The Effect of Problem Solving Method vs Brainstorming Method and Learning Motivation towards Learning Outcomes in Science

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Abstract: Learning outcomes is one of the most important aspect of learning variables. Learning outcomes are influenced by condition of learning and learning methods. Problem solving method and brainstorming method can be used to improve learning outcomes. Object of this research is 50 students of PGSD FKIP UNDANA, which is divided into 2 groups with 25 students in each class. The first class used problem solving method, and the other used brainstorming method. Both methods are connected to learning motivation to asses learning outcomes of science subject. This research uses factorial design which is factorial 2x2 with random assignment to treatment. Research instrument was used to measure learning outcomes which are pre and posttest, questionare was used to measure motivation and learning outcomes of analysis and understanding science concepts with hypothesis that used 2 ways anova. The results show that; there is a difference in learning outcomes between problem solving method and brainstorming method with F 27.071 with (sig).000<p. 0.05. There is also difference in learning outcomes of student with high and low motivation with F 75.389 with (sig).000<p. 0.0.05. This research also found that learning outcomes are affected by learning method and learning motivation (.039 < 0.05).

Keywords: problem solving, brainstorming, learning motivation, learning outcomes

One of the problems related to the quality of education is the learning process that occurs in higher education. Problems occurred in the process of learning which is still teacher centered in colleges, including UNDANA specifically on learning science on PGSD, so that changes need in the term of organizing instructional to achieve quality and good learning outcomes. The intent of this change is a change towards learning from a teacher-centered to student-centered, where students become more active. To make students more active then, the style of teaching by teacher need to be change. Using of conventional learning method need to reduce. The observations result of the academic year 2014/2015 at PGSD FKIP UNDANA indicates fact of learning such as; first, students who studied science at PGSD still far from student centered learning. This is because of the limitations of literature, infrastructure, and also the students who still think that the lecturer is the main source of information. In addition to the lack of space for students actively engaged in learning. In this case is relating to the use of conventional learning methods (lectures, questioning).

Second, students are generally less active in learning. Students are not active because of fears that the concept presented is contrary to the concepts taught by lecturers. This fear is emphasized with students never taught to think critically and creatively to express what they thoughts, as well as practice to find the concept itself. Third, student found difficulty to fit in science learning, because, most of the students who were in the program study PGSD is not come from department of sciences while in high school education. So in the process of learning a student is facing difficult to adjust. Fourth, the presumption of science is a difficult subject and scary. Assumptions about the science when embedded within the student will affect teaching and learning processes that have an impact on the achievement of the learning results

are insufficient. Fifth, the use of learning methods that are less varied and interesting, have an impact on the results of a study. Learning methods used are still a teacher centered like lectures, combined with the discussion, and the FAQ, and home work. Observation results showed 75% teacher at PGSD still using learning methods that is teacher centered. Although using of the methods was considered already quite varied but not enough impact on the results of the study.

To improve the cognitive ability of students required the selection of appropriate learning methods. The selection of learning methods regards to the conditions of learning and the expected results to be achieved. The use of learning methods associated with cognitive process. Where learning methods encourage learner to see experience, then push learner to do the experiment from the experience. The results of the experiment will help learner to construct their knowledge and develop understanding. The result of knowledge was depending on knowledge process by learner, which will used (Eggen & Kauchak, 2010).

The use of proper learning strategy can increase motivation and improve the learning outcomes. The link between learning methods, motivations and learning outcomes is evidenced by the results of the research. Research conducted by Klein and Pridemore (1994) concerning the effects of orienting activities and practice on continuing motivation, achievement, and student behaviors in a cooperative learning environment, note that the use of cooperative learning enhance learning results, motivate students to Excel and produce a change in behavior. The motivation of learning related to how learner have a tendency to find learning activities independently and have meaning. Because the motivation is an active process to achieve goals, lead, and manage one's actions all the time (Slavin, 2006). Motivation refers to the intensity of the action and the direction or goal, thus affecting learner to answer its needs and desires will be the achievement of a better learning results. Learner through learning activities independently will get the results of their learning processes which can then be measured and useful for learner, so that the selection of the method of learning and motivation can encourage students especially PGSD students related to learning science.

Sciences are a discipline that examines all of the results of human activity in the form of knowledge about the idea, the concept of an organized about the universe so that the acquired experience through a series of scientific process. In many cases, science has always been subjects complained many people especially students, as one of the subjects that are difficult and scary. It said to be difficult because science related to symbols and numbers that are abstract. Said to be scary because most teachers in process analytical study tend to use conventional methods, namely classical, lecture, and so much assignment. In addition, some students considered that the concept of science is very complicated so they are not able to develop themselves. This causes the students often wrong in understanding the concept of science and even less interest. Therefore, teacher claimed to be able to design a study that can encourage students to increase the cognitive dimension, reaching the good learning outcomes, solve problems in learning, and increase the motivation to learn to achieve a good learning outcome.

Observations during the year 2014/2015, found that the learning methods used in PGSD for learning science subject still conventional in nature. Based on those facts necessary testing of the use of new methods that can improve the learning results of students PGSD UNDANA Kupang. Students need to be given the ability to be able to think in high level (high order thinking skill) based on the substance of knowledge that is given during the learning process. But in fact, the students are not able to use the knowledge that is given to solve the problem (Stepich & Ertmer. 2009). Methods that can be used to improve learning outcomes are problem solving method and brainstorming method. Both of these methods can be used to look at the effectiveness of its use against the increase in the results of the study. Use of the problem solving method and brainstorming method related to high order thinking skill where HOTS

needed to complete a learning problem in science, the procedure through the scientific process, as well as encourage students to achieve a level of creative thinking and critical thinking.

Problem solving is the process of condition to solve the problem of belonging to neither of which comes unexpectedly or problems. Solving the problem starts from understanding the issues, make plans, to implement the settlement plan, and evaluate the effectiveness of the draft (Jonassen, 2011). Problem solving is a method of learning that can enhance the ability of higher-order thinking. Problem solving to divide the problem into two i.e. structured problem and not structured (Shunck, 2012). Structured problems closely related to academic issues. Because of problems in learning the science is structured problem, then problem solving method can be used.

Problem solving method is a way to present the material to learning by making the problems to be solved. This method encourages the learner to get involved actively associated with problem solving, encouraging thinking scientifically, critically and creatively, as well as involving a complex cognitive processes. Problem solving is seen as the process of forming the concept, style and structure of thinking to resolve the problem (Reusser. 1988). The use of this method will encourage learner stimulate the thinking of looking for data to decision-making, and the process to create a way out of the problems of creating meaningful learning. De Leeuw (1983) in his research about teaching using problem-solving to teach algorithms and heuristics in solving problems, obtain results that problem solving is very effective to shape the way you think, and generates problem solving in structured. In addition the study also shows that the problem solving can increase the motivation to learn.

The use of problem solving method in learning science is more natural and effective, compared to conventional methods such as lecture (Adams & Hamm. 2010). It further said Adams and Hamm (2010) in I science learning, problem solving is a process to generate questions, collect evidence, explain the solution, and makes the prediction results. Through this process students gains knowledge, understanding of concepts, models, and theories. In addition the research provided by Aleixandre and Erduran (in Adams & Hamm. 2010) shows that, the use of problem solving can boost creative thinking ability, motivation and give change in attitude on all types of learner. As well as, helping learner to understand the basic function of any material will be studied. Thus, this method can be used for teaching science on students on PGSD FKIP UNDANA. This learning method is using constructivist learning theory and cognitive learning theory to construct a thought and result in problem resolution.

Whereas a brainstorming method as a way to stimulate creative thinking. Brainstorming focuses on solving problems and using the ideas that are owned by the learner as a creative ways (Partin, 2009; VanGundy, 2005). This method provides the learning conditions in which learner should be; 1) conveys the idea without fear of mistakes because this method does not adhere to the principle of judging ideas, 2) wild ideas (thinking out of the box) can be accepted, 3) submission of the idea to build another idea that has been around, 4) search or a look at the number of ideas (in quantity) which can be obtained (VanGundhy, 2005).

Brainstorming is a one method used to teach science effectively. Because brainstorming encourages learner to boldly expressed opinions without fear of wrong concepts, creating alternatives, and explain it on the basis of learning understanding (Wayne. 1999). Brainstorming is also used to encourage learning solving problem independently, using different approaches (Romberg, Carpenter & Dremock. 2005). Brainstorming methods provide opportunities for potential discussion took place which encourages learner to explore their knowledge or understanding to generate ideas to answer the question (Hassard. 2005). Further, described Hassard (2005) that the method used for the achievement of metacognition at student. Achievement of Metacognition occurs because every learner in the process of using the brainstormed ideas and provide problem resolution. Brainstorming is a method used to collect

ideas objectively to see the value, capabilities, and the concept is owned by learner. In teaching science using the brainstorming, the student can ask an alternative hypothesis, synthesizes information, and think creatively. Thus this method can help students to construct their ideas and produce an idea that could solve the problem. Due to the principle of a brainstorming based on creative thinking and using constructivism learning theory.

Based on explanation in above, then it can be said that the problem solving method and brainstorming method can be used to teach science. With the characteristics of the science learning places emphasis on discovery, trial, and practice conducted systematically based on knowledge (facts, concepts, methods, and criteria) who has been there to make sure the find problem solving, acquisition of new knowledge, and test existing knowledge (Williams, 2011), then both of these methods appropriate for use in learning. Both of these methods can be used in learning science on PGSD FKIP UNDANA to form students who think creatively, can solve the problem, as well as generating metacognitive to improve the learning outcomes of students.

This research focus to see how the influence of problem solving method when compared with brainstorming method if linked with the motivation of learning that will have an impact on student learning outcomes on PGSD FKIP UNDANA. So this research aims to see "the effect of Problem-Solving Methods vs Brainstorming Method and Learning Motivation towards Learning Outcomes Students at PGSD FKIP UNDANA Kupang.

HYPOTHESIS

The hypotheses in this study are:

1. There is a difference in student learning outcomes, which is learning with problem-solving method and brainstorming method.
2. There is a difference in learning outcomes, between students who have different learning motivation.
3. There is an interaction between problem solving method and learning motivation towards learning outcomes, and brainstorming method and learning motivation towards learning outcomes in students.

METHOD

This study used a factorial research design. Factorial design is model of experiment research design that pays attention to the possibility of moderating variables that affect the dependent variable or variables the dependent variable or the treatment of the results. In a factorial design samples selected randomly in the control group and the experimental group (Sugiono, 2010). Factorial design used in this study is the 2 x 2. 2 x 2 factorial design means there are two free variables and have different levels. Free variables and levels which are owned in 2 x 2 factorial designs of experiments are shown in table 1.

Table 1. Factorial Research Design 2x2

		Instructional Method	
		Problem solving method	Brainstorming method
Motivation	High	Y_1	Y_2
	Low	Y_3	Y_4

By comparing the two methods of learning are problem solving and brainstorming. Then the two classes are conducted evaluation and comparison between the classes got problem-solving methods and classes with brainstorming method. In the experimental classes are both experiencing changes increase and decrease in that place after learning the IPA uses the method of problem solving compared results before using the brainstorming method. Wants a model this through two steps, namely:

1. Gives two classes pretest and posttest.
2. Provide treatment to experimental subjects (two classes), the treatment is using problem solving method and brainstorming method on students.

Subject

This subject selected by *random assignment to treatment*.

1. The subject of this research is majors in PGSD FKIP UNDANA, III semester, academic year 2015/2016.
2. Subject selection techniques, using cluster where each class amounted to 25 student.
3. The amount of the research subject is 50 students, in III semester. Academic year 2015/2016 which are divided into two classes.

RESULT

Description of Research Subject

The study was performed on college students at third semester on PGSD FKIP UNDANA academic year 2015/2016. Consist of 50 students and is divided into two classes. Each class consists of 25 students. Where at first class there are 25 students have been given the treatment by using the problem solving methods and another student given a brainstorming method. The treatments for two classes are equal. The same treatment is; given material and associated with pre-test and post-test. Both groups carry out the learning process in accordance with the design of the research.

Table 2. The distribution of the subject based on the learning method and motivation

		Learning Methods		Total
		Problem Solving	Brainstorming	
Learning Motivation	High	23 (92%)	16 (64%)	39 (78%)
	Low	2 (8%)	9 (36%)	11 (22%)
Total		25 (50%)	25 (50%)	50 (100)

An Overview of Pretest Result on Learning Outcomes

The data from pretest gives an early overview related to the ability of the subject. Does the subject have the equal capability or not. The results of the pre-test and mean and on the two groups could not be relied upon to notice any significant difference. Be using normality test results with the Kolmogorov-Smirnov test to get numbers of significance (SIG). Test results obtained for learning methods, show that .072 sig > 0.05 so the data is distributed normally. Test results with the Levene's test on the basis of mean, obtained the number of significance (SIG) 715 > 0.05, so the data pre-test revealed homogeneous and the two groups have the same academic ability. Pre-test data is normally distributed and have variance homogeneity.

Normality Test

Test of normality research data, namely data score the results of the study. Normality data testing uses a Kolmogorov-Smirnov test. Normality test results shows that the results of the study were the vicinity of the test lines that lead to the upper right, and no data is located far from the scattered data. While significant numbers on Kolmogorov-Smirnov results for each study method, for problem solving (.200) and brainstorming (.093). This result is obtained that the value of the variable on the significance of the results of the study are greater than 0.05, so it can be stated that the research data is distributed normally.

Table 3. Normality Test Result

Tests of Normality							
	Learning Method	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Learning Outcomes	Problem Solving	.117	25	.200	.967	25	.582
	Brainstorming	.161	25	.093	.907	25	.026

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Homogenity Test

Homogeneity test of significance using the Levene's Test for dependent variable (learning outcomes), the results shows that learning outcomes is (SIG). 881. That number is greater than 0.05 and suggest that these variables are homogeneous.

Table 4. Levene's Test of Equality of Error Variance

Levene's Test of Equality of Error Variance				
	F	df1	df2	Sig.
Learning Outcomes	.222	3	46	.881

Based on the table, it can be seen that the value of sig > 0.05, thus it can be said that the data homogeneous distribution. Due to the spread of data homogeneous then it can do the test of hypothesis. After testing homogeneity data, conducted a test to see the effectiveness of the method. Testing the effectiveness of this method uses the gain value. The gain value obtained from the value of post-test reduced the value of the pre-tests. The test results using the t-test two independent sample, the result shows values is (SIG) 228 > 0.05. The result means both of these methods can be used and effective in improving learning outcomes.

Hypothesis Test

Based on the test requirement analysis, namely the test of normality and homogeneity of variance data test, the results shows, both of these variables have normal data and homogeneous. Therefore the condition is eligible to proceed on the hypothesis testing 2 way ANOVA. From the results of hypothesis testing ANOVA analysis, the results of the data as shown in table 5.

Table 5. Analysis Using Two Way Anova

Tests of Between-Subjects Effects					
Dependent Variable: Learning Outcomes					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12296.612[a]	4	3074.153	62.851	.000
Intercept	413205.128	1	413205.128	8447.951	.000
Method	1324.099	1	1324.099	27.071	.000
Motivation	3687.416	1	3687.416	75.389	.000
Method * Motivation	213.522	1	213.522	4.365	.039
Error	4646.628	95	48.912		
Total	482886.000	100			
Corrected Total	16943.240	99			
a. R Squared = .726 (Adjusted R Squared = .714)					

Test of between Subject Effects is the test to determine the effect of independent variable towards dependent variable along with the interaction between learning methods and learning motivation. Based on hypothesis test, the test gained; the effect of problem solving method vs. brainstorming method towards learning outcomes. The first purpose of this research is to test the differences between student who taught with problem solving method and children who taught with brainstorming method. Based on result from 2 way ANOVA, obtained that F ratio is 27. 071, and this ratio have a significance is (.000), it means p <. 005, so it can be said that H_0 is rejected, it means there is differences between learner who is used problem solving method and learner who is used brainstorming method. Secondly, the purpose of this research is to know about the influence of learning motivation towards learning outcomes. The test in second hypothesis is to test and compared students with high motivation and student with low motivation. Based on the test result using 2 way ANOVA, obtained that F ratio is 75. 385, with significance (.000). Thus, the ratio of the significance probability is minor than the value of the degrees of significance (.000 < .0.05). The result shows that, there is difference in learning outcomes between students with high motivation and students with low motivation. Third, there is an interaction between learning method and learning motivation towards learning outcomes. Based on 2 way ANOVA test, obtained F ratio is .365, with significance is (.039). The result of significance ratio based on test is minor than significance ratio (.0.05), so $p < 0.05$ (.039 < 0.05), it means there is an interaction between learning method and learning motivation toward learning outcomes.

DISCUSSION

The Effect of Problem Solving Method and Brainstorming Method towards Learning Outcomes

Learning methods is a ways to achieve different learning outcomes under different conditions. In its use of learning methods are used to organize the content of the learning material, delivering learning, organize interaction between learners with other learning variable (Degeng, 2013). Problem-solving method, is a method of learning that do focus on teaching problem-solving skills and followed by reinforcement of skills. Problem solving is used to locate or find the solution in this pattern, the rules of a problem to solve. Problem solving is an ability to seek information, analyze, and identify the problem to be able to produce a selection of ways to solve problem so that a decision may be taken to resolve the problem.

Problem solving method begins by identifying the issue, confirmed the problem, choosing a strategy, implementing the strategy and evaluating results (Jacobssen, Eggen, Kauchak, 2009). Based on these steps this method encourages students to have high level thinking ability and creative in solving a problem. This method also encourages to make student as a centered of learning. Problem-solving methods are used to seeing its effect on the improvement of the results of the study. Aside from the problem solving method, brainstorming method is also used in this study to see how this method influence in the increase of learning outcomes. Brainstorming method focused on solving the problem by digging the idea or ideas from each member of the group, and any idea of a given stimulus to get the answer from the problem (VanGundy, 2005). Brainstorming methods have the goal to produce a variety of creative ideas which can then be used resolve problem (Partin, 2009).

Based on the characteristics of both these methods, then the problem solving method and brainstorming methods used in this study was implemented on students. The goal was to see the influence of both these methods towards student learning outcomes. Research results was obtained that both of these methods affects the results of student learning, but there is a difference in learning outcomes between students used problem solving method and brainstorming method. Based on the data, students who treatment by problem solving method gained mean for posttest score is highly than students who treatment by brainstorming method (problem solving = 69. 739 and brainstorming = 67.323). Both of this methods can increased students learning outcomes, because problem solving and brainstorming methods, provide stimulus to students to think creatively, active, and encourage students to work cooperative in groups, as the result there is an interaction between students and students have an understanding about the topics. The difference between problem solving method and brainstorming method in learning outcomes, is due to the existence of differences in the characteristics. Problem solving method more emphasis on structured problem solving and then evaluate the implementation. On the contrary, in the brainstorming method, solving problem is unstructured, and there is no step in brainstorming to evaluate idea, after implementation.

The Effect of Level Learning Motivation towards Learning Outcomes

Motivation to learn is an internal and external impetus that causes a person (individual) to act or do achieve the goal. Based on the results of research, obtained that the motivational impact significantly to improved learning outcomes. High motivation and low motivation, have an influence on learning outcomes of students. Based on data test retrieved that learning outcomes from students who have low motivation have an average 64. 167. While the high motivation has average 72,895. Based on the data there is an increased in learning outcomes for students who have high motivation. This study shows that there is a differencies between students with high motivation and students with low motivation on PGSD FKIP UNDANA. Based on theory, there is a correlation between learning outcomes and learning motivation (Eggen, Kauchak, 2012). This study proved that, when students have a high motivation to learn and will be impact on student learning outcomes. Joyfull learning, creative thingking and active learning also help and encourage students to have a high motivation, and succeed. Teacher also can provide students with instructional media, help students to have a conffidence, challenges students to think out of the box, give them sense of safe in classroom, and motivate students to reach their personal goal in learning process.

The Effect of Interaction Between Learning Methods and Learning Motivation towards Learning Outcomes

The research results obtained that there is interaction between the learning method and motivation to learn, towards learning outcomes. The value of significance are shown based on the ANOVA test shows that p = 0.39 and is smaller than the value of the sig value (0.05). The interactions that are formed from the used of learning methods, as well as learning motivation towards learning outcomes. Combination between learning methods and learning motivation give an interaction towards learning outcomes. This interaction affected by; 1) Using new learning methods in learning process, and give the bump into students, and encourage students to have hope for enjoy the learning process. 2) Students concerns related to the tedious process of learning is reduced, as a result of making students become excited in attending class. 3) Comprehensive learning through the selection of learning method and assist students learning motivation are combined to enhance learning outcomes. The interaction between learning methods and motivation to learn caused by the selection of the learning methods is differ from conventional methods used during this time.

Based on this study, we can conclude that problem solving method and brainstorming method can increased students learning outcomes. Where problem solving method gave better result than brainstorming method. Students with high motivation to learn can gained better result on learning outcomes compared with students with low motivation. There is interaction between learning method and learning motivation towards learning outcomes.

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