Mathematics Education and Graph Theory

PROCEEDINGS OF INTERNATIONAL SEMINAR
ON MATHEMATICS EDUCATION AND GRAPH THEORY

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MATHEMATICS EDUCATION AND GRAPH THEORY
Proceedings of International Seminar on Mathematics Education and Graph Theory

These proceedings contain the full texts of paper and talks presented in the International Seminar on Mathematics Education and Graph Theory on June 9, 2014

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PREFACE

These proceedings contain the full text of papers and talks presented in the International Seminar on Mathematics Education and Graph Theory. This seminar was held in conjunction with the International Workshop on Graph Masters. The workshop was held on June 7–8, 2014, while the seminar was on June 9, 2014. These events were organized by Islamic University of Malang (Unisma) in cooperation with Indonesian Combinatorial Society (InaCombS).

The workshop and the seminar would not have been possible without the time and energy put forth by the invited speakers. The invited speakers of the workshop were: **Mirka Miller**, University of Newcastle, Australia; **Joseph Miret**, Universitat de Lleida, Spain; **Christian Mauduit**, Institut de Mathematiques de Luminy, France; **Edy T. Baskoro**, Bandung Institute of Technology, Indonesia; **Surahmat Supangken**, Islamic University of Malang, Indonesia; **Tri Atmojo**, State University of Semarang, Indonesia; and **Purwanto**, State University of Malang, Indonesia.

The invited speakers of the seminar were: **Juddy Anne Osborn,** University of Newcastle, Australia and **Abdur Rahman As'ari**, State University of Malang, Indonesia. The seminar was held on the area of mathematics education and graph theory. The main themes of the mathematics education seminar include topics within the following areas (but not limited to): philosophy of mathematics education, curriculum development, learning methods and strategies, learning media, development of teaching material, and assessment and evaluation of learning. The main themes covered in graph theory seminar include topics within the following areas (but not limited to): degree (diameter) problems, ramsey numbers, cycles in graphs, graph labeling, dimensions of graphs, graph coloring, algorithmic graph theory, and applications of graph theory in various fields.

We would like to thank you to the invited speakers and all presenters who have submitted papers, for their valuable and inspiring presentation. A special appreciation goes to: **Surahmat Supangken**, Rector of Unisma and **Kiki Ariyanti Sugeng,** the President of InaCombS, who have made a lot of efforts to prepare this seminar.

We also do not forget to express our gratitude to Islamic University of Malang (Unisma) for providing financial support, and to the Indonesian Combinatorial Society (InaCombS) for the support. We hope that you had a great time and valuable experience during the seminar in Malang.

Malang, July 22, 2014

Editors

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Theoretical (Conceptual) Articles

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BUILD MATHEMATICAL KNOWLEDGE THROUGH PROBLEM-SOLVING STRATEGY

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Abstract

Currently, mathematics learning strategies can not develop students mathematical knowledge in Junior High School. Mathematical knowledge consists of conceptual and procedural knowledge. Therefore, it is necessary to change the strategy-oriented learning mathematics problem solving. Because the problems have an important role in mathematics. The strategy is a problem solving strategy which consists of four steps are understanding the problem, devising a plan, carrying out the plan, and looking back.

Keywords: *Mathematical Knowledge, Problem-Solving Strategy*

INTRODUCTION

Nasional Research Council of America recommends about mathematical knowledge or mathematical skills that should be developed in schools is the understanding of the concept, the smooth procedures, strategic abilities, thought processes, and mathematical disposition (Reys, Lindquist, Lambdin, and Smith, 2004). Recommendations mathematical knowledge can be classified into conceptual knowledge and procedural knowledge.

Mathematics knowledge has a variety of concepts and principles (Conceptual knowledge). Concept is an abstract idea that can distinguish between examples and non-examples (Soedjadi, 1999/2000). Like the concept of triangles, circles, and other variables. While the principles are the relationships between concepts. Such as Pythagoras theorem. In the theorem there is a relationship variable concept, the concept of squares, sum concept, and the concept of equality. As procedural knowledge, mathematical calculations related to the operating and problem solving. According Soedjadi (1999/2000), the operation count is craftsmanship, workmanship algebra and other mathematical processing. Arithmetic processing functions such as determining the derivative of a function or a function integral workmanship. Both of these activities includes procedures or steps in solving the problem. According Reys, Lindquist, Lambdin, and Smith (2004), procedural knowledge is reflected in a groove proficiency in performing mathematics (algorithms), where as conceptual knowledge related to aspects of the connection. Understanding of concepts in mathematics are very important in mathematics. Because of mathematical concepts related to load. Weaknesses of students to a particular concept can make students understand the concept of the other. Like the concept of squares associated with the concept of a parallelogram. Since the square is a rectangle with adjacent sides conruent.

Another mathematical knowledge skills related to mathematical disposition. According Sumarmo (2013), mathematical dispositions associated with self-confidence, the habit of responding, useful and utilitarian view of mathematics and consider the whole thing. Mathematical disposition included in the affective aspects of Bloom's taxonomy. This aspect is important in shaping positive attitudes towards mathematics students. Because hostility towards mathematics can directly influence students' mathematical ability (Suhena, 2009). Conceptual knowledge and procedural knowledge in middle school students (SMP) in the city of Bengkulu is still low. More than 65% of students can not understand the concept of function correctly. More than 60% of students are not skilled in calculating fractions multiplication operation. More than 70% of

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students are less like math. Many factors make the low student mathematical knowledge. One reason is the lack of effective teachers use instructional strategies in mathematics. The strategy used teacher-centered, while the students being passive. According to Sullivan in Hamzah (2003), learning mathematics is done in the classroom in general teacher-centered.

The teacher explains the concepts of mathematics, students observe and memorize it. Teachers explain and demonstrate the steps operations in solving a problem. Then the teacher explains the importance of mathematics in everyday life through the provision of mathematics applications in real life. The strategy is not able to improve students' mathematical knowledge. Pure Ebtanas value (NEM) mathematics courses, generally is below 5 from a scale of 0 to 10 (Hamzah, 2003). Improvement of mathematics teaching strategies need to be done, so that a good knowledge of mathematics students. In mathematics learning, teachers sought to make students understand the material and active in solving a problem. One strategy that can enable students to learn mathematics is problem solving strategies. According to Reys, Lindquist, Lambdin, and Smith (2004), problem-solving strategies consist of the following activities are: identifying facts, make drawings/diagrams, weave patterns, create tables, guessing, simplifying, and check back. How does the application of problem-solving strategies to build students' knowledge of mathematics?

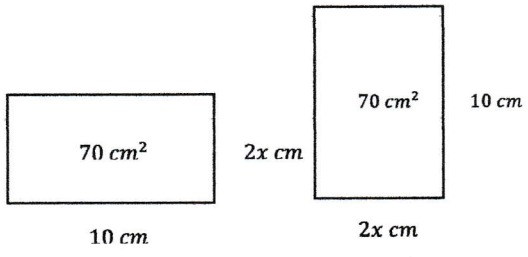
IMPLEMENTATION PROBLEM SOLVING STRATEGY IN TEACHING MATHEMATICS TO IMPROVE MATHEMATICAL KNOWLEDGE

Strategy is an issue in achieving a goal. One of the goals to be achieved in the learning of mathematics is mathematical knowledge consists of conceptual and procedural knowledge. Conceptual knowledge in mathematics associated with knowledge of facts, concepts, and principles. According to Hiebert and Lefevre (1986), based on the conceptual knowledge of various information networks. Such fact about a point, numbers, symbols and others. Examples include the concept of triangle, square, circle, and other functions. While the examples include the principle of the Pythagorean theorem. Procedural knowledge in mathematics relating to the calculation (algorithm) to solve a mathematical problem. According to Reys, Lindquist, Lambdin, and Smith (2004), procedural knowledge is based on a sequence of actions involving the norm of and algorithms. For example, the sequence of steps completed about 25×15. Lot of steps that can be used to obtain the result of Multiplying two numbers. Conceptual and procedural knowledge is developed with the understanding and meaning through problem-solving strategies. According to Polya (1973), problem-solving strategy consists of four steps: understanding the problem, devising a plan, carrying out the plan, and looking back.

1. Understanding the problem

In general, the problem is the gap between expectations with realitity. According Hudojo (2002), problems in mathematics is divided into five parts, namely: 1. Routine problems, 2. Problem of non-routine, 3. Problem routinely applied, 4. Applied non-routine problems, and 5. Problem of non-routine applied.

Such a problem on inequality for junior high school students as follows: It is widely known rectangle no more than 70 cm^2. If the width is $2x$ cm and length 10 cm. Determine the width of the rectangle. The teacher directs students to be able to understand the problem correctly, while finding a variety of conceptual and procedural knowledge contained in the question. Bengkulu City Junior High School Students 15 of 30 people actively understand the question. To understand the problem, 85% of students attempted to draw a rectangle. The results of their image as follows:



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A total of 15% of students did not describe a rectangle, but only write the information contained in the matter. Their writing as follows: Area of a rectangle is less than $70\ cm^2$, $width = 2x\ cm$, $length = 10\ cm$. Other students write w $ide = 7$, $width = 2x$, $length = 10$. Activity has been growing understanding of the conceptual knowledge of students, namely students' understanding of the concept of rectangular, the concept of length, width concepts, facts, numbers, and the concept of variables.

2. Devising a plan

The plan is a preparation in order to achieve the goal. Objectives to be achieved in the learning of mathematics is a creation of conceptual understanding and procedural mathematics. Problems (problem) that have been identified through pictures and written into the material in preparing a plan. Proper planning can provide effective direction in carrying out activities to achieve the goal. Form of planning that the students in solving a problem (problem) in the form of mathematical models and descriptions. As many as 90% of students plan to make the inequality. In the issue (problem) before he made the form inequality as follows:

$2x + 10 \leq 70$

$2x\ cm + 10\ cm \leq 70\ cm^2$

$2x + 10 < 70$

$2x\ cm + 10\ cm < 70\ cm^2$

As many as 10% of students make a plan in the form of equations. Form of the plan as follows.

$Wide = 70$

$Width = 2x$

$Length = 10$

$Area = length \times width$

$70 = 10 \times 2x$

Activity plan to solve a problem with the kind of conceptual and procedural understanding. Conceptual understanding of inequalities and equations. While the procedural understanding obtained is added the use of surgery and time in an equation or inequality.

3. Carrying out the plan

Plans that have been created by students, subsequently carried out by the student to obtain a settlement of the problem. Plan in the form of a mathematical model (inequality) solved to obtain the value of the variable (x) that satisfies the inequality. As many as 72% of students completing the inequality correctly. Completion as follows:

$2x + 10 \leq 70$

$2x \leq 70 - 10$

$2x \leq 60$

$x \leq 3$

The width of the rectangle less than $2x = 2(3) = 6\ cm$. A total of 28% of students answered incorrectly. One of those who answered one of the following:

$2x + 10 \leq 70$

$2x \leq 70 - 10$

$2x \leq 60$

$x \leq 3$

The width of the rectangle ` $= 2x = 2(3) = 6\ cm$. Answer other students as follows:

$2x + 10 = 70$

$2x = 70 - 10$

$2x = 60$

$x = 3$

The width of the rectangle ` $= 2x = 2(3) = 6\ cm$. The implementation of the settlement plan a growing problem in the form of understanding and ability procedural skills in performing arithmetic operations (inequality). Students skilled in performing addition, subtraction, multiplication, and division of numbers.

4. Looking back

Reviewing activities back to the work that has been done as an activity that gives students an opportunity to correct his mistakes. In addition, this activity as an activity to make sure what he had done right. The activities as reviewed, ranging from beginning to end. Similarly, the process and the result of settlement of a matter. Activities such as review of the notice rule axioms, postulates, definitions and theorems and accuracy of a calculation. While the review of the results of the aspect of the activities in question in the matter or things you want to look for in a matter of problem. About the case as reviewed in the previous description is to determine what is known, it is asked, the formulation of the model (inequality),

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how to solve the model (inequality), and the interpretation of the completion of the model. Reviewing activities foster conceptual and procedural capabilities. Because students use a variety of concepts and principles in reviewing a settlement of a matter. In addition, students use skills in performing arithmetic operations to review the settlement of a matter. Fourth step problem-solving strategies are interrelated in helping students solve a problem. The first step provides the basis to be able to perform the second step in the problem solving plan, as well as steps to provide direction on the two-to three-step operation to be performed against the student. Three steps to provide guidance on the fourth step to conduct a review of the things that have been done. Linkage fourth step problem-solving strategy also helps students to understand a mathematical concept (conceptual knowledge). The first step in helping students understand the components contained in a concept. Two steps to assist students in formulating a concept, three steps to assist students in applying the concepts, and the fourth step to help students in criticizing a concept. In addition, the linkage fourth step problem-solving strategies shaping students' skills in conducting an algorithm (procedural knowledge). The first step assist students in determining the component skills needed to be able to do an operation. Step two to assist students in preparing everything necessary to perform an operation. Three steps to assist students in forming operations skills. While the four steps to assist students in reviewing skills on the operations that have been carried out.

CONCLUSION

Problem-solving strategies using the following steps: understanding the problem, devising a plan, carrying out the plan, and looking back can foster students' understanding of mathematical knowledge, both conceptual and procedural knowledge.

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