ANALYSIS OF STUDENTS' MATHEMATICS REASONING WHEN SOLVING STORY TASKS

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ABSTRACT

This study is conducted to analyze in depth the reasoning of students' mathematics in solving story tasks. The approach is qualitative with case study-type. The subjects are 6 students of senior high school grade XI; 2 students of high classification, 2 students of medium classification and 2 students of low classification. Data collection methods are in the form of story and interview questions. The results show: 1) Students belonging to a high classification if they can meet the six reasoning indicators; present mathematical statements of both what was known and asked either in the first or second question; propose a guess by estimating the answers and the process of given solution; do mathematical manipulation; make a conclusion; provide a logical reason when not meeting several indicators; and always check every settlement step; 2) Students belonging to the middle classification also meet the six indicators, just do not meet some indicators such as incomplete writing down what is known and not writing down what is asked primarily in the first question, having error in solving the problem for lack of understanding of the problem and not making conclusions, but can provide a logical reason when interviewed; 3) Students belonging to the lower classification do not meet some indicators, which are incomplete presenting what is known and do not present what is asked either in the first and second questions; may propose by estimating the answers and the process of the given solution but the solution process and its completion step wrong; can perform mathematical manipulations but there are errors in the process of completion, can not provide logical reasons when interviewed.

Keywords: Mathematics Reasoning, Students, Resolving tasks, Story Tasks, Mathematics

INTRODUCTION

Nowadays, the development of science and technology rapidly runs, especially in the field of telecommunications and information. As the result, the number of competition among humans to have more superior within the ever-changing circumstances. to overcome, it is required the ability to obtain, select and manage information. In addition, the ability to think critically, systematically, reasonably, logically, creatively, and can cooperate effectively (Huda & Angel, 2013, Moharom, 2014; Purnamasari, 2014)

The purpose of learning mathematics at school as referred to in regulation of national ministry of education (Permendiknas) No. 22 of 2006 on the second point, using reasoning on patterns and traits, performing mathematical manipulations in generalizing, compiling evidence, or explaining mathematical ideas and statements. Then in accordance with its development, the purpose of learning mathematics in regulation of ministry of education and culture (Permendikbud) No. 59 of 2013 is as stated in the Core Competency on the fourth point of processing, reasoning, presenting and creating in the realm of concrete and abstract

255

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realms related to the development of the self-study in schools independently, acting effectively and creatively, and able to use methods according to the rules scholarship.

The enclosing of the reasoning aspect within Permendiknas year 2006 and Permendikbud Year 2013 is very important because reasoning is an abstract thinking activity. In accordance with the statement, mathematical reasoning is essential due to improving students' mathematical thinking skills (Minarni, 2010; Marlina, 2013; Supriyanto, et al., 2014; Sumartini, 2015).

The reasoning is also known as an intellectual activity which is a way of using reason, logical thinking or mental processes in developing the mind for some facts (national education board, 2008). The reasoning is also a process of thinking in drawing conclusions in the form of new knowledge or making a new statement based on a statement that the truth has been proved or assumed before (Sadiq, 2009; Sumartini, 2015). Utilizing of reasoning is often found in the process of mathematics learning, due to a reciprocal relationship between reasoning and mathematics, meaning learns mathematics using reason and practicing reason using math.

People who develop mathematical reason tend to notice patterns, structures or regularities in both real and symbolic situations (Minarni, 2010). This is supported by Riyanto & Rusdy (2011), Hidayati & Suryo (2015), they argue that mathematical reasoning is the foundation for building mathematical knowledge. Furthermore, Sugianto, et al. (2014) states that students' mathematical reasoning and communication is a very important factor for students' cognitive development and affect student learning outcomes. In addition, Supriyanto, et al. (2014) states that the students 'unique mathematical thinking ability in solving mathematical problems is related to students' reasoning abilities.

Depdiknas No. 506/C/Kep/PP/2004 has described that the indicators of students who have the ability in mathematical reasoning are 1) present mathematical statement orally, written, drawing and diagrams; 2) filed a presumption; 3) perform mathematical manipulation; 4) compile the evidence, give a reason or evidence toward the right solution; 5) draw conclusions from statements; 6) check the validity of an argument; and 7) find patterns or properties of mathematical phenomena to make generalizations. The seven indicators above are used in this study, this is because it is relevant to the problem formulation and proves and completes the research conducted by Utami et al. (2014).

However, problems in the field show that the reasoning is still low could be seen through given the problem (Riyanto & Rusdy, 2011; Sukamto, 2013; Sulistiawati, 2014; Ahmad, 2015). This is in accordance with the findings of Hutabarat (2008), namely the ability of mathematical reasoning in learning less developed mathematics and student independence in finding science is still low. In addition, Nataliasari (2014) argues one tendency that causes some students fail to know well the subject in mathematics, that is because students do not use logical reasoning in solving mathematical tasks given.

Furthermore, Based on the interview with the Senior High School mathematics (SMA) teacher, during this time when the teacher gives mathematics tasks, the students tend to follow the teacher steps and lack the confidence to express their own answer. Sometimes there are also students who wait for the work of his friend. In addition, when given the tasks that require reasoning, especially in the form of the story, students have difficulty in answering it. This results in students' mathematical reasoning not well developed and students become passive.

Therefore, it is a need for a deep assessment of how students reason during the process of mathematics learning. One way to find out how students reasoning can be seen in solving

mathematics tasks, especially for tasks relating to daily life, which is usually in the form of a matter of the story.

Story tasks is a modification of the quantification tasks in which have relevancy with the reality that exists among student environment (Wibowo, Djaelani & Sularmi, 2013, Marhayati, 2012; Lathifah, Zulkardi & Somakim, 2015; Nurussafa'at, Imam & Riyadi, 2016). Through the story, the students will get used to seeing the daily life relationship with the mathematical knowledge that has been obtained at school (Nurhayati, 2013). Mathematics Story tasks is a form of mathematical problem that contains aspects of the ability to read, reason, analyze and find solutions, for which students are required to hold the abilities in solving the math story tasks (Khasanah, 2015). The ability to solve the problem of mathematics is the intellectual ability to solve problems in which mathematical concepts are related to everyday life, and can be solved through non-routine procedures, that is understanding the problem, making plans, implementing plans and re-examining the answers (Sari, Dantes & Ardana, 2014).

The story tasks are made in the form of a sentence with the theme of problems in everyday life and demanded to be solved, and in the process of working, the student firstly have to understand the contents of the story, then draw the conclusions of objects to be solved then separates it from mathematics symbols, to the final stage of completion (Nurhayati, 2013; Nusi, Sumarno & Nurwan, 2013; Rindyana & Tjang, 2013). While processing this work, the students are required to be able to change the mathematical sentence into a mathematical symbol, for that reason math is very important. As with the results of Huda & Angel (2013) research, the story problem is very useful for the development of students' thinking process because in solving the problem required steps of settlement that require understanding and reasoning. The reasoning relationship with the story problem can be seen in Table 1 below.

Table 1. Reasoning in Solving Story Tasks

Indicator of Reasoning	Step of Answering story tasks
1. Present mathematical statement by spoken, written, picture, and diagram;	Understanding tasks by: a. Reading tasks; b. Repeating statement using her/his own words;
2. Filed allegations:	c. Revealing every sentence means, what has been known and will be asked.
3. Conducting math manipulation:	
4. Arranging proof, providing any reason or proof of right solution;	Answering tasks by: a. Creating design or mathematical sentences;
5. Drawing a conclusion from every statement;	b. Connecting the type of required number operation; c. Completing the mathematical sentence;
6. Ensuring argument validity:	d. Checking the answer to find out the true or false results;
7. Finding design or feature from mathematics symptom to take generalization.	e. Filling the conclusion.

This is a case study focusing on students' mathematical reasoning and tasks of continuous storytelling, as this study examines students' reasoning when solving story tasks. Therefore, the formulation of the problem in this research is "How the mathematical reasoning of the senior high school students from grade XI while answering the story tasks ?" The purpose of this research is "to analyze the student's mathematics reasoning of grade XI Nasional Senior high school while answering story tasks.

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RESEARCH DESIGN

Based on both prior statements above, this study proposed to explain and describe in depth the students' mathematics reasoning when answering story tasks. On behalf of complete and detailed data, the research approach used is a qualitative approach, since this approach more emphasis on process analysis of the process of thinking is inductive in reasoning mathematics. The appropriate type of research is a case study. The Case study is an intensive and detailed study of a case, which can be a particular event, environment and situation that allows expressing something (Prastowo, 2014).

The Subjects were six students at XI grade of the Nasional Senior High School, with the classification; two students belonging to the high classification (HS), two students belonging to the medium classification (MS), and two students belonging to the lower classification (LS). This classification is based on the value that students get after the test, more clearly can be seen in Table 2 below:

Table 2. Criteria for Student Grouping

Classification	Cross-division criteria
High	$X > M + 1\ SD$
Medium	$M - 1\ SD \leq X \leq M + 1\ SD$
Low	$X < M - 1\ SD$

(Sudijono, 2012)

The collected data is in the form of test results and interview results regarding with mathematical reasoning when solving story tasks. Methods of data collection were done by providing test methods and interviews. The test is given to gather information relating to mathematical reasoning in solving essay-type stories. Then interviewed after the students completed the test, the interview used to dig the data in order to clarify the test results that can not all be explained through analysis of student answers.

Instruments in qualitative research are divided into two categories, namely the main instrument and additional instruments (Moleong, 2015). The main instrument in this study is the researchers themselves. Whereas, the additional Instrument in this research is in the form of test questions and interview guidelines. Problem test in the form of this story is adapted from the question of the National Examination of the Year 2016/2017 which is modified in essay form, adapted to the material of class XI, ie linear program material, and trigonometry. This interview guide contains questions that will be asked and adjusted to the reasoning indicator, so that in accordance with the desired data in this study. But did not rule out the question can be developed in accordance with the circumstances and reality of research subjects related to student answers and the reasons for writing answers to the questions given (Sugiyono, 2015). Two data analysis were used, namely: 1) analysis of written test result and 2) interview result in analysis through data reduction, data presentation, conclusion and verification (Moleong, 2015; Miles, 1992; Gunawan, 2013). In this research testing the validity of data is done by means of triangulation of sources, intends to compare and check back the degree of confidence of an information obtained through test results and interview results are going well.

RESULTS

This research analyzes students' reasoning when solving a story tasks. The analysis is performed after conducting tests, from the results of the tests students will be classified into three classifications based on the mean and standard deviation, ie students who include high

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classification (HS), medium classification (MS) and low classification (LS). Each classification is taken two people to be subject, which then held an in-depth interview. This mathematical reasoning indicator consists of seven indicators and each indicator is analyzed and described in depth. The results, described as follows:

1. Presenting Mathematical Statements Orally, Written, Picture and Diagram

The reasoning of HS, MS and LS on this indicator are visible when they can identify what is known and asked verbally and can give an explanation that what is known and asked comes from the statement in the matter because he thinks it has been clearly written on the matter. While in writing only HS1 and MS1 complete in presenting what is known and asked. HS2, MS2 and LS are incomplete in presenting, ie not presenting what is being asked (HS2), not presenting what is known and asked (MS2 and LS1), and incomplete when presenting what is known (LS2).

2. Presenting Allegations

The Reasoning within these indicators is visible when they can predict the answers and the process of the solution through the settlement steps and able to provide a logical explanation that approximate and process of the solution are obtained when looking at what is known and asked. HS and MS can estimate the answer and the solution process by making the completion step, only the estimation and process of MS2 solution is slightly different from HS and MS1, this is because MS2 made a mistake in understanding the tasks and also does not present what is known and asked. While the approximation and process of LS solution is different from that given by HS and MS, because it does not present what is known and asked and does not understand the relation of data given.

3. Conducting Mathematical Manipulation

The reasoning within these indicators is visible when they can perform mathematical manipulations, include; providing the design of mathematical problems, providing tables of known data, visualizing data from a mathematical statement and solving mathematical problems. In general HS, MS and LS1 in the first question can manipulate, only LS1 in making graphs and inequalities is less precise. LS2 can not take mathematical manipulation, because of lack of fulfillment of previous indicators. In the second question, HS and MS can manipulate, it's just that MS2 is not exactly in the settlement. While LS does not manipulate because the image is made less precise and less fulfilled previous indicators.

4. Preparing Evidence, Giving Reason or Evidence to the Truth Solution

The reasoning within these indicators is visible when they can compile evidence from facts and provide precise reasoning of the answers given using facts from the mathematical model form and their relation to tasks solving. HS and MS can compile the evidence and give the right reasons to both questions, only MS2 in the second question has a mistake but can provide the exact reason for identifying the data. In the first question LS1 also gives the right reasons, but in the last step does not give the right reasons, while LS2 does not compile the evidence giving the exact reason for the answer given. In the second question, LS can compile the evidence and give the exact reason for the answer given after showing the picture he has made.

5. Drawing Conclusions from the Statement

The reasoning within these indicators is visible when they can draw a logical conclusion. In the first question, HS and MS can draw a logical conclusion from the statement. LS2 can also draw conclusions from statements, but the answer is less precise, whereas LS1 does not make any conclusions. In the second question, HS2 can draw conclusions appropriately. HS1 and

MS1 do not draw conclusions but the answer is correct. MS2 can also draw conclusions, it's just the answer is not quite right, and LS than not make a conclusion, the answer is also less precise.

6. Checking the validity of an argument

The reasoning within these indicators is visible as they check every step of the settlement. HS and MS always check every step of the settlement either during or after work, MS2 in checking every step of the settlement only occasionally, while LS does not check every step of the settlement.

7. Finding Design or Properties of Mathematical Symptoms to Make Generalizations

These indicators include finding a design of an existing statement so as to develop it into a mathematical sentence. However, in this indicator is not found the pattern of a statement, both on the first question is about linear programming and the second question, which is trigonometric.

DISCUSSION

Based on the overall the results such explanation above, the students belonging to the high classification are students who meet the six reasoning indicators. While the students belonging medium classification are only meeting some reasoning indicators as well as reasoning indicators that are not met due to lack of complete presents what is known and asked, and the mistake in doing mathematical manipulation, ie in solving the problem, but still can provide a logical argument. Students belonging to the low classification, few meet the reasoning indicator, for lack of careful understanding and identification of the problem, lacking what is known, assuming that writing down what is known and asked is not important because it is already in the question; the error of guessing the problem and the process of the solution given, so that the wrong completion steps, do not write a logical conclusion, and do not check every step of the settlement.

It is dealing with Nurussafa'at's research, et al. (2016) which shows that the factor that causes the student to make mistakes in solving the story problem is to assume that writing down what is known and asked is not very important, does not understand the material, and is not accustomed to writing conclusions. Retna, et al., (2013) adds that in solving the problem, students do not make a plan for completion and do not correct mistakes. The error of this answer is due to wrong in determining the steps of workmanship and not checking back the answer given (Sulistiawati, 2014).

The overall result of interviews reveals that students are rarely given a variety of questions, especially relating to the story tasks. in addition, students is rare to train their own reasoning mind in solving the problem tasks. It is dealing with research conducted by Rindyana & Tjang (2013) that the cause of errors in the completion of the story is due to lack of practice to work on the problem form the story with different variations. Furthermore, Nataliasari (2014) and Sugianto, et al. (2014) argue that some students fail to understand the concept due to a lack of logical reasoning in solving the given problem.

CONCLUSIONS

Based on the analysis of test and interviews results, it can be concluded as follows:

1. Students belonging to a high classification is the students could meet the six reasoning indicators; presenting mathematical statements, what is known and asked both in the first or second question; proposing a guess by estimating the answers and the process

of a given solution; can take mathematical manipulation; make a conclusion; provide a logical reason when not meeting some indicators such as not writing down what is asked and not making conclusions; and always check every step of the settlement.

2. Students belonging to the middle classification are the students which are also meet the six indicators, just do not meet some indicators such as incomplete writing down what is known and not writing down what is asked primarily in the first question, the error in solving the problem for lack of thorough understanding of the problem and not making conclusions, but can provide a logical reason when interviewed.

3. Students belonging to the lower classification are the students do not meet some prior indicators, ie incomplete presenting what is known and do not present what is asked either in the first and second questions; can propose a guess by estimating the answers and the process of the solution given but the solution process and its completion step wrong because of misunderstanding the problem; can do mathematical manipulation but there are errors in the process of completion, and not even make conclusions, do not check every step of the settlement and can not give a logical reason when interviewed.

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