The test items consisted of 25 multiple choice items, 10 short completion items, and 5 essay items. The validity of test instrument of this research, after being constructed by considering all aspects, furthermore it was made by the team of test item makers at the same times as the team of evaluation about four lecturers of Mathematics Education Study Program of STKIP Sebelas April Sumedang, and the instrument could be used without being repaired. This test instrument was based on the indicator of mathematical problem solving capabilities and the technical instructions of the implementation of KSMI at district and province level. The materials which were tested including the scope of Arithmetics, Geometry, and Data and Measurement.

Table 1
The Scope of Mathematics Lesson on KSMI 2014

No.	Scope	Tested (examined) Materials
1	Arithmetics	The Integers, Rasional numbers and representation (fractions, desimals, and percentages), number factorization, and Greatest Common Divisor (GCD), Least Common Multiple (LCM), sequencing of numbers, Ratio and Proportion.
2	Geometry	Angle Measurement, area and perimeter/circumference, triangles, square, parallelogram, trapezoid, circle, cube, prism and pyramids, the symmetry, reflection and rotation, resemblance and proportion/parts.
3	Data and measures	Representation of the data, the average, median and mode

Technically, the steps in this research were: 1) making the test instrument of mathematical problem solving by the team of evaluations; 2) implementing the research, that is, giving the test instrument at the time of the implementation of KSMI 2014; 3) Analyzing the data of test of mathematical problem solving capabilities; 4) drawing conclusion.

C. Research Findings and Discussion

In this research, the data which were analyzed was about all the result of the written test answers of mathematical problem solving of KSMI 2014 participants, including the scope: Arithmetics, Geometry, and Data and Measurement. It included materials which were presented on the table 1 with the data analysis results.

Table 2
Multiple Choice Test Results of Mathematical Problem Solving Capabilities

No. test item	Materials	Students answers correctly		No. test item	Materials	Students answers correctly	
		Total	Percentage			Total	Percentage
1	Integers	26	46%	14	Area and parimeter	6	11%
2	Rasional numbers and representation	31	54%	15	Circumference	24	42%
3	Representation of the data	11	19%	16	Circle	17	30%
4	Sequencing of numbers	9	16%	17	Prism	16	28%
5	Ratio and proportion	15	26%	18	Cube	9	16%
6	LCM	18	32%	19	Rotation	14	25%
7	Number factorization	18	32%	20	Symmetry	19	33%
8	The average	11	19%	21	Reflection	15	26%
9	Ratio and proportion	27	47%	22	Median	27	47%
10	Rasional numbers and representation	22	39%	23	The average	8	14%
11	GCD	11	19%	24	Representation of the data	13	23%
12	Parallelogram	11	19%	25	Mode	54	95%
13	Angle measurement	13	23%				

Table 3
Short Completion Test Results of Mathematical Problem Solving Capabilities

No. test item	Scope	Students answer correctly	
		Total	Percentage
1	Ratio and proportion	18	32%
2	Integers	16	28%
3	Greatest Common Divisor (GCD)	10	18%
4	The average	20	35%
5	Least Common Multiple (LCM)	31	54%
6	Pyramids circumference	17	30%
7	Circumference	8	14%
8	Rasional numbers and representation	6	11%
9	Cube volum	7	12%
10	Representation of the data	9	16%

Table 4
Essay Test Results of Mathematical Problem Solving Capabilities

No test item	Scope	Understanding the problems		Planning to solve		Implementing the plan		Interpreting the results	
		Students answers correctl y	Percen - tage	Students answers correctl y	Percen - tage	Students answers correctl y	Percen - tage	Students answers correctl y	Percen - tage
1	Ratio and proportion	48	84%	18	38%	13	23%	7	12%
2	Integers	45	79%	15	32%	10	17%	6	10%
3	Prism area	40	70%	8	17%	3	5%	4	7%
4	Circle area	38	66%	6	13%	4	7%	3	5%
5	The average	39	68%	6	13%	5	9%	3	5%

Based on the data from the table 1,2, and 3, it shoed that on the scope of Arithmetics, Geometry, and Data and Measurement with the materials which were explained on the above table, only a few of students who were able to answer problem solving test items. It meant that the students' capabilities of solving problems was still low. When a students was given multiple choice test items and short completion tes items, the result were not too low, because the process of doing the test items was not seen and the steps of the mathematical problem solving process were not looked.

Whilst on the essay items, it was seen clearly the difference in each level of the steps. On the step of understanding the problems, most of the students were able to do it. Only several students who were capable to do the step of planning to solve, and just a little of students who could do the implementation. And then, there are several students who could interpret the solution.

As a whole, from the test items which were given, the students felt so difficult to do Geometry test items. They did not understand the concepts of Geometry. The most important thing to pay attention to answering the problems solving test items was the

accuracy of steps, strategies, rules, and concepts. It was shown that the answers in solving the problems was not easy to get, but it had to pass through procedural steps and connected it with the previously concepts.

D. Conclusion and Suggestions.

Problems solving should be taught since the Elementary School/Islamic Religious Elementary School (SD/MI) as a provision to go through the stage of higher education. By having capabilities of solving problems creatively, it is hoped that the students are used to thinking more free or creative, so that they are to become people who can face any kinds of challenges in the future.

Based on this research, the researcher suggest: 1) The teachers should get used to giving problems solving test items to their student and doing it by using appropriate strategies, 2) Make the students be accustomed to using the four steps for solving problems, those are : a) understanding the problems, b) planning to solve, c) implementing the plan, d) interpreting the results.

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