DEVELOPING SKILLS UNDERSTANDING OF MATHEMATICAL HIGH SCHOOL STUDENT

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Abstract: This study aims to improve (develop) the ability of high school students' mathematical understanding. Therefore, in actual use two classes of experimental class given the open-ended approach to the treatment and control group of conventional learning approaches. The study population was high school students of class XI, selected purposively sampled two classes. The study design used Randomized Control group pretest-posttest design. The results obtained are: (1) an open-ended approach both to increase the activity of students in the learning process of mathematics; (2) There is an increased understanding of the mathematical ability of students significant learning classes using open-ended approach. In addition, the class that learning to use open-ended approach to obtain an average value of normalized gain of 0.51 (quality improvement being), the largest gain normalized value of 0.63 and 0.40 the smallest gain normalized value. While classroom learning using conventional learning, obtaining a mean value of normalized gain of 0.21 (lower quality improvement), the largest gain normalized value of 0.30 and a normalized value of the smallest gain 0.13; (3) The ability of mathematical understanding of students learning to use open-ended approach significantly better improvement of the ability of students' mathematical understanding using conventional learning.
Keywords: Increase understanding of mathematical, open-ended approach.

A. Introduction

Mathematical understanding is a very important part in the learning process of mathematics. Mathematical understanding is the basis for thinking in solving mathematical problems and problems in daily life. In addition, the development of mathematical understanding capabilities is one of the goals of the educational curriculum of mathematics, for mathematical understanding strongly supports the other mathematical abilities, such as mathematical communication, mathematical reasoning, mathematical connection, mathematical representation and problem solving.

Knowledge and students' understanding of mathematical concepts by NCTM (2000) can be seen from the student's ability to (1) define the concept of verbal and written; (2) identify and create examples and not an example; (3) Using the models, diagrams and symbols to present a concept; (4) Changing a form of representation to other forms; (5) recognize the various meanings and interpretations of the concept; (6) To identify the properties of a concept and know the terms that define a concept; (7) Compare and contrast the concepts.

Many experts define the levels of one's own understanding of a concept or law. Polya (1973), Qohar (2008: 117) suggests four levels of understanding a law, that understanding of mechanical, inductive understanding, understanding rational and intuitive understanding. Someone said to have a mechanical understanding of the law, if he can remember and applying the law correctly. Then someone said to have had an inductive understanding of the law, if he had tried that law applies in the case of a simple and confident that the law applies in similar cases. Someone said to have a rational understanding of the law, if he can prove it, and somebody said to have had an intuitive understanding of the law, if he had been convinced of the truth of the law without hesitation.

Skemp (1976) distinguishes two kinds of understanding, the understanding of instrumental and relational understanding. Instrumental understanding some concepts interpreted as an understanding of the concept of mutually exclusive and just memorize the formula and apply it in our calculations without knowing the reason and explanation. In contrast to the relational understanding contained a complex knowledge structure and interconnected that can be used in solving the problem is more extensive and complex. In a relational understanding, the nature of its use is more meaningful (Qohar, 2008: 20).

According to the NCTM (2000), to achieve a meaningful understanding of the learning of mathematics should be directed at developing the ability of mathematical connections between different ideas, understand how mathematical ideas are interrelated to one another thereby building a thorough understanding and use of mathematics in contexts outside of mathematics. Anderson (2001), Kusumawati (2010: 22-23) understanding consists of seven types, namely interpreting, exemplifying classifying, summarizing, inferring, Comparing and explaining. The seventh kind of understanding is explained as follows: (1). Interpreting occurs when students are able to convert information from one representation to another representation. Interpretation involve the conversion of words into words, images into words and so on. (2). Exemplifying occurs when students are able to give specific examples or examples of general concepts or principles. (3). Classifying occurs when students know that something (example or specific events) in a category (egg concept or principle). Classifying involves finding traits or patterns that are relevant, matching the specific examples and concepts or principles. Other names are categorizing and subsuming. (4). Summarizing occurs when students are able to propose a single statement that represents the presentation of information or a summary of common themes. Summarizing involves the construction a representation information, make a summary, such as determining the main themes or topics. Other names are generalizing and abstracting. (5). Inferring involves finding a pattern in a

series of examples or events. Summing occurs when students are able to summarize the concept or principle which consists of a string of examples or events through encoding the relevant characteristics, of each of the events. Other names are extrapolating, interpolating, predicting and concluding. (6). Comparing occurs when students discover the similarities and differences between two or more objects / objects, events, problems or situations. Other names are contracting, matching and mapping. (7). Explaining occurs when students are able to build and use the model of a system of cause and effect. The model can be derived from the theory of formal, or may be based on research or experience.

Based on observations in high school students 2 Kendari, indicates that the learning process is done in the classroom teachers still use conventional learning. The learning process is only centered on the teacher and the students as passive listeners. Teachers provide results-oriented exercise, and do not see how the process is done by the students. While students are not familiarized with exercises that involve high-level thinking skills, students are directed at memorizing formulas, and how to use the formula. Learning math emphasis to work on the problems, rarely directed to analyze, develop thinking skills, and apply mathematics in everyday life.

Learning Path performed as follows: the teacher explains the concept of an informative, gives the example problems, and provides exercises. As a result, when the students were given a different matter with exercises, or non-routine matter, they have difficulty to solve them, and even make mistakes. Allegedly this is one of the causes of low student mathematical understanding.

Selection of the approach in the learning process of mathematics, teachers should choose the approach that supports the development of students' mathematical understanding capabilities. One approach to learning that emphasizes the active role of students in the building and give meaning to information and events experienced by students is a constructivist approach. Part of the constructivist learning approach is open-ended. Katsuro in Noer (2007: 9) states that there are similarities between the open-ended approach and constructivism. Constructivism has basic principles, namely, knowledge is constructed by the students themselves. Likewise in the open-ended approach, knowledge is constructed by the students themselves and the learning is presented a problem that has a variety of completion or completion method.

By administering a problem situation with settlement not only be presented with one way and answer many, students gain experience in discovering new things, namely by combining all the knowledge, skills and mathematical thinking has been owned by the students of previous lessons. Furthermore, students analyze the problems and methods of solving problems through a process of

solving the problem one way and then discuss and evaluate a variation of the method of settlement that can be developed and presented by classmates (Noer, 2007: 17).

The open-ended approach to the study of mathematics aims to create an atmosphere of learning that students gain experience in finding something new through a learning process (Shimada, 1997). Interest familiarization mathematics learning with open-ended is to help develop students' mathematical activity and thinking simultaneously in problem solving (Hudiono, 2008: 23). According Suherman, open-ended approach goal is not to get an answer, but more emphasis on the way arrive at an answer (Suherman in Asriah, 2011: 10). Thus, it is not just one way to get answers, but some or many ways. Lambertus (2013), states that another goal of the open-ended approach, namely, that mathematical thinking skills students can develop optimally, and at the same time each student creative activities communicated through a learning process. The main idea behind learning with open-ended approach to the problem, is learning that builds interactive activities between mathematics and students, thus inviting them to address the problem through a variety of strategies.

According Nohda (2000), there are several benefits of using open questions in mathematics, is as follows: (1) Students have become more active in expressing their ideas; (2) Students have more opportunity to comprehensively use their knowledge and skills; (3) Students have a rich experience in the process of finding and receiving the consent of the other students on their ideas.

Various benefits of using question open as well stated by Sawada (1997), Mahmudi (2008: 5), that there are some benefits to using questions open, as follows: (1) Students participate more actively in the learning and express their ideas in a more intensive. Troubleshooting an open and supportive learning environment, providing freedom of expression to the student to develop his idea, because there are many true solution, so that every student has the opportunity to make one or more unique answer. Such activities will encourage interaction and interesting conversations between students in the classroom. (2) Students have more opportunities to use their knowledge and skills in a comprehensive manner. Since there are many different answers, so students can choose their favorite way to get a unique answer them. (3) The students have more opportunities to develop his reasoning. By comparing and discussing the strategies and solutions of students in the class, students will be motivated to give a rational explanation to another student or to strategies or solutions that they generate. It thus will foster students' reasoning power. (4) Students have a lot experience to enjoy the discovery process and receive approval from the other students to strategies or solutions that they generated. Because each student has a solution based on their unique ideas,

then each student will be interested or interested in the solution of other students. This will further increase knowledge and also can enrich its strategy.

The success of the open-ended approach to improve student understanding of mathematics can be seen by measuring certain aspects of the process of solving problems. These aspects are to interpret, classify, explain, calculate, formulate, using or comparing the context of mathematics in mathematics, and comparing or use mathematics in contexts outside of mathematics.

B. METHODS

This study is an experimental research, carried out in class XI high school students 2 Kendari. As the study sample was taken purposively two classes, one as an experimental class and one as a control class. Experimental class, learning is treated using open-ended approach, while the control group remained untreated learning using the conventional approach (approach which has been used).

Research design was Randomized Control group pretest-posttest design. The design of the structure is simple, consisting of experimental treatments and a control. The procedure can be seen in Table 1 below.

Table 1. Design Research

Group Experiment (E)	T_0	X	T_1
Group Control (C)	T_0	—	T_1

(Nazir, 1988:289).

To = Measurement pre test
X = Treatment
T_1 = Measurement post test

Collecting data in this study carried out by administering a research instrument in the form of sheets of observation and tests the ability of understanding mathematical description of the test form. To measure the ability of mathematical understanding, before learning activities undertaken, the first to do pre-test in the control class and experimental class to determine the ability of the initial students' mathematical understanding. Furthermore, after learning activities with open-ended approach to do in the experimental class, and conventional learning in the classroom control, then held a post-test to determine the increase that occurred in the second grade.

The data analyzed in this study of the score pre test and post test the ability of mathematical understanding, the data must first be calculated N-Gain (normalized gain), which aims to determine the quality improvement that occurred in the two classes.

$$N\text{-Gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad \text{(Hake, 1999)}$$

Description: S_{post} = post tes score,
S_{pre} = pre tes score, and
S_{max} = maximum score that may be obtained by students.

Table 2. Criteria N-Gain

N-Gain Acquisition	Criteria
N-Gain > 0,70	High
0,30 ≤ N-Gain ≤ 0,70	Medium
N-Gain < 0,30	Low

Furthermore, the value of N-Gain is processed to see the difference increased understanding of mathematical experimental class control class.

C. RESULTS

1. Description Implementation Results Learning Approach Open-Ended

Based on observations activity of students in mathematics learning implementation using open-ended approach in the experimental class continued increase, at the first meeting and the second achievement of all aspects observed were 48.33% and 55.33%. The third meeting until the fourth reel showing achievement observed aspects are respectively 61.33%; and 64.66%. Similarly, the implementation of learning in the fifth and sixth meetings tend to show an increase in achievement for all aspects observed successively reached 71.33% and 76.66%.

2. Descriptive Capabilities Understanding of Mathematical Experiment Class

Data score pre-test and post-test students who obtained the experimental class, generating an average value of normalized gain of 0.51 (medium quality), and the classification of the relative frequency of normalized gain is presented in Table 3 below:

Table 3. Frequency Distribution and Classification Normalized Gain
The ability of understanding mathematical Student Class Experiment

Normalized Gain	Classification	F	Relative Frequency (%)
G < 0.30	Low	0	0
0.30 ≤ G ≤ 0.70	Medium	34	100
G > 0.70	High	0	0
∑		34	100

3. Descriptive Capabilities Mathematical Understanding Student Class Control

Data score pre-test and post-test students who obtained the control class, generating an average value of normalized gain of 0.21 (low quality), and the classification of the relative frequency of normalized gain is presented in Table 4 below:

Table 4. Frequency Distribution Normalized Gain
Understanding mathematical ability Grade Control

Normalized Gain	Classification	F	Relative Frequency (%)
G < 0.30	Low	31	93.94
0.30 ≤ G ≤ 0.70	Medium	2	6.06
G > 0.70	High	0	0
∑		33	100

4. Increasing Significance Tests Class Experiment

Table 5. Mean Significance Analysis of N-Gain
Understanding of Mathematical Ability

One-Sample Test

	Test Value = 0					
	t	df	Sig,(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
N_Gain_ Experiment_Class	42.221	33	.000	.51088	.4863	.5355

In Table 5, it appears that the experimental class value t is greater than t table $_{(34;\ 0.05)}$ (t = 42.221> t_{table} = 1.691), then H_0 is rejected. Thus, there is an increased understanding of the mathematical ability of students significantly after being taught by the open-ended approach.

5. Test Mathematical Understanding Differences Upgrades

To test the significance of the mean difference two groups used Independent Sample t-Test

Table 5. Results of Statistical Analysis Test Difference Upgrades
Understanding of Mathematical Student Class Experiment and Control

	t-test for Equality of Means						
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Upper	Lower

N_Gain	Equal variances assumed	18,829	65	,000	,29240	,01553	,26138	,32341
	Equal variances not assumed	18,897	62,3	,000	, 29240	,01547	,26147	,32333

In Table 5, it appears that the value t is greater than t table $_{(61;\ 0.05)}$ ($t = 18.829 > t_{table} = 1.670$), then H_0 is rejected. Thus, the ability of students taught mathematical understanding by using open-ended approach significantly better improvement of students' mathematical understanding abilities are taught using conventional learning.

D. DISCUSSION

1. Description of Learning Implementation

Increased activity of students in the learning process in the experimental class occurs gradually. At first the students are still unaware of their duties and responsibilities within the group. They tend to be mutually hope to friends, so that cooperation within the group had performed poorly. Some students also have not been able to find its own resolution of a given problem. At a meeting of the second to fourth this time students are getting used to learn in groups by using an open-ended approach, they began to take the initiative to engage actively in the group during the learning process.

Students need time to adjust to the new learning approach applied in the classroom, especially during the formation of the group, the process is quite time-consuming. Students unfamiliar with study groups, so it is less enthusiastic in the learning process. Some students show unfavorable attitude of cooperation within the group. This resulted in the absorption of the subject matter is given to students is less than the maximum. However, at a subsequent meeting these obstacles can be minimized. Teachers can control and direct their students very well, so that students who initially less enthusiastic, finally had the pleasure to work together in groups.

This is evident at the third meeting and the next meeting, the learning process can run smoothly. Although the third and fourth meetings, some students still have difficulty in digging and processing information from the student worksheets and other learning resources, students have not been able to find the solution of the given problem. However, with the direction and guidance of teachers, students begin to understand the procedures that must be done in learning to use the open-ended approach. Teachers and students began to show an enthusiastic attitude in the learning process. Students also begin to feel responsible for the study group, to work on group tasks. In addition, teachers can give feedback on student responses and encourage students to gather information to obtain a solution of a given problem. It can be concluded that students need time to

adapt to a new learning approach is applied. It is also evident from the percentage of achievement observed aspects, the overall increased compared to the percentage in the first and second meetings.

2. Understanding of Mathematical Ability Students

Data obtained through the ability of understanding mathematical ability test mathematical understanding. After learning in class experiments conducted using the open-ended learning approach and the control class using conventional learning approaches. Results of data analysis obtained by the average value of the N-Gain understanding of mathematical abilities in the experimental class of 0.51 included in the category of medium quality improvement. While in the control class, 0.21 included in the category of low-quality improvement. Despite the increased ability of mathematical understanding, but the increase occurring in the control class is still low, so it can be said that the students' mathematical understanding of the experimental class is better than the control class.

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Similarly, the learning process does not emphasize control class students to take an active role in finding a solution / mathematical problem solving, learning the control class is still centered on the teacher. This is in contrast to the experimental class, the experimental class shows that the contribution of open-ended approach is superior compared to conventional learning. In the experimental group, the cooperation within the group are good. Students do not feel reluctant to ask questions or ideas to peers in a group or teachers. Courage and confidence are seen rising. Culture think, ask and answer the look began to take shape. Appreciate your friends and motive to understand the material being studied is also already visible. Hail impact on the ability of students' mathematical understanding increases.

To know the difference increased ability mathematical understanding of students taught using an open-ended approach and taught using conventional learning hypothesis test the value of N-Gain understanding of mathematical abilities in both classes using a statistical t-test. From a single t test, that there is an increased understanding of mathematical ability significantly to students who are taught by open-ended approach (experimental class). Similarly, when viewed from a mean value of the N-Gain, students taught by conventional approach to obtain an average value of N-Gain understanding of mathematical 0.21 (increase of low quality), while students who are taught by open-ended approach to obtain an average value of N-Gain understanding mathematically 0.51 (medium quality improvement). This shows that learning with open-ended approach is better than learning by conventional approaches.

This is the impact on the learning process does not emphasize control class students to take an active role in finding a solution / resolution of mathematical problems. The learning process in the classroom control tends to be centered on the teacher. On the other hand, the contribution of open-ended approach to the provision of the problems of non-routine with a lot of settlement or settlement are many ways to make the ability of students' mathematical understanding that learning to use open-ended approach is superior compared to conventional learning.

Furthermore, t-test results of the party, showed that the average increase in the ability of students' mathematical understanding of the experimental class and control class is significantly different. Based on t test results obtained by t > t table, which means that H0 is rejected. In other words, significantly increase the ability of understanding mathematical average of the experimental class is better than the control class. Improved mathematical understanding the experimental class this happens because the learning process encourages students to develop thinking skills and the ability mathematical understanding. This is because in the learning process, open-ended approach emphasizes the active role of students to find different ways of settlement or many answers to mathematical problems are solved.

E. CONCLUCION

1. The open-ended approach both to increase the activity of students in the learning process of mathematics.
2. There is a growing understanding of the mathematical ability of students significant learning classes using open-ended approach. In addition, the class that learning to use open-ended approach to obtain an average value of normalized gain of 0.51 (quality improvement being), the largest gain normalized value of 0.63 and 0.40 the smallest gain normalized value. While

classroom learning using conventional learning, obtaining a mean value of normalized gain of 0.21 (lower quality improvement), the largest gain normalized value of 0.30 and 0.13 the smallest gain normalized value.

3. Ability mathematical understanding of students taught using an open-ended approach significantly better improvement of the understanding of mathematical ability of students taught using conventional learning.

F. SUGGESTIONS

1. Teachers can apply the open-ended approach as an alternative learning approach to improve high school students' mathematical understanding.
2. Increasing students' mathematical understanding in classifying indicators and indicators to compare / use mathematics in contexts outside of mathematics is an indicator that the lowest increase, because it needs serious attention for teachers in mathematics in high school.

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