p-ISSN 2339-1286
e-ISSN 2089-4392

Jurnal Pendidikan IPA Indonesia

Indonesian Journal of Science Education

Science Education Studies Program , Faculty of Mathematics and Natural Sciences, Semarang State University collaborate with Perkumpulan Pendidik IPA Indonesia (PPII) / Indonesian Society for Science Educators

JPII	Volume 7	Number 1	Page 1 - 129	Semarang March 2018	p-ISSN 2339-1286 p-ISSN 2089-4092

p-ISSN 2339-1286
e-ISSN 2089-4392

Jurnal Pendidikan IPA Indonesia
Indonesian Journal of Science Education

List of Article **Vol 7, No 1 March (2018)**

JPII 7 (1) (2018) 106-113

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

COMPARISON OF MATHEMATICAL REPRESENTATION SKILL AND SCIENCE LEARNING RESULT IN CLASSES WITH PROBLEM-BASED AND DISCOVERY LEARNING MODEL

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DOI: 10.15294/jpii.v6i2.9512

Accepted: November 19th, 2017. Approved: February 22nd, 2018. Published: March 19th, 2018

ABSTRACT

The purpose of this research is to know the difference of mathematical representation skill, the result of science learning and its influence on problem-based learning and discovery learning model. The population of this study was 16 students of PGSD FKIP University of Lampung. Among 534 students, there were two experimental classes consisting of 35 students and each was determined through cluster random sampling. The data on mathematical representation skills and learning outcomes of science were obtained through a description test, five questions for assessing mathematical representation skills, and ten questions for assessing science learning outcomes. From the instruments that had been tested to 30 respondents, it was obtained a valid and reliable instrument with a score of 0.505 for mathematical representation skills, and 0.832 for learning outcomes. Furthermore, the data were analyzed by using normality test, homogeneity test, independent sample t-test, correlation test, and simple linear regression test. The results showed that there was no difference in the result of mathematical representation skill and science learning outcomes, between the problem-based learning model and real discovery. But there is a positive and significant linear influence between the mathematical representation skill and the learning outcomes of science, through a problem-based learning model of discovery.

Keywords: discovery, problem-based, skill representation.

INTRODUCTION

Science or Natural Science (IPA) is a complex science and it is closely related to everyday life. Science is a field of study that not only applies formulas, concepts, or principles in solving a problem, but also scientific activities in the learning process This scientific activity aims to discover the natural phenomena associated with science in a systematic way. Prospective teachers (Primary School Teacher Education students) are required to be able to conduct scientific activities that can provide solutions to solve a problem encountered related to learning Science.

Science education is expected to be a vehicle for prospective teachers to gain hands-on experience in the process of developing competence and has the prospect of further development in everyday life. Therefore, in order to achieve the educational objectives set by the government, both general and specific goals, teachers (lecturers/teachers) not only teach as they stand in front of the class, but also educate and facilitate

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in various activities. In addition to educating and guiding the learners to present knowledge and skills, they also guiding in developing all the potential and character that exist in the learners, so that learners have a deep understanding of science concepts, instead of memorizing it.

In fact, theoretical knowledge can last longer and be stored in memory, if it is obtained empirically, not theoretically. This empirical experience can be obtained through a scientific approach (Budiyanto et al., 2016). The scientific approach also involves learners on the observations required for the formulation of hypotheses or data collection. The scientific approach is generally based on the exposure of data obtained by observation or experiment. Pramita & Rochintaniawati (2015) stated that the scientific approach has a learning activity consisting of the main learning experience, namely: observing, asking, gathering information, associating, and communicating. The scientific approach (Hermawan, 2014; Ambarsari, 2016) can also be applied to some supportive learning models, such as problem-based learning model and discovery.

The research result of problem-based learning model proposed by Purnamaningrum, et al (2012) showed that in a class of problem-based learning, teachers' role is different from traditional class. There are 5 steps of problem-based learning, namely: (1) students are given a phenomenon in everyday life to create problems; (2) students define problem-related; (3) students explain the solution to solve problems ; (4) preparation and planning for reporting, and (5) evaluation of students' learning outcomes. These are problem-based learning steps. By using this problem-based learning model, the students are trained to be more active in learning.

The results of the study with the discovery learning model in its application, according to Istiana et al. (2015) and Isnaningsih & Bimo (2013) showed that the active-student learning method development was underlaid by their curiosity and willingness to self-investigate. Teachers in the classroom serve only as a mentor and direct the learning activities in accordance with the purpose. This model is also defined as a learning model that guides learners to participate in conducting scientific activities of discovery, through systematic steps. Starting from the provision of stimulus, problem determination, problem formulation, hypothetical retrieval, data collection, hypothesis testing for the conclusion, resulting in more meaningful learning. In learning activities with various learning models, the main principle is none other than the success obtained from the learning. Students' learning outcomes with discovery learning model proposed by Widiadnyana, et al (2014) and Putrayasa (2014) had been proven to improve learning outcomes and mathematical representation skills, because students experience learning and find solutions. Likewise, learning outcomes obtained through the problem-based learning model is the result of student learning from the process of understanding and observing the learning activities provided. According to Santyasa (2007), the results of problem-based learning is the pattern of actions, values, understandings, attitudes, appreciation, and mathematical representation skills.

In the learning activities, representations are generally done through various ways of communication, either in conversation, reading, or writing, as mentioned by Suhandi & Wibowo (2012); and Abdurrahman et al. (2008) that the role of representation is very important in processing information. Representation (Sabirin, 2014) is a substitute for the expression shown in searching for solutions to the problem at hand, as a result of the interpretation of his mind. Solving problems with representations can be displayed through images (visual), words (verbal), tables, graphics, or mathematical symbols. Mathematics is unreal, hence to clarify or to declare in solving the problem, representation is very helpful, that is by changing the unreal thoughts into real (Hayati & Fahrurrozi, 2015). Mathematical representation can be used to express, describe, and analyze a problem to find a solution for it. Thus, it helps students to have the ability of reasoning and understanding the concept by extending their way of thinking mathematically (Chusni, 2017).

In fact, the ability of reasoning or understanding of the concept by the learners is still poor. Learners' bad understanding is influenced by the inability of the learners to represent a problem. Representation is one way to communicate an idea to a problem faced. Tsani (2015) and Artha et al. (2014) in his research point out that the use of representations to communicate ideas or mathematical ideas can enhance the understanding of the concept One of the representations that can help in understanding the concept of science is mathematical representation. It is a mathematical ability in representing the mathematical form of verbal, graphics, visual forms into new, varied mathematical forms.

The mathematical ability of a person is influenced by his/her concept mastery, someone who has high mathematical ability will have high understanding of the studied concept of Suhandi & Wibowo (2012); Abdurrahman et al. (2008), in

their research concluded that Students' mathematics mastery supports them to master science subject. Understanding the concept that students have will affect the learning outcomes achieved by these students. This statement is supported by Widianingtiyas et al. (2015) and Yusup (2009) in his research stating that "Basically a person who has the high mathematical ability will easily understand concepts and solve calculation problems, and mathematical ability has a significant effect on learning outcomes".

Problem-based and discovery learning models are very important in a learning process. This is supported by Muhamad (2016) and Puspita et al (2014), who stated that problem-based learning model and discovery learning model can improve the students' learning outcomes because the students learn the concepts in meaningful ways by discovering the new concepts. Knowledge was gained through inquiry and discovery learning and it can last longer and have a better effect on knowledge transfer. Inquiry-based and discovery-based learning improve reasoning and thinking ability freely, and they train the skills from students' knowledge to discovery and the students are able to investigate and solve the problems. Learning outcomes are represented by the ability of students in achieving the end result and it can be noticed by how far the students can solve the problem in the learning process.

The purpose of this research is to know the difference between mathematics representation result and science learning result, and its influence on problem-based learning and discovery model.

METHODS

This research is an experimental study using Cluster Random Sampling technique. The population of research is six students of PGSD FKIP University of Lampung. The sampling procedure was performed by drawing the class to be selected as the sample in the study (Nazir, 2013). Two classes were taken consisting of 35 students each. The first class was treated using problem-based learning model, while the second was treated using discovery learning model.

In the learning process, the class with problem-based learning model (Fakhriyah, 2014) adopted learning steps based on problem-based steps on LKS, while the discovery model class adopted learning steps according to discovery steps on LKS.

This research used two descriptive test instruments. The first instrument is five descriptive items, which is used to assess mathematical representation skills, given at the end of each lesson. The second instrument is 10 descriptive items to assess the learning outcomes of Science, given at the end of all material delivery. Data collection was carried out during the learning process. In the implementation, the problem-based class and discovery class are given the same materials, and the learning process is in accordance with the used learning model. Data analysis techniques used were normality test, homogeneity test, Independent Sample T-test, correlation test, and simple linear regression test.

RESULTS AND DISCUSSION

The results of research are in the form of science learning outcomes and mathematical representation skills. In problem-based learning class, it was obtained that the average score of students' science learning outcomes was 82.11 and mathematical representation skill was 70.57. Meanwhile, in discovery learning class, it was obtained the students' science learning outcomes with the average of 80.11., and the average of mathematical representation skill is 71,71.

The average difference of science learning outcomes and mathematical representation skills in both classrooms is presented in figure 1.

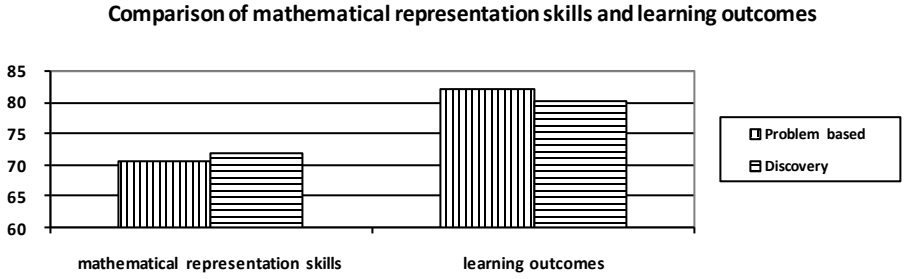

Figure 1. Achievements of Learning Outcomes and Mathematical Representation Skills

In Figure 1, it is seen that the results for mathematical representation skills with the problem-based learning model are relatively lower than the discovery learning model, and the learning outcomes of science with the problem-based learning model are relatively higher. The results of the science learning are slightly different due to different learning model factors. It further led to the different average of learning outcomes of science because in discovery learning model learners do relatively little inquiry activity on learning than in the problem-based model. However, both models of learning, there seems to have the same learning activities namely, group work, discussion, and experimenting.

In learning activities of the two experimental classes, learners more frequently learn in groups, discussion activities, experimenting, and discussing the results in groups. They occasionally discuss the problems with the teacher whose function serves as a facilitator. In group learning activities, there are several factors that influence learning, for example, there is a learner who does not contribute in the group, he/she just relies on his/her friends' help. Furthermore, to find out the comparison of mathematical representation skill, the result of science learning and its effect between the problem-based learning model with the discovery learning are then tested using Independent sample t-Test and regression test.

To test the data distribution whether it is normal or homogeneous, data normality and homogeneity test were conducted. According to Haryati (2012) and Sugiyono (2010), the sample size is relatively large where the sample size ≥ 30, then the distribution of the value differentiation from the data will be close to the normal distribution. In this study, the total number of samples used is 70 students with 35 students with problem-based learning model and 35 students with discovery learning model, so it can be said that the sample of research is normally distributed. To test the data distribution whether it is normal or homogeneous, data normality and homogeneity test were conducted. The test results are listed in table 1 below:

Table 1. Sig Value and Decision Making Normality Tests for the Independent Sample T-test

Variable	Sig. Value	Test Criteria	Test Decision
Skill of mathematical representation	0,062	Sig Value ≥ 0,05	Normal
Learning Outcomes	0,075	Sig Value ≥ 0,05	Normal

In table 1, it can be seen that the sig value in each sig ≥ 0.05 for mathematical representation skill and learning result of learning of learner. Based on the decision-making criteria, it is concluded that the population is normally distributed.

Table 2. Sig Value Based on Mean and Decision Making Homogeneity Test of Science Learning Result and Mathematical Representation Skill for Independent Sample T-test

Variable	Sig. Value	Test Criteria	Test Decision
Skill of mathematical representation	0,402	Sig Value ≥ 0,05	Homogeneous
Learning Outcomes	0,941	Sig Value ≥ 0,05	Homogeneous

In table 2, it is seen that the sig Value $\geq$ 0.05 for each. Based on the decision criteria, it is concluded that the sample data is homogeneous. After the data were concluded normal and homogeneous, the Independent Sample t-Test was conducted by testing the variant on Sig Levene's Test for Equality of Variances to see if there are differences in learning outcomes and mathematical representation skills in learning SD Science with discovery and problem-based learning models.

Tabel 3. Test Result Independent Sample T-test

Variable	Sig. Value *(2-tailed)*	Test Criteria	Making Decision
Skill of mathematical representation	0,705	Sig Value *(2-tailed)* ≥ 0,05	There is no difference
Learning Outcomes	0,627	Sig Value *(2-tailed)* ≥ 0,05	There is no difference

In table 3, the results of the Independent Sample t-Test, Sig. (2-tailed) ≥ 0.05, this means that the H_0 is accepted for the learning result hypothesis and the mathematical representation skill, or there is no difference between the learning result and the mathematical representation skill in the problem-based learning and discovery model.

Table 4. Correlation Test Results

Data	r count (*Pearson Correlation*)	*Sig. (2-taied)*	R *Square*
Skill of mathematical representation -Learning Outcomes (*Problem Based Learning)*	0,661	0,00	0,436
Skill of mathematical representation -Learning Outcomes (*Discovery learning)*	0,638	0,00	0,407

Table 4 describes the correlation of the test results. It can be stated that between the mathematical representation skill and the students' learning outcomes, there is a linear correlation. The relationship level of both variables shows that the value of Pearson correlation is 0.661 and 0.638, meaning that have a strong and positive relationship, R Square value 0.436 and 0.407, which means that learning outcomes are influenced by the skill of mathematical representation with positive regression coefficient.

Table 5. Simple Linear Regression Test Result

Learning Outcomes		t-count	Sig.	Remark
Constants	46,630	6,539	0,000	(*Problem Based Learning)*
SRM	0,495	5,056	0,000	
Constants	45,771	5,907	0,000	(*Discovery learning)*
SRM	0,519	4,758	0,000	

Table 5, explains the result of data analysis at PBL with simple linear regression test that obtained the t-arithmetic for coefficient a of 6,539, bigger than t-table that is 0,36 with Sig value of 0.000 < 0,05. Thus, H_0 is rejected and coefficient a significant. While in the DL with a simple linear regression test that obtained t-count for the coefficient b of (5,056) bigger than t-table that is (0,36) with value of Sig. (0.000) <(0,05), so H0 is rejected and coefficient b significant, hence it can be said that there is significant linear influence and positive influence of mathematical representation skill to result of learning.

The normality test in table 1 and the homogeneity test in table 2 are conducted in several ways i.e. independent sample t-test, correlation test, and simple linear regression test. Based on the test results of Independent sample t-Test in table 3. Apparently, there is no difference in learning outcomes and mathematical representation skill between problem-based learning model with discovery learning model, it means that both learning models have their respective advantages which mutually strengthen the learning activities. Based on figure 1, the results of the analysis show that, the average value of mathematical represen-

tation skills in the discovery learning model is relatively higher compared to the problem-based learning model, while for the average value of learning outcomes in the classroom of learning-based model is relatively higher compared to the discovery learning model class to find out why it can happen and then the assessment can be done as follows.

The average score of science learning outcomes obtained in both experimental classes, after the implementation of the problem-based learning model and discovery learning model, suggest that the material in the problem-based learning model is more easily understood and gives higher learning outcomes because the learning model gives problem closely related problem to everyday life. As the problems are given in the form of LKS, learners are more challenged in finding solutions so that they feel easy to find problems in their daily lives.

The average learning outcomes of the problem-based learning model are relatively higher than in the discovery learning model. The difference in mean scores of learning outcomes in these two small experimental classes may be related to the learning activities of the two classes, both of which have the characteristics of scientific learning: observing, asking, trying, reasoning and communicating (Hermawan , 2014; Ambarsari, 2016), so both models of learning equally provide reinforcement to learning outcomes. Therefore, both learning models are also recommended for learning in primary education (Ertikanto et al., 2017).

Table 4 and table 5 describe the learning activity of the problem based class model which gives a significant and positive linear influence between the mathematical representation skill and the learning outcomes of science with the contribution of 43.60% with the regression equation is Y = 46.63 + 0.49X, one score of mathematical representation skill of student can increase score result of student learning equal to 0,49, with r value equal to 0,661 indicates that both variables have strong relation with linear positive direction. That is, the higher the skill of mathematical representation by using the problem-based learning model, the higher the learning result of science. The r2 value of 0.436 indicates that the mathematical representation skill of the students contributes solely to the students' learning result of 43.60%, while the rest of 56.40% is caused by other variables that are not examined. This is in line with The previous research done by Tsani (2015) and Artha et al. (2014) suggesting that problem-based learning approaches are richer with representation, and can increase students' motivation in solving problems, generating conceptual knowledge well, and confidence in mastering concepts

The discovery learning model class gives a positive linear influence (Muhamad, 2016; Puspita et al., 2013) and it is also significant between mathematical representation skill and science learning outcomes with contribution of 40.70% with the regression equation is Y = 45,77 + 0,51X, where the increase of one skill score of mathematical representation of student can increase score of student learning result equal to 0,51, with r value equal to 0,638, this indicates that both variables have strong relation with positive linear direction. R2 value of 0.407 indicates that the mathematical representation skill contributes solely to the learning result of 40.70%, while the rest of 59.30% is caused by other variables not examined. This is consistent with previous research that discovery learning model can train students' ability in representing a problem, especially the ability of mathematical representation, as revealed by Muhamad (2013) and Aprilia & Mulyaningsih (2014) that the ability and improvement of mathematical representation and self-learning students with discovery learning model is better than students who received conventional learning.

Table 5 explains that the problem-based learning model has a positive effect on learning outcomes and it has a significant influence on the mathematical representation skill on learning outcomes. It is in line with Fakhriyah (2015) and Purnamaningrum et.al. (2012). The application of problem-based learning generates creativity, and critical thinking to the problem, and better instructional implementation. The students are more flexible in the delivery of ideas and opinions, and learners enjoy working in group work. Chusni (2017) states that basically, someone who has the mathematical ability will easily understand concepts and the can solve the problems of calculation and mathematical items. It is also in line with Widianingtiyas et al. (2015) and Yusup (2009). The concept of learning explains that if students are able to construct and build their own knowledge through the learning process, the knowledge that students have becomes more memorable in the longer term.

CONCLUSION

Based on the results of research and discussion, it can be concluded that: (1) statistically, there is no difference in the average of science learning outcomes between the problem-based learning class and discovery learning class; and (2) there is difference of influence of student's mathematical representation skill to result of learning between problem based model with discovery.

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