

Adaptive Reasoning Junior High School Students In Mathematics Problem Solving

Teguh Wibowo

Mathematics Education

Muhammadiyah University of Purworejo

Purworejo, Central Java, Indonesian

e-mail: teguhwibowoup@yahoo.com

Abstract- The purpose of this research was to determine adaptive reasoning on junior high school students grade VIII in mathematics problem solving. The method used is a qualitative method of data analysis techniques triangulation. The results showed adaptive reasoning students in mathematics problem solving are as follows: (a) formulate what is known of the mathematical problem given, (b) formulate the unknown, (c) formulate the terms in question, (d) identify strategies to solve mathematical problems, (e) be able to write formulas to help solve mathematical problems given, (f) found the final result of a mathematical problem, (g) write the conclusion of a mathematical problem, (h) write the reasons of the strategy being obtained, (i) write the reasons for their conclusion, (j) examine the solution back.

Keywords: *adaptive reasoning, mathematics problem solving*

I. INTRODUCTION

During this time the mathematics is still considered difficult to be understood by students. Although education is now growing quite rapidly compared with education antiquity, it is supported by the development of teaching aids and learning mathematics media that can facilitate students in understanding mathematics. In face of science and technology development so fast this time, the necessary human resources that are reliable and capable competent globally [1]. With competition so tight that each person required to develop the mindset associated with reason.

National Council of Teachers of Mathematics (NCTM) states that the purpose of learning mathematics is to develop mathematical communication skills, mathematical reasoning, mathematical problem solving, mathematical connections and mathematical representations [2]. Basically, every student is required to hold the mathematical purposes, but in reality, not all students are able to hold all existing mathematical purposes. This relates to the smoothness during the learning process takes place. But of all the goals that a student needs to hold one is about the mathematical skills of mathematical reasoning abilities.

Reasoning is a major component in mathematics. Ross in [3] saying that, that should be emphasized as a foundation in mathematics is reasoning, if reasoning ability is not developed in the students, then the mathematics will only be a problem for students while following a set procedure of learning and imitating the example without thinking about why math makes sense.

Reasoning is divided into several types, including adaptive reasoning, quantitative reasoning, intuitive reasoning, and there is still another reason. Students are said to be capable of adaptive reasoning when students are able to think logically about the existing problems, estimating the problem until students can conclude. Besides the adaptive reasoning there is a process in which a student is required to be able to give a reason for what the students have been working on. Adaptive reasoning also interacts with the process of understanding the other, especially in the problem solving process. Problem solving skills can be hold students well if students also hold the mathematics skills, one of which is the ability to adaptively reason.

Based on observations the author on one of the junior high scholl in Purworejo district, found that when students solve a problem, there are some students who can predict these problems until it can conclude and give the reasons of what the students do. But there are also students who can only infer a problem or otherwise, the student can only estimate it. This process is already leading to adaptive reasoning, but does not necessarily indicate that the student has developed adaptive reasoning to solve a mathematical problem. It can be concluded that the adaptive reasoning owned by students is very varied. This can be seen when students solve a problem, many ways in which students in solving the problem.

Research related adaptive reasoning had been done by [4], the results showed that male subjects tend to be less careful and thorough in solving mathematics story, it supports the skills to suggest that female are superior to male in accuracy, thoroughness, and exactitude of thinking. Based on the above, authors are encouraged to conduct research related to adaptive reasoning students in solving mathematical problems. The purpose of this study was to determine the adaptive reasoning junior high school students grade VIII in mathematical problem solving.

II. ADAPTIVE REASONING

Mathematics has a great relationship closely related to reasoning. Ministry of Education in [5] states that matter of mathematics and mathematical reasoning are the two things that can not be separated, ie, matter understood through reasoning and mathematical reasoning to understand and learn the material drilled through mathematics. Reasoning can also build mathematical understanding about what he saw, they think and they conclude in mathematical problem solving.

Mathematical reasoning according to Ball & Bass [3] are the basic skills of mathematics and is required for some purpose, to understand mathematical concepts, use of mathematical ideas and procedures flexible. Students who use reason ability in learning mathematics will find the learning of mathematics more meaningful, because the mathematical reasoning would establish a new relationship with the relationship that has been previously owned.

In mathematics there are two kinds of reasoning, inductive reasoning and deductive reasoning. John Stuart Mill stated that the induction of an activity in which we conclude that what we know to be true for special cases will also be true for a similar case for certain things [5]. While deductive reasoning is a way of drawing conclusions from statements or facts that are considered correct use logic. This reasoning tend to use theories or formulas that have been proven to be true deductively.

Adaptive reasoning included deductive reasoning conclusion withdrawal ways is based of facts which are true logician, and also includes inductive reasoning based on observation generalization of some cases. Adaptive reasoning refers to the ability to think logically about the relationship between the concept and the situation [6]. Meanwhile, according to [7], adaptive reasoning is the ability to think logically about the relationship between the concept and situation, ability for reflective thinking, the ability to explain, and the ability to provide justification. So it can be said that the adaptive reasoning is the ability to think logically about the relationship between concepts and procedures makes sense generalized manner, so as to demonstrate the possibilities in problem solving, as well as allow the differences of opinion must be resolved in a way that is reasonable.

Students are said to be capable of adaptive reasoning when students are able to think logically about the existing problems, estimating the problem until students can conclude. In the adaptive reasoning be a process in which a student is required to be able to give a reason for what the student has done. Adaptive reasoning also interacts with the process of understanding the other, especially in the problem solving process. Problem solving is a mental process and requires a high level of more complex thought processes including reasoning [8].

Some experts have proposed indicators to determine the adaptive reasoning students in solving mathematical problems. In this research the authors formulate indicators adaptive reasoning such that when the student is able to: 1) write an allegation of mathematical problems, 2) draw a conclusion of mathematical problems, 3) give the reasons for the outcome of mathematical problems, 4) to re-examine the results of the settlement, 5) finding algorithm on a mathematical problem.

III. RESEARCH METHODS

The research is a qualitative research with descriptive design. Descriptive is a collection of data in the form of words, pictures and does not contain the figures in it [9]. The study was conducted in September-November 2015 on the junior high school 4 Purworejo. Subjects were 3 students of grade VIII F ie students who can solve problems and have adaptive reasoning. Subject retrieval is done by purposive sampling and snowball sampling [10].

The instrument used consisted of the main instruments and supporting instruments. The main instrument is the researchers themselves, while supporting instruments is a matter of the test, the observation sheet and interview guidelines. Data collection is done by test, observation, interview techniques and field notes. Data analysis technique used is based on the model of Miles and Huberman [10]: (1) data reduction is choosing the data needed by researchers, the data reduction requires triangulation techniques, (2) data display, (3) conclusion.

IV. RESULTS AND DISCUSSION

In this research the researchers choose three subjects based on test results at an early stage. In this research, there are four forms of data at the time of the research activities taking place, that the results of the students' answers, the result of observation, interviews and the results of field notes. Four of these data will become a measurement to deduce how the adaptive reasoning in solving mathematical problems in grade VIII junior level.

Giving matter on the subject is done after school hours starting from 12:30 o'clock. The material was tested in the form amounted to 2 questions about the story with the material Quadrilateral. When students have completed work on the next step is an interview based on the results of the students' answers. By the time the students do the problems, researchers conducted observations and write field notes for further data. Under this problem sheet that I use in this study.

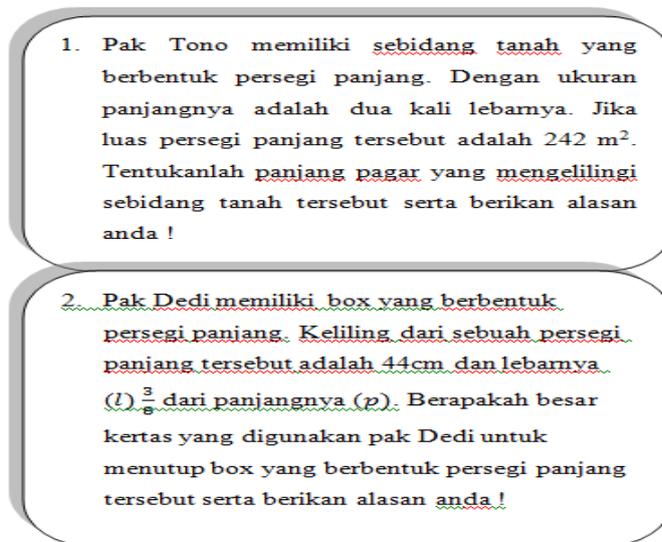


Figure 1. Research Problem Sheet

The first phase is done by the students is to formulate what is known of the mathematical problem. This is shown by the results of the answers to the student in point 1 be presented in the figure below.

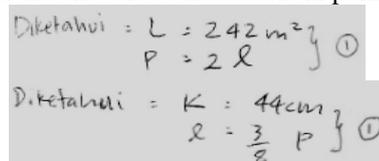


Figure 2. Writing Things to Know

The second phase is done by these students is to formulate the unknown of mathematical problems. This can be demonstrated by the results of the students' answers based on the question contained in point 2 of which will be presented in the figure below.

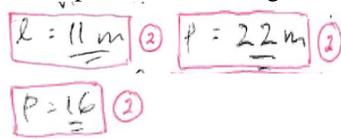
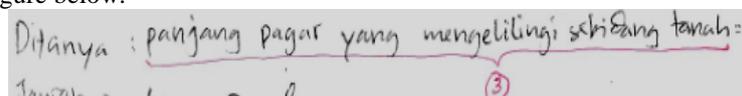


Figure 3. Formulate Things Not to Know

The third stage is done by these students are able to formulate the terms of those asked in a given mathematical problem. It can be shown in the results of the students' answers on point 3 which will be presented in the figure below.



Ditanya : besar kertas yg digunakan untuk menutup box
 berbentuk persegi panjang : ... ?
 jawab = $K = 2(p+l)$

Figure 4. Formulate Asked Things

The fourth stage is done by these students are able to find strategies to solve mathematical problems given. It can be shown in the results of the students' answers are contained in point 4, which will be presented in the figure below.

Jawab = $L = p \times l$
 $242m^2 = (2 \cdot l) \times l$
 $242m^2 = 2 \cdot l \cdot l$
 $242m^2 = 2 \cdot l^2$
 $l^2 = \frac{242m^2}{2}$
 $l^2 = \sqrt{121} m^2$
 $l = 11m$
 $p = 2 \cdot l$
 $p = 2 \cdot 11m$
 $p = 22m$
 $K = 2(p+l)$
 $K = 2(22m + 11m)$
 $K = 2 \cdot 33m$
 $K = 66m$

Jawab = $K = 2(p+l)$
 $44cm = 2(p + \frac{3}{2}p)$
 $44cm = 2(\frac{5}{2}p)$
 $44cm = \frac{5}{1}p$
 $44cm = \frac{11}{1}p$
 $p = 44 : \frac{11}{1}$
 $p = 44 \times \frac{1}{11}$
 $p = 4$
 $l = \frac{3}{2}p$
 $l = \frac{3}{2} \times 4$
 $l = 6$
 $L = p \times l$
 $L = 4 \times 6$
 $L = 24 cm^2$

Figure 5. Finds Possible Settlement Strategy

The fifth stage is done by these students are able to write the formula to help solve mathematical problems given. This can be demonstrated by the results of the students' answers on point 5 which will be presented in the figure below.

$L = p \times l$ (5) $K = 2(p+l)$ (5)
 $K = 2(p+l)$ (5) $L = p \times l$ (5)

Figure 6. Writing Formulas

The sixth stage is done by these students are able to get the final result of a mathematical problem. It can be shown in the results of the students' answers on point 7 which will be presented in the figure below.

$K = 2(p+l)$
 $K = 2(22m + 11m)$
 $K = 2 \cdot 33m$
 $K = 66m$

$L = p \times l$
 $L = 4 \times 6$
 $L = 24 cm^2$

Figure 7. Subject Acquiring Solutions

Seventh stage is done by these students are able to write the conclusion of a given mathematical problem. It can be shown in the results of the students' answers in point 8 which will be presented in the figure below.

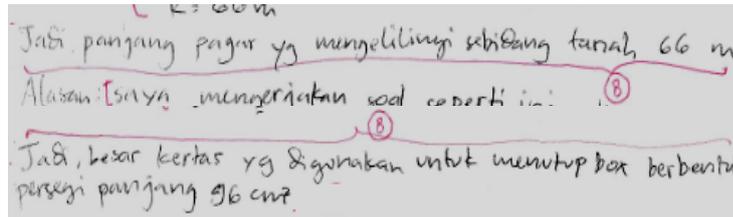


Figure 8. Writing Conclusion

Eighth stage is done by these students are able to write down the reasons of the strategy to get students of mathematics problems. It can be shown in the results of the students' answers on point 9 which will be presented in the figure below.

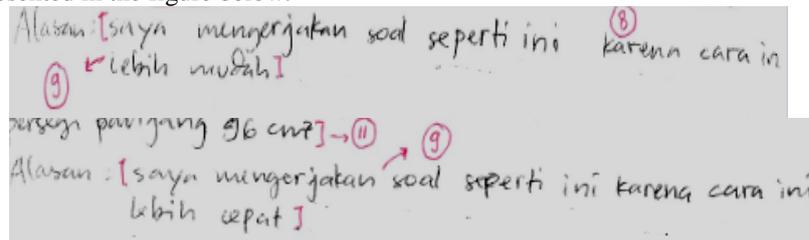


Figure 9. Writing Reasons On Strategies Used

Ninth stage is done by these students are able to write down the reasons about conclusions that students get from mathematical problems. It can be shown in the results of the students' answers on point 10 which will be presented in the figure below.

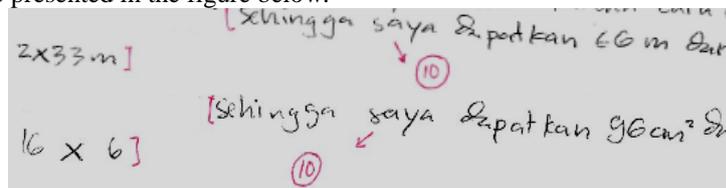


Figure 10. Reasons Writing On Conclusion

Tenth stage is done by these students are able to check the answer back so that no one counted on the job. This is indicated by the results of the interview are presented in the figure below.

Peneliti : Berarti kalau misalnya lebih cepat itu apa jawaban kamu sudah benar?
 Subjek : Eee.. sudah mbak
 Peneliti : Kok kamu sudah yakin itu dari mana?
 Subjek : Soalnya tadi sudah diteliti
 Peneliti : Apanya yang diteliti?
 Subjek : Eee.. jawabannya
 Peneliti : Jawaban? Terus gimana jawaban kamu? Sudah benar?
 Subjek : Benar
 Peneliti : Yakin?
 Subjek : Yakin
 Peneliti : Oke, kalau seperti itu berarti kamu sudah yakin sama jawaban kamu ya?
 Subjek : Ya yakin
 Peneliti : Kenapa kok yakin?
 Subjek : Soalnya sudah diteliti
 Peneliti : Apanya yang diteliti?
 Subjek : Jawabannya
 Peneliti : Terus jawabannya gimana? Gimana dek?
 Subjek : Benar
 Peneliti : Benar dari? Sudah yakin benar?
 Subjek : Sudah

Figure 11. Subject Check Solution Back

The interview above indicates that the subject has been check solution back. Subject believe the answer is correct.

From the above it can be concluded that the reasoning adaptive performed students in solving mathematical problems are (a) to formulate what is known of the mathematical problem given, (b) determining the unknown, (c) formulate the terms in question, (d) find strategies for solving mathematical problems, (e) be able to write formulas to help solve mathematical problems given, (f) found the final result of a mathematical problem, (g) write the conclusion of a mathematical problem, (h) to write the reasons of the strategy being obtained, (i) describes the reasons for their conclusion, (j) checking back solution. Based on the conclusions from these results, it can be done further research associated with adaptive reasoning process of the students in solving mathematical problems.

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REFERENCES

- [1] R. Karyadinata, "*Growing Power of Reason Students Learning Through the Mathematics Analogy*", Bandung: Scientific Journal of Mathematical Studies Program STKIP Siliwangi Bandung Vol.1, No.1, February 2012.
- [2] A. Sroyer, "*Quantitative Reasoning in Mathematical Problem Solving*", Yogyakarta: Proceedings of the National Seminar of Mathematics and Mathematics Education UNY, November 9, 2013.
- [3] E. Susanti, "*Improving Mathematical Reasoning Students Through Connections*", Yogyakarta: Proceedings of the National Seminar of Mathematics and Mathematics Education UNY, November 10, 2012.
- [4] H.P. Arkham, "*Adaptive Reasoning Students in Math Story Problem Solving Build Space Materials in SMP Negeri 4 Surabaya Based Gender Differences*", 2014. Downloaded on <http://digilib.uinsby.ac.id/1628/> Accessed on April 16 2016, 8:48
- [5] F. Shadiq, *Problem Solving, Reasoning, and Communication*, Yogyakarta: High School Mathematics Study Training Association, 2004.
- [6] J. Killpatrick, *Adding It Up: Helping Children Learn Mathematic.*, Washington, DC: National Academy Press, 2001.
- [7] D.B. Widjajanti, "*Developing Mathematical Skills Prospective Students Master Mathematics Through Problem-Based Collaborative Strategies Class*", Yogyakarta: Proceedings of the National Seminar on Research, Education and Application of Mathematics, Faculty of Science, University of Yogyakarta, May 14, 2011.
- [8] D. Haryani, "*Critical Thinking Process Profile High School Students with Cognitive Style Manifold Field Independent and Gender Women in Mathematics Problem Solving*", Yogyakarta: Proceedings of the National Seminar of Mathematics and Mathematics Education UNY, November 10, 2012.
- [9] L.J. Moleong, *Qualitative Research Methodology*, Bandung: Rosdakarya, 2012.
- [10] Sugiyono, *Understanding Qualitative Research*, Bandung: Alfabeta, 2014.