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THE EFFECT OF OPEN-ENDED LEARNING MODEL ON THE UNDERSTANDING OF CONCEPT BY CONTROLING NUMERICAL TALENT OF STUDENTS

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ABSTRACT

The purpose of this study was to determine the effect of the Open-Ended learning model on understanding mathematical concepts by controlling students' numerical talents. This research was conducted in class X SMA Negeri 7 Denpasar with quasi-experimental methods with the design of The Non Equivalent Posttest Only Control Group Design, involving a sample of 72 students taken by simple random sampling technique. The independent variable in this study is the learning approach which is divided into two levels of factors, namely the Open-Ended learning model that is imposed on the experimental group and the conventional learning model that is imposed on the control group. As the dependent variable in this research is understanding mathematical concepts. Numerical talent is a control variable (covariable). The research instrument was a test, namely a test of understanding mathematical concepts and numerical aptitude tests. Data analysis used t-test and one-way Anakova. The results showed that: (1) there is an influence of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow conventional learning models, 2) there is an influence of understanding of mathematical concepts between students who take the Open-Ended learning model and those who follow the learning model conventional after numerical talent control. Understanding of mathematical concepts achieved by controlling students' numerical talents, proves that Open-Ended learning models can influence understanding of mathematical concepts themselves.

Keywords: *Learning model, Open-Ended, numerical talent, concept understanding*

PRELIMINARY

Mathematics is no longer considered a scary subject. This can be seen from the number of students who begin to be happy with mathematics in school. Mathematics is the basis of all lessons, especially subjects that use calculations such as chemical physics and others. In achieving the learning objectives the teacher's role is very important in choosing learning methods that are appropriate to the material to be taught in the learning process. The accuracy in choosing a learning model

can provide student motivation in improving learning outcomes.

Some problems that are often faced such as (1) The low quality of education produced is inseparable from various factors including the learning process. The process of learning mathematics so far has been done by teachers who tend to go through learning and general form explanations followed by explaining examples of formal problems with the steps in the process and students imitating. The learning process applied by the teacher has not been able to stimulate students to increase motivation in solving a problem, (2) Students' mathematical problem solving abilities are still relatively low. This is due to the fact that there are still teachers who are less creative in directing students to be able to stimulate the enthusiasm of each student to be actively involved in their learning experiences, and the problems presented by the teacher are dominated by the presentation of closed problems, less emphasis on integrating problem solving, and tend to be faced only in presenting problems that do not provide space for students to be creative, (3) Learning that is carried out in classrooms is still classical, does not involve students actively in the learning process, and tends to recognize class as a uniform so that learning is competitive.

In an effort to improve the quality of education in schools, many learning models can be developed. But there are still some teachers who use conventional learning models that refer to the material in the textbooks. This tends to have an imperfect impact on students 'understanding of the subject being taught, so that students' motivation and learning outcomes become low. Thus the teacher is required to be skilled in choosing learning models that are used during the learning process at school so that students more easily understand the material being studied. With the advancement of information technology, students are not only fixated on the material provided by the teacher, but students are also told to look for material from other sources such as appropriate books and the internet so that the subject matter is

getting better with a variety of literature.

To increase student motivation, teachers are required to be more innovative in developing learning models that are in accordance with the subject matter. the problem solving model alone cannot improve student learning motivation, so this model needs to be developed into an Open-Ended learning model. By developing a problem solving learning model into an Open-Ended learning model, it is hoped that it will improve student learning outcomes. Open-Ended learning model, namely with mathematical problems that are formulated in such a way that has more than one correct answer, with various solving procedures. Because during this time learning often uses mathematical problems in a closed form, meaning that mathematical problems are formulated in such a way that they have one correct answer and one way of solving it, so students must answer according to what is intended by their teacher without any development of the flow of thinking because different ways of solving are considered is wrong. With the application of the Open-Ended learning model students are expected to be able to open their horizons to the material being studied, so students are required to play an active role in the learning process and students' opinions are well valued and more motivated because of the maximum interaction between the teacher and students in the learning process in class.

To gain the ability to solve problems, students must have a lot of experience in solving various problems. The application of the Open-Ended learning model will provide opportunities for students to discover mathematical concepts through the learning steps contained in this learning model. Through these learning steps, students will be delivered to the discovery of mathematical concepts, and organize them to solve the problems encountered. With the application of the Open-Ended learning model it is hoped that it can add new nuances in mathematics learning, and be able to develop abilities in problem solving, which in turn are expected to improve student learning outcomes.

In addition to a lack of understanding of mathematical concepts, students are also less thorough in calculating operations. The accuracy also comes from the abilities / talents of students. According to Munandar as quoted by Sulistyowati, (2013) the definition of talent (aptitude) in general is as a person's innate ability which is a potential. Student academic potential can be divided into several things, including: verbal talent, numerical talent, logical talent, technical talent, spatial talent and so forth. In relation to mathematics, numerical talent has a very big contribution in learning. According to Robbins, as quoted by Indrawati, (2012) one of the five dimensions of intellectual ability is numerical intelligence, which is defined as the ability to count quickly and accurately. With numerical talent possessed by students will help them analyze every mathematical problem and help students apply mathematical concepts in everyday life. In an effort to overcome the problem of understanding mathematical concepts and numerical talents, a new paradigm is needed by a teacher in the learning process, from initially teacher-centered learning to innovative and student-centered learning. An innovative learning model is an Open-Ended learning model that is formulated so that it has more than one correct answer, with various solving procedures.

The objectives to be achieved in this study are: (1) To determine the effect of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow conventional learning models in class X students of SMA Negeri 7 Denpasar in the academic year 2018/2019. (2) To determine the effect of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow conventional learning models after numerical talent control is held in class X students of SMA Negeri 7 Denpasar in the academic year 2018/2019.

RESEARCH METHODS

This study uses two comparison groups namely the experimental group (which is given treatment) and the

control group (comparison group). The research design used in this study is The Non Equivalent Posttest Only Control Group Design which only considers post test scores in data analysis, or only compares Post test data.

The population used by researchers is class X SMA Negeri 7 Denpasar in the 2018/2019 academic year consisting of 9 MIPA classes and 3 social science classes with 433 students consisting of 200 male students and 233 female students. Sampling in this study using a random technique that is simple random sampling means the sample is chosen from groups of individuals or classes randomly. From the two classes obtained by the experimental group namely Class X MIPA 2 was given an Open-Ended learning model while as a control group namely Class X MIPA 7 was given a conventional learning model.

Research variables are anything in the form of what is determined by researchers to be studied so that information about it is then drawn conclusions. This study contains three variables, including:

a) Independent Variable (X)

The independent variable is a variable that affects other variables or which is the cause of change and the occurrence of the dependent variable. The independent variable in this study is the Open-Ended learning model.

b) Bound Variable (Y)

Dependent variable is a variable that is influenced by other variables or which is the result of an independent variable. The dependent variable in this study was the understanding of the mathematical concepts of Grade X MIPA students of SMA Negeri 7 Denpasar.

c) Control Variables or Covariables

Control or covariable variables are other variables besides controlled independent variables and are thought to affect the dependent variable. The control variable in this study is the numerical aptitude of the 10th grade MIPA students of SMA Negeri 7 Denpasar.

In this study, researchers used two tests, namely numerical aptitude tests and tests of understanding mathematical concepts. Numerical aptitude tests are used to measure students' initial abilities in the field of mathematical

calculations using Open-Ended learning models and conventional learning models. The mathematical concept understanding test is used to find out the understanding of mathematical concepts in the function graphic material, composition function and inverse function using Open-Ended learning models and conventional learning models.

To test the effect of the Open-Ended learning model on understanding mathematical concepts by controlling numerical aptitude, the data collected was then analyzed by prerequisite tests namely normality tests, homogeneity tests, and regression linearity tests. If all the prerequisite tests are met in other words the data is normally distributed then parametric statistics will be used with the first hypothesis test using the t-test and the second hypothesis using the one-way covariance analysis test (ANAKOVA). If the prerequisite tests are not met in other words the data are not normally distributed, then non-parametric statistics will be used with the first hypothesis test using the sign test and the second hypothesis using the Wilcoxon signed ranks test. The significance level of testing of 5% ($\alpha = 0{,}05$)with the testing criteria is to reject the null hypothesis (H0) and alternative hypotheses (Ha) accepted, if. jika $t_{hitung} > t_{tabel\left(\frac{\alpha}{2}\right)}$

For normally distributed data or in other words the prerequisite test is fulfilled, the second hypothesis test uses a one-way covariance analysis test (ANAKOVA) with numerical aptitude covariables. The second hypothesis testing is done by comparing the value of Fcount and Ftable at the significance level of testing of 5% ($\alpha = 0{,}05$) with the test criteria is rejecting the null hypothesis (H0), if $F_{hitung} > F_{tabel\left(\frac{\alpha}{2}\right)}$

RESEARCH RESULTS AND DISCUSSION

The object of this study is the difference in understanding students' mathematical concepts as a result of the treatment of the application of Open-Ended learning models and conventional learning models. This research uses t-test and ANAKOVA by

involving numerical talents as controllers to control data.

Table 1. Recapitulation of Calculation Results of Numerical Talent Values and Understanding of Mathematical Concepts of Students in the Experiment and Control Groups

Data Statistik	Kelompok Eksperimen		Kelompok Kontrol	
	Bakat Numerik	Pemahaman Konsep Matematika	Bakat Numerik	Pemahaman Konsep Matematika
Mean	80,91	80,245	76,97	73,77
Median	80	80	76	74
Modus	84	83	76	71
Standar Deviasi	8,843	7,91	7,144	9,325
Varian	78,198	62,60	51,03	86,967
Nilai Minimum	64	63	60	51
Nilai Maksimum	96	94	92	86
Rentangan	32	31	32	35

a) Deskripsi Data Bakat Numerik Kelompok Eksperimen

Numerical aptitude value data of students in the experimental group who followed the Open-Ended learning model with 36 students had an average of 80.91 with a median of 80 and mode 84, a standard deviation of 8.843, a variance of 78.198, a minimum value of 64 and a maximum value of 96 , many grade 6, and class length 6. If the average, median, and mode scores are depicted in the graph, it appears that the numerical aptitude distribution curve of students who take open mathematical problem solving learning models includes negative squint curves, because mode> median> average. This means that based on the norm reference benchmark most of the numerical aptitude scores of students who follow the Open-Ended learning model tend to be high.

b) Control Group Numerical Talent Data Description

Data on numerical aptitude scores of students in the control group who followed the conventional learning model with 36 students had an average of 76.97 with a median of 76 and mode 76, standard deviation of 7.144, variants of 51.03, minimum value of 60

and maximum value of 92, many grade 6, and length of class 6. If the average, median, and mode scores are depicted in the graph, it appears that the numerical aptitude distribution curve of students who follow the conventional learning model includes positive squint curves, because of> median> mode. This means that based on the norm reference benchmark most of the numerical aptitude scores of students who follow the conventional learning model tend to be low.

c) Description of Experimental Group's Mathematics Understanding Data

Data on the understanding of students' mathematical concepts in the experimental group following the Open-Ended learning model with 36 students has an average of 80,245 with a median of 80 and a mode of 83, a standard deviation of 7.91, a variance of 62.60, a minimum value of 63 and a value of a maximum of 94, a lot of grade 6, and a length of grade 6. If the average score, median, and mode are depicted in the graph, it appears that the distribution curve of the mathematical understanding of students' concepts following the Open-Ended learning model includes a negative squint curve, because mode> median> average. This means that based on the norm reference assessment, most of the scores in understanding the mathematical concepts of students who follow the Open-Ended learning model tend to be high.

d) Data Description of Understanding Mathematical Concepts of Control Groups

Data on the understanding of students' mathematical concepts in the control group following the conventional learning model with 36 students has an average of 73.77 with a median of 74 and mode 71, a standard deviation of 9.325, a variance of 86.967, a minimum value of 51 and a maximum value of 86, many grade 6, and class length 6. If the mean, median, and mode scores are depicted on the graph, it appears that the distribution curve of students' mathematical concept understanding of scores following the conventional learning model includes a positive squint curve, because average> median> mode. This means that based on the norm reference

reference, most of the students' understanding of mathematics concept scores that follow the conventional learning model tend to be low.

Discussion of Hypothesis I

Based on the results of the first hypothesis analysis test using the t-test (t-test) obtained is, with a significance level of 5% degrees of freedom db = (35 + 33) -2 = 66, then obtained (2 tail test) amounted to 1.99656 , so the value of or > 1.99656, so the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Thus it was found that there is an influence of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow conventional learning models in class X MIPA students of SMA Negeri 7 Denpasar.

In addition, the results of data analysis also showed that the average understanding of mathematical concepts between the experimental group and the control group there were differences. The average value of understanding mathematical concepts of students who follow the Open-Ended learning model is 80.245 and for the average value of understanding mathematical concepts students who follow conventional learning models have an average of 73.77.

Based on data analysis, it is shown that students' understanding of mathematical concepts that follow the Open-Ended learning model is better than understanding mathematical concepts of students who follow conventional learning models. The influence of understanding mathematical concepts achieved by students, proves that the Open-Ended learning model can affect the understanding of mathematical concepts themselves.

Discussion of Hypothesis II

Based on the results of the second hypothesis analysis using the one-way anacova obtained Fcount is, with a significance level of 5% degrees of freedom db numerator 1 and the denominator db 65, then obtained (test 2 tails) amounted to 5.27, so the value of Fcount> or> 5,27, so the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Thus it was found that there was an influence of understanding

mathematical concepts between students who took the Open-Ended learning model and those who followed the conventional learning model after numerical talent control was held in class X MIPA students of SMA Negeri 7 Denpasar. After the influence of numerical talent is eliminated, it is obtained the average corrected understanding of students 'mathematical concepts following the Open-Ended learning model by 79.28 and the average corrected understanding of students' mathematical concepts following the conventional learning model by 74.74.

It can be concluded that the understanding of mathematical concepts of students who take the Open-Ended learning model is higher than those who follow the conventional learning model after controlling numerical talent. So it is proven that there is an influence of the Open-Ended learning model on understanding mathematical concepts after controlling numerical talent. Open mathematical problem solving learning models lead students to a new concept that they find from the results of solving problems. The process of solving problems using abilities possessed an effect on students' mathematical disposition. Students who are used to faced with problem solving problems are able to solve them, they will become more confident and not easily give up facing challenges.

In addition, the problem-solving process using the Open-Ended learning model is done in stages, meaning that from the given problem, sub-problems are created which will then be solved by students one by one so that it does not burden the students. Helping students to be able to understand and solve mathematical problems. Train students to be able to think carefully in solving problems. Improving learning outcomes with group collaboration makes students feel happy and the classroom atmosphere is not boring, not tense and between the teacher and students can contribute to each other and be active in the learning process, whereas in conventional learning models the teacher plays a major role in determining content and the sequence of steps in delivering the material to students. The learning process runs boring and students become passive,

because they do not have the opportunity to find the concepts taught themselves. Students also lack courage in surfaceing their opinions or lack courage in asking teachers or friends. The Open-Ended learning model is a learning model that is suitable for the development of modern learning psychology which considers learning to be a process of behavior change thanks to experience. The Open-Ended learning model can help strengthen students' personalities by increasing confidence in themselves from the processes that have been passed. Thus it is very appropriate that this open mathematical problem solving learning model influences students' understanding of mathematical concepts, especially students participating more actively in learning and often expressing their ideas.

Numerical talent is the ability in terms of number calculations because mathematics cannot be separated from calculations. The ability in terms of counting numbers to know how well someone can understand the ideas and concepts expressed in numbers and how easily someone can think and solve problems with numbers. Students who have low numerical talent or less tend to understand low mathematical concepts or less then students who have good numerical talent tend to understand mathematical concepts well. So mathematics requires a high understanding of mathematical concepts so that the learning outcomes of mathematics are high or good too.

CONCLUSION

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

1. There is an influence of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow the conventional learning model in class X students of SMA Negeri 7 Denpasar in the 2018/2019 academic year.
2. After numerical talent control is held, there is still an influence of understanding mathematical concepts between students who take the Open-Ended learning model and those who follow conventional learning models in class X students

of SMA Negeri 7 Denpasar in the academic year 2018/2019.

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