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INCREASING THE VOCATIONAL STUDENTS' ABILITY IN MATHEMATICAL UNDERSTANDING BY APPLYING PROBLEM BASED LEARNING AND TEAM GAMES TOURNAMENT MODEL

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Abstract

The students' understanding ability is still relatively low, caused by the quality of mathematics learning in the classroom, so students feel bored in learning mathematics, passive students in learning, students are not independent in constructing knowledge and students are not trained to develop the ability to think. Learning model that is expected to be good for applied to learning mathematics and in order to encourage the emergence of students' understanding in mathematics is Problem Based Learning and Teams Games Tournament model. The purpose of this study is to improve the students' understanding in mathematics through the application of Problem Based Learning and Teams Games Tournament Model. This research is experimental research with preetest-postest design group design. The population of this study is all students of class XI SMKN 4 Kendari, the research sample taken two classes with purposive sampling technique and the determination of experimental class and control class chosen at random. First experimental class got model of Problem Based Learning Learning (PBL) and second experiment class got cooperative learning model Type Teams Games Tournament (TGT). The research instrument used is pretest and postes Mathematical Understanding. The data obtained were analyzed descriptively qualitative and t-test. Based on the results in data analysis can be concluded that: 1) There is improvement of students' understanding in mathematics through PBL model .2) There is an improvement in students' mathematical understanding through TGT model. 3) There is a difference in students' mathematical understanding improvement among those taught by PBL and TGT model.

Keywords: mathematical understanding skill, problem based learning model, teams games tournament model

A. Introduction

Mathematics as a science, has a very important role in life. Many mathematical concepts are needed to solve problems in everyday life, as well as to help solve economic, social, scientific, and technological problems. So that the learning of mathematics in school is expected to form understanding and skill of student in connecting mathematics with other science and everyday life.

Understanding the concept and reasoning of mathematics are two aspects of the ability that students must achieve when studying mathematics. Depdiknas (2002: 6) states that there is a very close relationship between mathematical material, conceptual understanding, and mathematical reasoning, in which mathematical material can be understood through reasoning

and reasoning understood and trained through mathematics learning. It can be developed in primary and secondary education, one of them at the Vocational High School level.

Being aware of these conditions, hence exploring and developing students' mathematical understanding skills need to gain teachers' attention in mathematics learning. Students should have plenty of opportunities to use their ability to understand, practice, formulate, engage in solving complex problems that demand the enormous and hard effort of the students. But the reality shows that students' mathematical understanding is still very low. This can be seen from the result of the students' mathematics comprehension test given in 2012 at SMK Negeri 4 kendari in grade XI students shows that the low ability of students' mathematical understanding is in the aspect of using model, diagram, and symbol in representing a concept.

Skemp (Sumarmo 1987: 24) distinguishes two types of understanding: (1) an instrumental understanding defined as an understanding by memorizing concepts without any relation to other concepts, defining formulas, and working on algorithmic calculations; and (2) a relational understanding of mutual understanding between concepts. The abilities measured in the ability of mathematical understanding include (1) procedural counting; (2) apply the formula directly; (3) apply the formula to a concept; (4) give examples and non-examples; (5) distinguish two things with reason; (6) estimates and estimates with consideration. Basically, mathematical problem solving requires the ability to understand mathematics.

To help overcome the problems mentioned above, it requires an active learning atmosphere, effective, and creative, and fun, so that students always improve the ability of mathematical understanding in learning mathematics. The learning model that is expected to be applied to mathematics learning and in order to encourage the emergence of students' mathematical understanding is the Problem Based Learning (PBL) model and cooperative learning model of TGT type (Teams Games Tournaments).

Similarly, the model of cooperative learning learning type TGT (Teams Games Tournaments) is a model of cooperative learning is easy and simple to apply in the classroom. The existing happiness dimension of the TGT learning model can foster the motivation to learn the mathematics of the students. In addition, with the TGT learning model students are expected to be active in understanding the material delivered by actively discussing and exchanging knowledge. So that students who are taught with TGT model for comprehension ability tend to be better than students who are taught with conventional learning model.

It is seen that the importance of improving students' mathematical comprehension skills in mathematics learning in Vocational High School (SMK), as this is in line with the objectives of mathematics learning. With high students' mathematical understanding ability, it is expected to have an impact on the mental development and the students' personality as well as the increase of students' mathematics learning outcomes. Therefore, the purpose of this study is to know the description of students' mathematical understanding ability which is taught by using Problem Based Learning (PBL) model, to know the description of students' mathematical understanding ability which is taught by using Teams Games Tournaments (TGT) model, knowing the improvement of students' mathematical understanding ability through Problem Based Learning (PBL), to know the improvement of students' mathematical comprehension ability through Teams Games Tournaments (TGT), and to know the difference of improvement of students' mathematical comprehension ability between the taught using Problem-Based Learning Model (PBL) and Teams Games Tournaments (TGT) model.

B. Literature Review

Mathematical Understanding

The ability of mathematical understanding is one of the important goals in learning, giving understanding that the materials taught to the students not only as memorization, but more than that with the students' understanding can better understand the concept of the subject matter itself. Polya (1973: 5-22) details the ability of comprehension in four stages:

1. A mechanical understanding, characterized by remembering and applying formulas on a regular basis and calculating simply.
2. Inductive understanding, applying formulas / concepts in simple cases or in similar cases.
3. Rational understanding, validating a formula and a theorem.
4. Intuitive understanding, introducing truth with certainty (without hesitation) before further analysis.

Michener argues (Sumarno, 1987: 24) to understand something in depth as one must know (1) the object itself, (2) relation to other similar objects, (3) relations with unlike objects, (4)

relations with dual other similar objects, (5) relations with objects in other theories. While Hakim (2008: 19) said that the ability of mathematical understanding is the ability of students in applying and applying mathematical concepts related to each other into various and model form of calculation and can menginterprestasikan into other forms, where the mathematical understanding is focused on understanding relational and instrumental which includes:

1. Ability to interpret concepts and application concepts.
2. Formulas
3. Count operation
4. Interpreting diagrams and charts.

Based on the above description, the ability of mathematical understanding as measured in this study are as follows:

1. Instrumental understanding, including calculating procedural and applying the formula directly.
2. Relational understanding, including applying formulas to a concept, distinguishing two things with reason, and estimating and guessing with consideration.

Problem Based Learning

Problem Based Learning (PBL) is one of the innovative learning models that can provide active learning conditions to students. Problem Based Learning is a model of learning that exposes students to real-world problems to learn (Nurlimasari, 2008: 16).

The foundation of the problem-based learning philosophy is the cognitive-constructivist perspective put forward by Jean Piaget and Lev Vygotsky that students of any age are actively involved in the process of obtaining information and constructing their own knowledge. This knowledge is not static, but evolves and changes constantly as long as learners construct new experiences that force them to base themselves on and modify their previous knowledge (Arends, 2008: 47). Furthermore, contemporary problem-based learning also relies on other concepts derived from Bruner, whose idea of scaffolding, a process for a teacher-assisted student or a more capable person to solve a problem or master a skill slightly above the current level of development .

***Teams Games Tournament* (TGT) Model**

Sunal and Hans (in Isjoni, 2011: 15) suggest that cooperative learning is an approach or set of strategies specifically designed to encourage students to work together during the learning process. In addition, Huda (2011: 117) with cooperative learning type TGT, students will enjoy how the atmosphere of the tournament, and because they compete with groups that have equal ability, the competition in TGT feels more fair than the competition in the traditional learning processes in general.

C. Methodology

This research is a quasi-experimental research applying a learning model to two experimental classes. The first experimental class is a class that is taught with Problem Based Learning (PBL) model with a scientific approach, and the second experiment class is a class that is taught by cooperative model of Teams Games Tournament (TGT) model also with scientific approach.The design used in this research is Pretest-Posttest Group Design which is presented as follows:

KE_1	O_1	X_1	O_3	
KE_2	O_2	X_2	O_4	(Sugiyono, 2011)

This research was conducted at SMK Negeri 4 Kendari, in the odd semester of academic year 2015/2016. The population of this study was all students of class XI SMK Negeri 4 Kendari which was divided into 12 parallel classes. Research sample was determined by several stages that was first done normality test and homogeneity of the 12 classes. Based on the data of students' early math ability that was normal and homogeny, so in the selection for two classes to be made experimental class that was class XI MMA set as a class that is taught with PBL learning model and class XI KTB taught with cooperative learning type TGT.

Data collection techniques used in this study were test techniques, observation, and interviews. Data analysis techniques used was descriptive statistic analysis, N-Gain analysis and independent t-test.

D. Finding and Discussion

1. Findings

Prior to the implementation of PBL and TGT learning models, pretest is first done with the problems constructed in accordance with indicators of mathematical understanding ability. The matter of pretest consists of: linear equations and systems of linear equations.

The result of pretest obtained minimum score of mathematic understanding ability taught by PBL learning model is 13, maximum value 26, average value 19,235, deviation standard 3,885 and variance 15,094. While the minimum value of mathematical understanding taught by cooperative learning model type TGT is 12, maximum value 26, average value 18,200, deviation standard 3,347 and variance 11,20. These findings show that in general the ability of students' mathematical understanding before being given treatment is relatively the same. Furthermore, after doing the learning process as much as 8 times meeting on each experiment class, conducted posttest on the material: equation of straight line; and rows and rows. The posttest result of mathematical understanding ability is presented below.

Table 1. Description of posttest result of students' mathematical understanding ability

Source	PBL Model	TGT Model
Amount	34	30
Minimum	28	25
Maximum	43	38
Mean	35.588	32.000
Deviation Std.	3.743	3.504
Variance	14.007	12.276

Based on Table 1, the minimum values taught with PBL are 28, the maximum value is 43, the average value is 35.588, the standard deviation is 3.743 and the variance is 14.007. Meanwhile, in classes taught by cooperative counseling type TGT a minimum value of 25, a maximum value of 38, an average value of 32.00, a standard deviation of 3.504 and a variance of 12.276. From this description, it can be argued in general that the mathematical comprehension skills taught by the PBL learning model are higher than the cooperative learning model of TGT type. Description of table 1 shows that in general the ability of mathematical understanding in the class that is taught by PBL model is higher than the students taught by TGT model.

Inferential analysis results using independent t-test to see pretest and posttest differences in mathematical understanding taught by PBL model and cooperative TGT type are presented in table 2.

Table 2. Results of pretest and posttest analysis of mathematical understanding

Learning Model	t_{count}.	t_{table}	Prob.	Alpha
PBL	18,735	1,67	0,000	0,05
TGT	12,985	1,67	0,000	0,05

Table 2, t_{test} of pretest and posttest of mathematical understanding taught by PBL model is 18,735, and taught with cooperative learning model of TGT type is 12,985. Because the value of t arithmetic is greater than t_{table} 1.67 at $\alpha = 0.05$ it can be said that there are differences in pretest and posttes of mathematical understanding taught by PBL model and cooperative learning model type TGT. Furthermore, differences in understanding of mathematics after teaching using the PBL model and cooperative learning model of TGT type are shown in table 3.

Table 3. Posttest analysis of mathematical understanding between PBL and TGT Model

Learning Model	t_{count}	t_{table}	Prob.	Alpha
Posttest PBL & TGT	3,963	1,67	0,000	0,05
Gain PBL & TGT	3,564	1,67	0,001	0,05

Table 3, the value of t arithmetic posttes of mathematical understanding taught by PBL model compared with cooperative learning model type TGT is 3.963. Because, the value of t arithmetic is greater than t_{table} 1.67 at $\alpha = 0.05$ it can be said that there are differences in posttes of mathematical understanding taught by PBL model and cooperative learning model type TGT compared with cooperative learning model type TGT.

In addition, the gain values of PBL and TGT are 3,564. Because the value of t arithmetic is greater than t_{table} 1.67 at α = 0.05, it can be said that the increase in mathematical understanding that is taught by PBL model is better than cooperative learning model type TGT.

2. Discussion

The result of descriptive analysis of posttest value of students' understanding of mathematics in a class using PBL learning model generally increased compared to pretest value. The increase was not only based on the average total score, but also based on the percentage of achievement of mathematical understanding indicator. From the average pretest score the achievement of the mathematical understanding ability is 2.42, and the posttest is 3.22. An improved indicator of the ability of understanding of mathematics is on the instrumental and relational aspects. Meanwhile, the result of statistical analysis with t test obtained value of tcount value between pretest and posttes of mathematical understanding that is taught by PBL model is 18,735. This shows that there are differences in pretest and posttes of mathematical understanding taught by PBL model. In other words, there is an increase in students' mathematical understanding after being taught using the PBL learning model. The increase in students' mathematical understanding as described above is suspected as a result of different activities performed by students in the learning process. In learning with PBL, students are actively involved in contextual learning so that they are able to build knowledge.

The result of descriptive analysis of posttest value of students' mathematical comprehension in the class using cooperative learning model of TGT type generally increased compared to pretest value. In the instrumental ability indicator, the pretest value of 2.93 increased to 2.98, and on the relational ability indicator, the pretest value of 2.26 increased to 2.83. So in general, the ability of mathematical understanding in pretest is 2.43 to 2.88. The increase is also in line with the result of statistical analysis with t test where the value of tcount value between pretest and posttes of mathematical understanding that is taught with cooperative model of TGT type is 12,985. These findings suggest that there are pretest and posttest differences in mathematical understanding taught by cooperative model of TGT type. In other words, there is an increase in students' math understanding after being taught with cooperative learning model of TGT type. The increase in students' mathematical understanding as described above is suspected as a result of the student activity of the learning process. In learning with PBL, students are actively involved in contextual learning so that they are able to build knowledge. Learning by applying cooperative model of TGT type makes the students more freely in discussion, so more ideas are emerging and for students who are reluctant to ask directly to the teacher can ask a friend in his group. Through the discussion, more opportunities to ask the student's understanding to be better so that the learning outcomes are also better.

The result of descriptive analysis about the difference of the achievement of mathematical understanding ability before and after learning shows improvement of student performance during learning. This is in line with van Wyk's (2011) study showing the TGT learning model is more effective than traditional learning. Furthermore, Tarim and Akdeniz (2008) studies show that mathematics learning implemented in cooperative learning settings enables students to improve problem-solving skills, solve abstract mathematical problems, and develop mathematical understanding skills. In addition, from the perspective of cognitive development, student cooperation based on the same age and common goals is very important.

Statistically analyzed that posttest analysis of mathematical understanding that is taught by PBL model compared with cooperative learning model of TGT type shows the difference of students' math comprehension ability. This is also supported by gain analysis of PBL learning model and cooperative learning of TGT where tcount is 3.592, which is bigger than t_{table} 1.67 at α = 0,05. These findings suggest that improvements in mathematical understanding taught by PBL models are better than TGT type cooperative learning models.

The search for each indicator of mathematical understanding also shows the differences for the two applied learning models. In the instrumental ability indicator, the mean pretest values of students taught with PBL are 2.93 and posttest 3.35 with an increase of 0.42. While for students who were taught by cooperative model of TGT type was 2,93 and posttest 2,98 with increase of 0,04. On the relational ability indicator, the average pretest grade of students taught by PBL is 2.25 and posttest 3.16 with an increase of 0.90. While for students who were taught with cooperative model type TGT is 2.26 and posttest 2.83 with an increase of 0.57. Thus, overall, the mean increase for the PBL learning model class is 0.80 and the TGT model class is 0.46.

Although the two applied learning models differ, each aspect of the two classes shows an improvement for relational indicators. According to Skemp (Sumarmo, 1987: 24), instrumental

understanding involves calculating procedurally and applying formulas directly, whereas relational understanding is mutual understanding between concepts, distinguishes two things with reason, and estimates and guesses with consideration. From these findings shows that students have the ability to manage their cognitive processes. This ability according to Brown (in Gama, 2004) plays an important role in solving the problem.

Comparison of learning models between PBL and TGT has been done by various circles. The result of research of Anggraeni, et al (2013) showed that there is significant influence of cooperative model of Teams Games Tournament type and Problem Based Learning model on mathematics learning outcomes, but the Problem Based Learning model is better than cooperative model of Teams Games Tournament type. Similarly, Fadjrin's research, et al (2015) showed that PBL provides better learning achievement in three-dimensional materials compared with TGT and DI. TGT provides better learning achievement on three-dimensional materials compared to DI.

Problem-based learning (PBL) which indicates an improved mathematical understanding of students in this study allegedly supported by learning factors that are done. In PBL learning, teachers present problems at the beginning of learning. Students are then organized to solve problems. In an attempt to solve the problem, students look for relevant references to find solutions, for example by accessing the internet. At SMKN 4 Kendari, the availability of computer facilities and internet network is sufficient to enable students to conduct an investigation. When finding the relevant settlement process, students then discuss in their group to build a new understanding. Inter-understanding between individuals are then expressed in groups so that obtained mutual understanding of the problems given.

E. Conclusion

Based on the results of research and discussion, the conclusions of this study are as follows.

1. The average of students' mathematical understanding before being taught by PBL learning model is 2,419, after learning 3,235, and average gain is 0,471 (medium category), with percentage increase equal to 33,74%. For every aspect of mathematical understanding, the instrumental enhancement is 0.42 with an increase percentage of 14.32%. While the relational ability is 0.91 or 40.24%. This description shows that there is an increase in students' math understanding after being taught using PBL learning model. In addition, the improvement of students' relational ability after being taught with PBL learning model is better than the instrumental ability.
2. The average of students' mathematical comprehension before being taught by TGT learning model is 2,425, after learning 2,909, and average gain is 0,223 (low category), with percentage increase is 19,96%. For every aspect of mathematical understanding, the instrumental enhancement is 0.04 with an increase percentage of 1.42%. While the relational ability is 0.57 or 25.40%. This description shows that there is an increase in students' math understanding after being taught with the TGT learning model. In addition, improving students' relational ability after being taught with TGT learning model is better than instrumental ability.
3. There is an improvement in students' mathematical understanding through Problem Based Learning (PBL). This can be interpreted that the students' mathematical comprehension ability has improved after being taught with PBL learning model.
4. There is an improvement in students' mathematical understanding through cooperative learning type Teams Groups Tournaments (TGT). This shows the ability of mathematical understanding of students experiencing improved mathematics after being taught with the TGT learning model.
5. There is a difference in the improvement of students' mathematical understanding among those who have PBL learning model and cooperative learning model of TGT type. The average increase for the PBL learning model class is 0.471 and the TGT model class is 0.223. This indicates that the increase of mathematical understanding in students who are taught by PBL model is higher than the TGT learning model.

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