Mathematics reasoning through inquiry learning model

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Abstract. This research is a descriptive study that aims to study mathematical thinking aspects of reasoning through inquiry learning models on the slope of line. This research focus is on deductive deduction. The subject of this study were 3 students in class VIII of SMP Negeri 1 Indralaya Utara. Based on the results of tests and interviews, it can be concluded that students have mathematical thinking. Students can make conclusions based on a general picture. However, one of the indicator is using algorithms in calculations. There are some students still have difficulty in calculations because of constraints in arithmetic operations and errors in determining the coordinates which are the prerequisite material in this learning. Interesting, students unable to make correct conclusions.

1. Introduction
Mathematical learning plays a role in developing mathematical thinking processes (mathematical thinking) [1]. Mathematical thinking is a process of thinking specifically on something related to the mathematical parts of life that involve logic, analysis, reasoning, and others [2]. Based on the National Council of Teachers of Mathematics, reasoning is a standard process in learning mathematics that must be achieved [3]. According to [4], mathematical thinking aspects of reasoning include three types, namely deductive reasoning, inductive, and logical analysis.

One important material in mathematics is slope of line. In everyday life the concept of slope can be used in measuring the steepness of roads and mountain slopes, the speed of change, and others [5]. However, in applying the slope concept students still experience difficulties [6]. Based on the results of the study [7] the majority of the 17 subjects did not understand the effect of the increase and decrease of the size of the wheelchair whether it became steeper or not. [7] added that an important aspect in reasoning on slope material is identifying the slope with a ratio (comparison), because it is an appropriate measure in determining a trait, such as speed of movement and steepness. From these results, it can be concluded that there are difficulties in reasoning in solving problems related to the application of the concept of line slope.

To solve mathematical problems there needs to be reasoning ability [8]. [8] added, the reason for the low reasoning was that students had difficulty organizing mathematical ideas and concepts in solving problems. In addition, learning is still centered on the teacher. So students only pay attention to the teacher's explanation and are accustomed to solving problems based on the examples given [9]. Teacher-centered learning certainly causes students to explore their knowledge less. This also contradicts [10], that exploration is the beginning of reasoning. Reasoning can be used to solve problems through prior knowledge and concepts [11]. Thus, learning is needed where students can explore by investigating and investigating mathematical concepts in solving a problem. Through inquiry learning students can use their knowledge and experience in building and applying mathematical knowledge [12].
From the description above, this study is entitled “Mathematics reasoning through inquiry learning model”. This study aims to determine the mathematical thinking aspects of reasoning in class VIII through inquiry learning models on the slope of line.

2. Method
The method used in this research is descriptive qualitative. This research was conducted in class VIII.B of SMPN 1 Indralaya Utara with total of 32 students. This research consists of 3 stages, namely the preparation, implementation, and data analysis stages.

In the preparation stage, researchers make research instruments in the form of lesson plans, student activity sheets, teaching materials, and aspects of reasoning tests. On the student activity sheet, it consists of three problems that have been validated and are applied by the inquiry learning model. At the implementation stage, learning through the inquiry model was held 4 times. The first meeting is about the slope of the real problem, the second meeting about the slope of parallel lines and the third meeting about the slope of the perpendicular lines. Then, proceed with the implementation of a written test using the question description.

The data obtained from this research are in the form of written test and interview data. The researcher determines the appearance of reasoning indicators from students’ answers. From the written test results, it was determined 3 research subjects will be interviewed to get supporting data in the form of mathematical thinking processes of reasoning aspects.

The reasoning indicator which is the focus of this research is deductive reasoning. Deductive is the process of reasoning from general to specific [8]. Deductive reasoning is the process of making conclusions from general statements to specific statements. According to [13], the deduction process includes the process of data collection and verification. Deductive reasoning indicators used in this study, namely: (1) using general mathematical statements (definitions/formulas/rules, etc.), (2) using algorithms in calculations, (3) make conclusions.

3. Result and Discussion
The study was conducted in class VIII.B, amounting to 32 students on October 23th, 2019 to November 6th, 2019. The research was conducted in stages, namely 3 learning process meetings using the inquiry model and 1 written test meeting. According to [14], the inquiry learning model has six stages, namely:
- Orientation
  This stage is the first step in managing and conditioning the atmosphere so that students are responsive to learning.
- Formulate the problem
  At this stage, students are faced with problems that the solution will be sought. Problems in inquiry learning contain clear concepts that encourage students to find and find them.
- Formulate the Hypothesis
  After formulating the problem, students formulate hypotheses or temporary answers. To prove it, students will be motivated to think further.
- Collect data
  At this stage, students collect or solicit related data or information to test hypotheses through questions, explanations, as well as their concepts and principles.
- Testing hypothesis
  Hypothesis testing is the process of determining the level of truth and confidence of answers given based on data.
- Formulate the conclusions
  Is the final step of inquiry learning. The findings obtained by students are described based on testing the hypothesis to get a conclusion.
3.1. Subject 1 Answer Descriptions

Figure 1 is a test answer of Subject 1. It shows S1 uses a right triangle to determine the slope of each side formed. After calculating and getting the results, S1 makes conclusions, namely, the AB side is parallel to the CD. The algorithm and conclusions that S1 made were correct. Before making the final conclusions, S1 observes pairs of sides facing each other then determines the interim answers. The temporary answer of S1 is the AF side aligned with BC and the AB side parallel to the CD. After formulating a provisional answer, the researcher ensures the final answer of S1 is based on calculations. Research interviewed S1, why the AF and BC sides did not align, S1 answered that the slope of the sides was not the same. In this case, S1 can use a general mathematical statement in the form of the slope of parallel lines, to produce a new statement that the AB side is parallel to the CD. S1 can use deductive reasoning in solving problems.

3.2. Subject 2 Answer Descriptions

Figure 2 is a test answer to subject 2. S2 collects information in the form of the coordinate points that each side traverses. The coordinates obtained are used to determine the slope of each side. Before
carrying out the calculation process, S2 also determines in advance pairs of sides facing each other and determines the temporary answers. Based on the results of the interview, S2 is able to propose assumptions well. S2 assumes that AB is parallel to EF and AF is parallel to BC. Based on interviews, S2 determines sides that are parallel to determine sides that have the same slope. In solving this problem, S2 is able to use deductive reasoning. However, the conclusion S2 is wrong because there is an error in determining the coordinates of the BC and CD points. S2 also made a mistake in determining the results of the division. Thus, S2's conclusion is wrong and contradicts his assumptions.

3.3. Subject 3 Answer Descriptions

Figure 3 is the answer to the subject test 3. S3 uses a right triangle to determine the excitement of each side. S3 is able to draw conclusions based on a general mathematical statement that is, parallel sides have the same slope. From the above calculation, S3 determines that the AB side is parallel to the CD side. Conclusion S3 is correct. However, in determining the slope of the DE and EF sides, S3 is wrong in substituting the values of $\Delta y$ and $\Delta x$. Based on the interview, he was able to determine the correct value of the side slope. S3 is also not quite right in turning fractions into decimal numbers. S3 only writes 1 digit after the comma. In solving this problem, S3 is able to use deductive reasoning, but there are errors in calculations.

In the test questions given, students are asked to determine which side is parallel to a hexagon flat figure. The questions designed are in accordance with the inquiry learning stage. Basic activities in learning mathematics with inquiry according to [15], namely asking, exploring, observing, discovering, assuming, explaining, and proving. Students who already know the position of parallel lines will certainly directly determine the answer to the problem, this activity is the stage of formulating hypotheses in inquiry learning.

One of the concepts, principles, and theorems that students find is to link the solution using the slope rules of parallel lines, that is, the values of the slope are the same. Students can collect facts in two ways, namely determining the coordinates of the points traversed by the sides and determining the triangles formed from each side. According to research conducted by [5], that students prefer to use a right triangle in determining the slope. This can be seen from the three answers of the subjects, 2 of which use a right triangle in determining the slope of each side.
Based on test and interview results, students can solve a problem using deductive reasoning. According to [16], students will direct themselves in part inductively and partly deductively when investigating at least one relationship or the relationship between the independent variable and the dependent variable. Based on interviews conducted by researchers, students determine the answer while observing specific things in the form of images in the problem. This is part of inductive reasoning. However, most of the activities carried out by students are deductive reasoning. This is seen in students' test answers and indicators of the appearance of deductive reasoning. According to [17], students basically use more deductive reasoning.

From all of the answers, there were some students who made calculation errors resulting in mistakes in drawing conclusions. Based on the results of previous studies, students 'errors in solving slope problems that can inhibit students' reasoning processes are the most errors in arithmetic operations, such as addition, subtraction, multiplication and division [18]. The algorithm is considered efficient in solving a problem, but not to understand the lesson [19]. The conclusions obtained from the results of reasoning are observations of existing data and can be tested for truth. In addition to errors in arithmetic operations, students lack mastery in prerequisite material in the form of Cartesian coordinates and find it difficult to understand the meaning of negative signs on the slope. This can be seen in the calculation results of students who use a right triangle. Students do not add negative signs to the descending graph. According to [20], negative slope is clearly more difficult to understand than positive slope.

Thus, calculations are also needed in this study. In order to be able to do calculations well, students should understand the concept of comparison in advance when doing learning because the concept of slope is the ratio of changes in the upright side and the flat side changes that must be realized as a result of the calculation [5].

4. Conclusion
After doing the inquiry learning process on the material slope of the line, it can be concluded that students can do mathematical thinking aspects of deductive reasoning in solving problems. Students can draw conclusions based on general statements. But the indicators using algorithms in calculations, there are still students who have difficulty in calculation because of constraints in arithmetic operations and errors in determining the coordinates of a point which is a prerequisite material in this learning. As a result, students cannot draw correct conclusions.

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