Mathematics Education
and Graph Theory

PROCEEDINGS OF INTERNATIONAL SEMINAR
ON MATHEMATICS EDUCATION AND GRAPH THEORY

Unit of Publication
Department of Mathematics Education
Faculty of Teacher Training and Education
Islamic University of Malang (UNISMA)
2014
MATHEMATICS EDUCATION AND GRAPH THEORY
Proceedings of International Seminar on Mathematics Education and Graph Theory
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Islamic University of Malang, 2014

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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First published, 2014
ISBN 978-602-71141-0-4

Published by

Unit of Publication
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Faculty of Teacher Training and Education
Islamic University of Malang (UNISMA)
Malang, East Java, Indonesia
Phone +62341- 551932, 551822.
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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 Aavyanti 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
CHARACTERISTICS OF THINKING PROCESSES OF ELEMENTARY SCHOOL STUDENTS WITH MODERATE ABILITY IN MATHEMATICS PROBLEMS SOLVING

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Abstract
This paper is aimed at analyzing characteristics of thinking processes of the elementary schools male student with moderate ability in mathematics problems solving in reading comprehension perspective. One fifth year elementary school male student with moderate-mathematics ability was chosen as the subject. Data were collected through in-depth interviews and task analysis based on the task of mathematical solution. Data credibility were made by continuous and consistent observations and perseverance improvement, time triangulation and member check. Data were analyzed using a flow model covering data reduction, data presentation and conclusion drawing. Theresults showed that the characteristics of thinking processes of male student in understanding problems is grouped into situation and established models, but solving the problems is grouped into consolidation or emerging models.

Keywords: Thinking Process, Moderate Ability, Mathematics Problems Solving

INTRODUCTION
Problem solving as a process with many steps in which problem solving has to find the relation of past time (scheme) with the problem that is facing and then acts to find the solution (Meyer, 1992). There are three characteristics of problem solving: 1) Problem solving as cognitive activity but it is concluded based on the behaviour, 2) Problem solving the result as te result of the solution and 3) Problem solving as the process that involves manipulation or operation of knowledge have before. The characteristics of problem solving involves cognitive, behaviour, and attitude. This is suitable with the characteristics of mathematics problem solving.

The importance of problem solving of mathematics problems and related to the thinking process argued by NCTM (National Council of Teachers of Mathematics) in Principles and Standards for School Mathematics (NCTM, 2000): "Solving problems is not only a goal of learning mathematics but also a major of doing so...". By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity and confidence in unfamiliar situations..." Stacey (2008) says that there are three important thing in thinking mathematically, they are,(1) thinking mathematically is the main purpose of the school (2) thinking mathematically is the way learning, and (3) thinking mathematically is very important for teaching mathematics. It means that thinking mathematics is not only important in mathematics but also for the students both when they learning in school and when they graduated from certain level/grade. Based on this fact, thinking mathematically need to be trained and becomes the teacher's attention. One of the ways to develop the thinking process in learning is matematic problem solving (Depdiknas, 2006; Pimta dkk, 2009).

Many researchers who have searched the characteristics of students, thinking process are Baiduri and Taufik (2014). They analyzed the characteristics of elementary students' thinking process with high ability in understanding mathematics problem. Another researcher, Pape (2004). He analyzed high School students’ problem solving by using consistent and nonconsistent languages. Österholm (2006a)
searched theoretically the relation between understanding text with problem solving. And also Österholm (2006b) analyzed understanding mathematical text that related to material ‘grup’ in university level.

The reason why the students with moderate mathematics ability are chosen because generally they are mostly found in school (following normal distribution). So it refers to analyze all of the elementary students.

LITERATURE REVIEW

Mathematics Problems Solving

Problem solving is the ability to formulate new answers (Arnold et al., 2005). Bransford and Stein (in Arnold et al., 2005) use acronym IDEAL to describe problem solving. I—Identify the problem, D—Define and represent the problem visually, E—Explore possible strategies to solve the problem, A—Act on the chosen strategy and L—Look back and evaluate the outcomes. This model is the same as common problem solving used in academical program and industrial training.

Krech and Novelli (2006) say that there are five fantastic steps in helping students in solving mathematics problem systematically, those are: 1) What do I know?, 2) What do I want to know?, 3) Can I eliminate it?, 4) Do I have choose the strategy or act and solve the problem? and 5) Is may answer meaningful?. The first step, ‘What I know’ related the fact or the data given in a problem. The second step, ‘What I want to know’ related to thing that is asked in a problem or thing that they have to finish. The third step, related to using and choosing information in problem to finish the problem. The fourth step, choosing the suitable operation to do solving problem, and fifth step related to checking the answer, whether the answer is rational, and answering the problem.

Based on Polya (1973) and Posamentier, Jaye and Krulik (2007) in mathematics problem solving, there 4 steps, those are 1) understand the problem/read the problem, 2) devise a plan/select a strategy, 3) carry out a plan/solve the problem and 4) look back.

If the steps of Krech dan Novelli (2006) are referred to Polya (1973), the first and the second steps are referred the first step of Polya. The third step and the fourth step portion (choose strategy) is identical to thesecond step of Polya. The fourth step (action andsolving problems) is identical to the third step and the fifth step is identical to the fourth step of Polya.

In this paper, the researcher will analyze the characteristics of students’ thinking process of the students of elementary school with the moderate mathematics ability in understanding and solving problem (step I and III) of Polya.

Understanding and Problem Solving

When understanding, the main factor is reading problem. In this context, it is not only reading, but also understanding the material that are given and understanding what is going on. Reading is the active process where the reader interact with the text to construct the meaning. Understanding is activating or building scheme as the explanation of the coherence between the thing and event that is mentioned in the text (Anderson, 1984). It means that when one is reading the text, mental representation in the text is build or reconstructed by the reader that is described how the reader understand the text. Some research about the understanding the text show or support the conclusion that there is improvement of mental representation when the reading process is going on (Österholm, 2006a; Van Dijk and Kintsch, 1983). The level of those mental representation are: surface component, textbase, and situational model. Understanding the problem/reading the problem is the activity of identifying what is asked to be solved and the facts that are given. Questions that can be used by students to understand the problems are: What thing that is not known/asked? Which one that is called data? What is the condition and its prerequisite? How to know that is asked? How to know what is known (data)? How to know its prerequisite?

However, in the step of problem solving, students use arthmetic, algebra, and geometry and apply certain strategy in
solving the problems. In this step, students find the correct answer. Questions that can be used to solve: Have you planned your solving? Can you use the method? Are you sure that this step is right? Do you use all of the data? Do you use all of the condition? Have you used all of the basic idea that involved in this problem?

METHOD

Kind and Approach
The aims of this research is to analyze the characteristics of elementary students’ thinking process in understanding and solving mathematics problems. Kind of research that was used in this research was descriptive explorative with qualitative approach.

Research Subjects
The subjects of this research was one male fifth grade student of elementary school with moderate mathematics ability, 55 ≤ score test < 80.

Instruments
Instruments used in this research include key instrument that is the researcher himself and support instruments those are test of mathematics ability, mathematics problem solving task, and interview guide. Test of mathematics ability used to group mathematics (low, moderate, and high). Meanwhile, mathematics problem solving task, and interview guide used to explore subject’s thinking process.

Test of mathematics ability and mathematics problem solving task was validated by the professionally certified teacher of, the expert of evaluation and mathematics education that related to the content and language used. Special formatematics problem solving task, the informal readability test was applied to two fifth grade students. The result of readability test, students are able to mention what is known and what is asked in the problem, that those the crucial things in understanding (Polya, 1973). In this research were developed two equivalent task mathematics problems solving, namely are TPM I and TPM II.

Data and Analysis
Based on TPM I dan II that have been done by subjects, the data that from interview and the students’ working in understanding and problem solving were got. The technique of collecting the data, both task problem I and II started with asking the student to read problem solving task followed by in-depth interview, write what the problem is understood and followed in-depth interviews again based on the writings. Next, the subject solve the problem and after completion, then the subject was interviewed based on the answer sheet. The data were recorded by using video recorder. To get credible data, the researcher did the consistently examine and continuously (to improve diligence), time triangulation and member check (Moleong, 2011; Sugiyono, 2011).

Based on the credible data, the analysis was carried out by using flow model that covers three activities: data reduction, data presentation, and drawing conclusion (Miles & Huberman, 1992).

DISCUSSION

The Characteristic of Thinking Process in Understanding Problem
Based on the result of in-depth interview and the result of subject’ writing, the thinking process in understanding the problem building relationship inter and intra of four basic elements of problem, those what is known, what is asked, meaningful word and important phrase and using symbol.

About what is known, the data got from the information from the problem that is related with the numbers. What is asked got from the information in the problem that has not related to the numbers and question words. There is relationship that is known with that is asked, those is if there is nothing known, no answer that is asked.

Meanwhile, the use of the symbol and the meaning of word and phrase related with understanding on the word and phrase or phrase related to the understanding words or phrase that is found in problem and the knowledge owned by the subject.
before. It means that subject has integrated information in the problem (reading text) and knowledge that owned before (use of symbol) in understanding problem.

Word or phrase “not more than” the subject understand that the not more, less than symbolized with minus, “–”. Although the use of symbol “–” not correct (the correct one is ≤). Phrase “that is possible” understood with “that is only speculative”, “not defined answer”. Symbol “×” as the translation from times.

Based on this fact, in understanding the problem, subject has integrated information available in the problem (reading text) and knowledge that is owned before (the use of symbol). This characteristics of understanding in the perspective of understading reading (text) included the third level /the highest, that is situation model (Österholm, 2006a; Van Dijk and Kintsch, 1983).

The subject has done any relation in understanding, if it is similarized with Stephens and Wang (2008), so the characteristics of thinking process included the established type, they are it can spesify relation on what is knwn, what is asked, give the meaning on word and important phrase and the use of symbol as the important element in understanding problem (Polya, 1973).

The Characteristics of Thinking Process in Problem Solving

Based on the student’s work at the picture, the first question was answered by following the counting operation procedures; a) adding, b) division and c) subtraction. Meanwhile, to answer the second is by subtration operation. The subject’s thinking process in answering the the first and the second question, he used meta-startegy procedure (Hejnyá dkk., 2006).

Besides, based on the answer sheet of task problem solving, the subject has used some symbol operation; “+” for adding, “:” for division and “−” for subtraction, relation symbol; “=” for equal to. To use the operation symbol and relation correctly, it needs understanding on the problem and the knowledge before. It is said that in using symbol, subject related with the knowledge that has been owned (operation symbol and relation) and understanding on problem/test.

The Result of Interview and lohk over based on result of student’s work

<table>
<thead>
<tr>
<th>Code</th>
<th>The Result of Interview and lohk over based on result of student’s work</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>80 what does it state?</td>
</tr>
<tr>
<td>S</td>
<td>Candy with stroberry (see the problem)</td>
</tr>
<tr>
<td>P</td>
<td>Where?</td>
</tr>
<tr>
<td>S</td>
<td>In red topless.</td>
</tr>
<tr>
<td>P</td>
<td>Then 44 what does it sate?</td>
</tr>
<tr>
<td>S</td>
<td>Candy with lemon taste in red topless (see the problem)</td>
</tr>
<tr>
<td>P</td>
<td>80 + 44:2 –39, which one you do first?</td>
</tr>
<tr>
<td>S</td>
<td>80 + 44.</td>
</tr>
<tr>
<td>P</td>
<td>Then what wil you do?</td>
</tr>
<tr>
<td>S</td>
<td>Divided into two</td>
</tr>
<tr>
<td>P</td>
<td>What do you do with result of division?</td>
</tr>
<tr>
<td>S</td>
<td>Subtrected with 39</td>
</tr>
<tr>
<td>P</td>
<td>O, is it the right order. The answer?</td>
</tr>
<tr>
<td>S</td>
<td>23</td>
</tr>
<tr>
<td>P</td>
<td>Please write in answer sheet!</td>
</tr>
<tr>
<td>S</td>
<td>(Writing the result of remain milk taste)</td>
</tr>
<tr>
<td>P</td>
<td>80 + 44 in which toplless?</td>
</tr>
<tr>
<td>S</td>
<td>(silent, attention to the problem, then say): Red topless</td>
</tr>
<tr>
<td>P</td>
<td>For what 80 + 44?</td>
</tr>
<tr>
<td>S</td>
<td>Yes, to find the result of dividing</td>
</tr>
<tr>
<td>P</td>
<td>Why is it divided into two?</td>
</tr>
</tbody>
</table>
Because the number of candy in red topless twice much than in green topless (see the problem)

What for is divided into two 2?

To get the result, the result is substracted 39, the result is milk taste

Why is subtracted with 39?

(silent, see the problem, and say): because it is the result of milk taste

Isn’t it the purpose substracted by 39?

Yes (nodding head)

Then why is it substracted with 39?

I don’t know (smilling, shaking his head)

Which explanation used to answer the question I?

The number of candy in red topless is twice much than those in green topless (see the problem)

Is there the others?

Red topless containing 80 candy with strawberry taste and 44 lemon taste green topless containing, 39 candy with coofee taste and the remain is milk taste (see the problem)

Ok, if 56 in question sheet no. 2, what does it state?

(silent, see the problem, then says): Candy with pineaple taste in green topless

If 23 what does it state?

Candy with milk taste

From which part did you get?

From the answer!

If 33 what does it state?

Remain melon taste

Please write on answer sheet!

(Writing the result of remain melon taste)

Is it the only answer?

Yes (Nodding his head)

The previous 56 substracted with milk taste, why is it substracted?

Nothing. I haven’t known the answer (smilling)

O, that is. Planation that you use to answer the question II?

The numbers of candy in blue topless is not more than those in green topless (reading the problem)

Other else?

Blue topless contain 56 pineaple taste and the remain is melon taste (reading problem)

What else?

Done (nodding his head).

Note: P = researcher, S = subject

Based on the result of interview, in writing 80 + 44 : 2 – 39, it needs attention. Because it will give different result from the answer given. Based on the interview with the subject, the correct writing is (80 + 44): 2 – 39.

When answering the question number 1, subject is able to explain the purpose of doing counting operation, but he get the difficulties in explaining why counting operation is carried out. It is analogized with Stephens and Wang (2008), so the characteristics of subject’s thinking belongs to consolidation type, that is to know what is carried out, but he doesn’t know why is it carried out. Meanwhile, in answering question 2, subject mentioned information that is used, but he doesn’t know the purpose and reason why he carried out counting operation because he doesn’t know the how to solve. If it is analogized with Stephens and Wang (2008), so the characteristics of subject’s thinking process belong to emerging type, that is not knowing what is done and why doesn’t know the information that s used, but he hasn’t related it to solve the problem.

CONCLUSION

The characteristics of male student of elementary thinking process with moderate mathematics ability in understanding problem builds relation inner or intra among four elements of problem, those are what is known, what is asked, meaningful words and phrase and the use of symbol. The four elements are the
important elements in understanding the problem. The Characteristics of this thinking process is categorized into established type. Based on this fact also, in understanding problem, subject has integrated it this information to problem (reading text) and knowledge that he has owned before. The characteristics of such kind of understanding, in perspective of understanding reading (text) is categorized into the third level/the highest, that is situation model.

Meanwhile, in solving problem, the characteristics of subject’s thinking process belongs to consolidation type, that it knowing what is done, but doesn’t know why it is carried out or it was called emerging type, that it doesn’t know what is carried out and why it is carried out, but it hasn’t been related to problem solving.

Based on the characteristics of subject’s thinking process in understanding and solving the problem, so there is contradiction relation for elementary male student. He is able to understand the problem well, but in solving the problem he still finds some difficulties, that is not totally understand the purpose and the reason why it is carried out. One reason is because he has not fully able to use mathematical symbols correctly when understanding the problem.

This paper is limited on elementary students with moderate mathematics ability and mathematics problem that is related with arthmatics in elementary school. That is why it is necessary to be examined also the characteristics of elementary students’ thinking process of students with high and low mathematics ability of the junior high scholl and senior high school or in a university with different mathematics problem.

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Krech, B. Novelli, J. 2006. 50 fill-in math word problems grades 4-6, Scholastic Inc.U.S.A.


CERTIFICATE OF APPRECIATION

Awarded to

BAIDURI

as

PRESENTER

In International Seminar on Mathematics Education and Graph Theory
Conducted on June 9, 2014 at Islamic University of Malang

Malang, June 9, 2014

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