JPII 4 (1) (2015) 67-72

Jurnal Pendidikan IPA Indonesia
Indonesian Journal of Science Education

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

THE USE OF PROBLEM BASED LEARNING TO INCREASE STUDENTS' LEARNING INDEPENDENT AND TO INVESTIGATE STUDENTS' CONCEPT UNDERSTANDING ON ROTATIONAL DYNAMIC AT STUDENTS OF SMA NEGERI 4 BANDA ACEH

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DOI: 10.15294/jpii.v4i1.3503

Accepted: 6 January 2015. Approved: 5 April 2015. Published: April 2015

ABSTRACT

The objective of this study is to find out the increase in student's independent learning and concept understanding on the rotational dynamics after getting the PBL learning and handout. This study was conducted by using "pretest - posttest control group" experimental design. The result of analysis data showed the The average value of N-gain understanding concepts for the experimental group was 74,76%, with the higher category, but for the control group obtained N-gain is 26,76% with low category. N-gain self-regulated laerning for the experimental group was 31% with the medium category and for control group of 20% low category. These results were confirmed by t-test with significant value (0.000) under the probability value (0,05). So that it can be said that PBL learning and the handouts could to improve the student independent learning and concept understanding on the rotational dynamic.

Keywords: independent learning; concept understanding; PBL; rotational dynamic; handout

INTRODUCTION

Nowadays curriculum development demands students to participate actively in a learning process started from elementary level to high school level. The learning process implemented in school should be able to encourage and to form the students as a critical, independent, creative, and responsible learner. This agrees with a character building education based on an Act of National Education System number 2 year 2003, educated humans who believe in God Almighty, have morality and healthy, are skillful, creative, and independent, and become a responsible and democratic citizen. Therefore, it is needed an effective learning which functions optimally to build the character.

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Physics is considered a difficult subject for some students. Its learning process should be started by putting the students to a real problem and the problem solving should be able to be implemented to their real life, so that they can gain knowledge independently and can master physics deeper. On the contrary, in a real condition, the physics learning process is far from what it should be. The students are sitting and listening thoroughly all their teacher information so the active interactions are lack. According to the information gathered from one of the physic teacher at SMA Negeri 4 Banda Aceh, a difficult topic to understand by the students is rotational dynamic. In this case, the students' scoring data becomes an indicator in understanding this topic. Based on the data, the students' grade on rotational dynamic topic is under the minimal score which is 75. The low grade is caused by several

factors, one of them is the teaching method used by the teacher. The teaching method is not varied. Lecturing and teacher centered is so often used that the students tend to be passive and dependent. By implementing those methods, learning physics becomes less interesting so the students' understanding becomes low. Therefore, an innovative learning needs to be considered in order to improve students' ability to study independently and to understand the physics concepts well.

One of the innovative teaching methods that can be implemented in learning physics is problem based learning (PBL). PBL is a learning model facing the students to a contextual physics problem. With the whole knowledge which the students have, they are expected to solve the problems containing the rich physics concepts. However, before teaching the teacher has to give a fundamental concept so well in each material. It aims to avoid his students having a misconception between theory and its implementation. In PBL, the students are working together as a group to figure out a problem solving and most importantly they can improve their ability to solve the problems and make a decision.

Besides the innovative method, teaching material is also needed in the independent learning to understand the physics concepts. According to Elfis (2010) teaching material is all kind materials used by the teacher to help him in teaching. Recently, most schools rely on students' worksheet as the source of teaching material but it still cannot help to improve students understanding and to train them to study independently. Other teaching materials should be used.

One of the teaching materials which can be used to teach rotational dynamic is *handout*. Based on Annis (2011), the use of *handout* in a group of study can increase students learning independency; therefore, it is expected to improve students' independency when studying and to ease students in comprehending physic basic concepts. It also helps to maintain a consistency in delivering the material. According to the writer's observation after conducting a case study at SMAN 4 Banda Aceh, it can be concluded that the use of *handout* is never be implemented in physic teaching and learning process.

METHOD

This research uses *quasi experimental research* because this method is appropriate to be conducted in educational research provided that many factors can influence the result of the investigation which is difficult to control.

The research design used as a basis to conduct this research is *Pretest-Posttest Control Group Design.* The population is taken from all science program students grade XI of SMA Negeri 4 Banda Aceh which consist of 6 classes. Based on the population data, *purposive sampling* method is used to determine the class that become the sample. The pretest decided that the students who have low understanding in physic concepts becoming the sample. Class XI IA 5 is chosen as a control group and class XI IA 6 is experimental group. Each class consists of 30 students.

This research is conducted in the even semester year 2013/2014. The learning stage begins with giving the pretest to both the experimental class and control group to measure concept understanding and learning independency. The next step is giving a treatment. The treatment for the control group is a conventional teaching method such as lecturing and teacher centered, while the experimental group is given the PBL model and *handout*. Before giving the treatment, the students are provided with the basic concept about rotational movement and its relation to rotational dynamic with the help of the given handout. The handout is specially designed and compiled as interesting as possible based on the basic physics concept which relates to a daily life, so that the students are interesting in reading the handout and it also can improve their ability in comprehending rotational dynamic. Furthermore, the handout is also designed to help the students solve the rotational dynamic problems found in the daily life more skillfully. At last meeting, posttest is given in the both classes to measure the students' understanding and learning independency level. The students are also asked to fill a questionnaire about learning independent.

Instruments used in this research are questionnaire sheet and concept understanding test. The questionnaire sheet measures students' independency in learning. Based on some reviews about the theory of students' learning independent, they are six indicators such as (1) are not dependent to other people, (2) be confident, (3) have goal or target, (4) want to get an achievement, (5) have a self initiative, (6) evaluate the learning process and the study result. Meanwhile, the test (pretest and posttest) is 20 multiple choices form. Both instruments are being tested for the validity and reability.

RESULT AND DISCUSSION

The learning process for rotational dynamic material using PBL and handout as a media

was done in class XI IA 6 SMA N 6 Banda Aceh. Before applying PBL in learning rotational dynamic material, the students were provided with rotational movement material first. In applying PBL, the students were divided into several small groups containing five students in each group. Generally, it was noted that there is a significant changes from the level of the students' independence and liveliness during the learning process. In addition, learning using PBL method and handout as a media to deliver the material and to discuss rotational dynamic problems shows the students' concept understanding better.

PBL along with the use of handout is an interesting way to study, to solve physics problem and to transform learning habit. The reason why it becomes such an interesting way to study is because it offers an enjoyable and fun learning situation. In a usual way, the students are asked to learn all the physics formula, to memorize it, and then to use it to answer a question. This conventional way does not help them sharpening their basic concept understanding in depth. So, PBL becomes is an alternative way to teach physics in a fun way.

The basic concept of rotational dynamic material given to the students was covering all materials which are based on physics standardized competence and basic competence for the students of class XI. In this research, the improvement of the concept understanding on rotational dynamic was gained from pretest and posttest that is already given. The first bar chart below shows a comparison of the mean score of rotational dynamic concept understanding achieved from both tests.

In PBL learning, the students are asked to solve the problems actively, to determine what kind of concept needed to answer the question by gathering information also by applying the basic concept that is already learned. Based on the score improvement on the pretest and the N-Gain mean score, it can be seen that the improvement rose significantly. The post test score at experimental group after implementing PBL and using handout is 79,67% while the pretest score is 27,17% so it means that the posttest score is higher than the pretest score. The result shows the increase in understanding the physics concept in every student after receiving a PBL model and using handout treatment. This alternation was seen from the students' behavior during the teaching and learning process because they are brave to express their opinion based on their strong and good understanding. The students who show a determine desire in following every material are able to comprehend the concept better so they are active in using their ability to figure out the problem solving with the help of the handout, in fact there is a student who asked a difficult question to challenge himself. In addition, the male students are able to comprehend the material faster than the female students. In solving the physics case, the female students need a little longer time to solve it on the contrary the male students can finish the case faster.

The concept understanding occurred in every student can be reviewed according to every student N-Gain score. It is shown in the Figure 2.

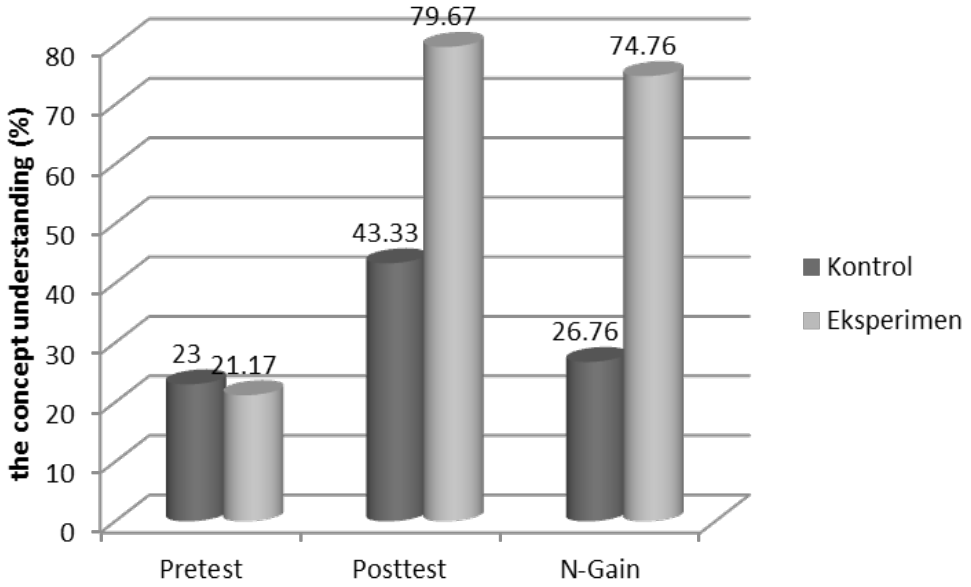


Figure 1. The Mean Score Percentage Comparison of Pretest, Posttest, and N-Gain in Understanding the Concept of Experimental Group and Control Group

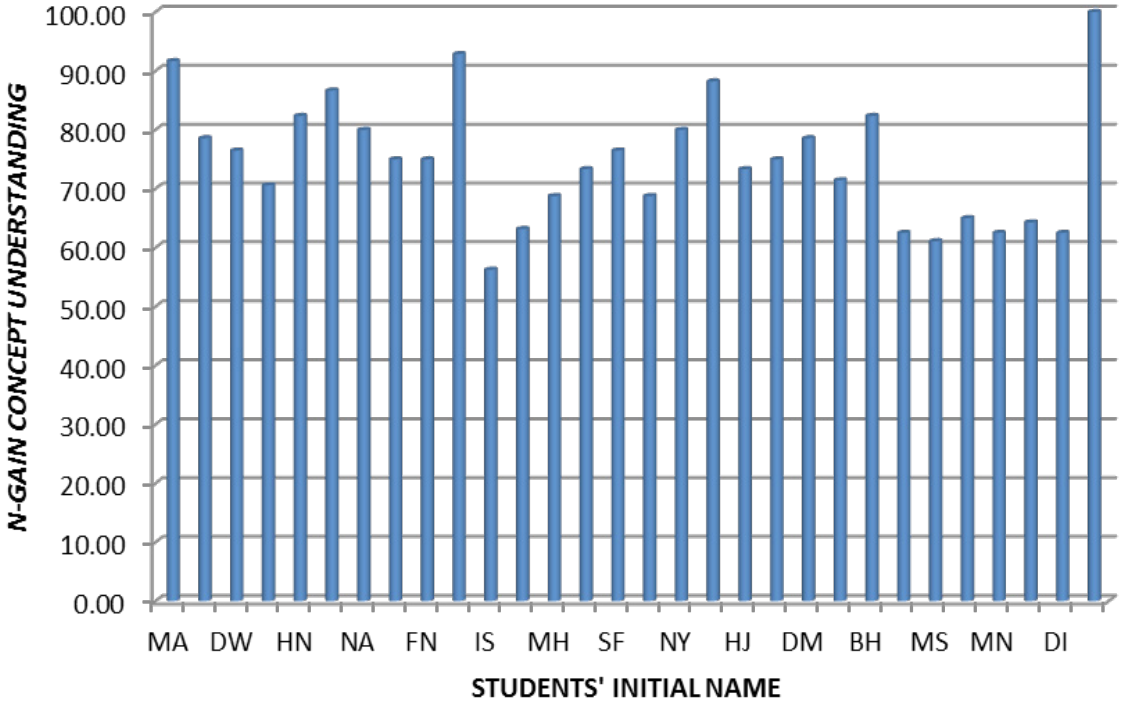


Figure 2. The *N-Gain* Score in Concept understanding in Every Student

Based on the figure 2, the students' concept understanding has improved better. The students who achieve the highest N-Gain score above 80 are 7 students and there is only student who gets 100. Meanwhile, there are 10 students who get the score under 70 or 30% students are categorized unaccomplished and there is a student who gets the lowest score which is under 60. This is happened because some students did not master nor had a full understanding on the angle momentum material. Many students answered the question incorrectly. There are only two students who answered the question correctly, one student is having full understanding about the material and the other one is just guessing. In short, it shows that the handout especially in presenting the angle momentum material is not easily understood by the students. They get confused in applying the concept to answer the angle momentum question, especially in a form of question story.

By developing a new concept through the problem needing to be done, the students have succeeded in improving of the concept understanding especially in rotational dynamic material wider although it needs time to implement it. The implementation of PBL and the use of handout become an interesting way for the students to study. The handout helps the students to comprehend the basic concept to solve the physics problem. This is supported by Piaget (Ibrahim, 2004) who says that a good pedagogy must involve the students to do an experiment independently, to ask a question, to discover a problem solving themselves and to match what they discover to other problems, to compare their finding to other findings. According to the two independent sample t test on $\alpha = 0,05$, it shows a significant discrepancy of the concept understanding improvement between the experimental group and control group after applying PBL learning method. Gamze's research in 2003 also shows that PBL learning method used in physics is significantly improve the students competence in mastering dynamic and kinematics concept. Sahin (2010) and Wardana (2012) say in their research that students who receive PBL model treatment have a critical thinking ability and have a physics understanding better than that conventional model.

This research has revealed that applying PBL and handout give a positive influence in order to improve the students' concept understanding, especially rotational dynamic concept. The students' attention and active participation are excellent. They can express their opinion and idea confidently and can work well together with their group. Some students who are not too sharp looked very enthusiastically in solving the given problem and they proposed some ideas to solve the problem according to their daily life experience.

This research is not only investigate how the model influences the students' concept understanding but it also investigate how it affects the

students' independence. To calculate the score of the students' independence begins with calculating the mean score of the students' statement, whether it is positive or negative. Then, the data were calculated by using MSI method, the Microsoft Office Excel 2007. The comparison of the mean score percentage of the pretest, posttest, and N-Gain of the students' independence learning between experimental and control group is shown in the Figure 3.

According to the pretest and posttest data on figure 3 above, it is shown that the independence study on the students at experimental and control group is rising 14 % and at the control group is rising 10 %. It shows that the alteration on the students' independence study is happened after applying PBL and using the handout. However, the data also shows that the N-Gain mean score on the students' independence study at experimental group is higher than that of the control group. The N-gain mean score at the experimental group is categorized into a Fair category, while the N-gain mean score at the control group is categorized into a Low category.

The mean score of the students' independence study can be reviewed based on every developed indicator. The percentage of the N-Gain independence study mean score from an ideal score in each indicator is shown as in the Figure 4. Figure 4 above shows the percentage of the N-Gain mean score in independence study at the experimental group with fair category occurred in indicator number 1, 2, 3, and 4. The highest percentage happened in indicator number 3, deciding goal/target of the study, is 45, 92%. At this stage the students are aware that learning physics is not only memorizing all the formula but also understanding the concept well because it relates with the implementation on their daily life. On the other hand, the lowest N-Gain mean score, 15,01%, happened in indicator number 5 that is behaving based on own initiative. In this case, there are the students who have not read the handout yet so when the physics problem was given to them, they needed some times to finish it and asked for help from their friends to help solving the problem. Besides, they had not accustomed to PBL and handout since they were accustomed to conventional learning which resulted a passive and quite students. so, it takes a little longer time to alter their habit.

This research also shows the students independence while studying through PBL model along with the handout. The result says that the students' independence in teaching and learning process is higher than before because PBL promotes a class discussion and question and answer session. Furthermore, the use of handout in PBL works very well to train students' independence. When they are get confused or do not remember the physics concept, they will read the handout voluntarily. This is supported by Mikits (2009) who says that in learning process, the students can use handout to gather, to process, and to access information faster and easier than before.

Based on the explanation above, it can be concluded that the improvement of the independence study through PBL model and the handout is considerably better than that of conventional way. The result of this research is consistent with the previous research conducted by Afandi (2012) and Fidiana (2012) which shows PBL learning model, compare to conventional way, in fact can improve the students' independence in learning material. Other research investigated by Annis (2011) also says that the use of handout in

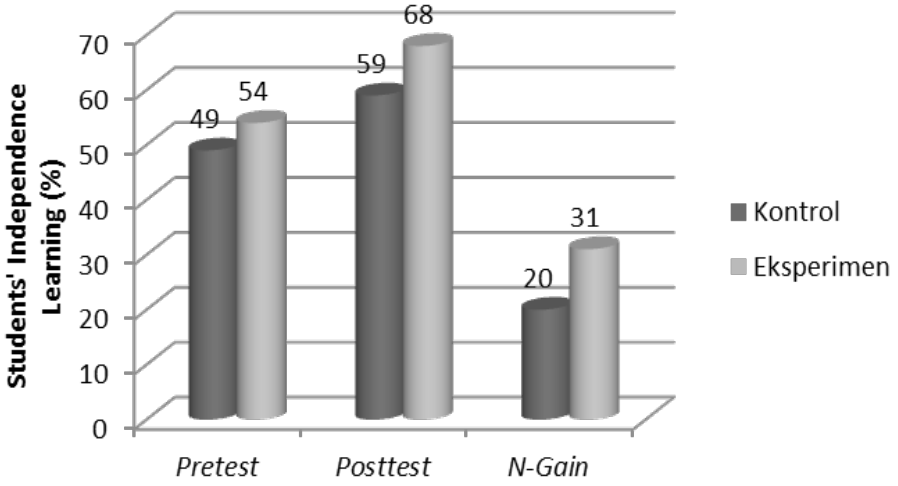
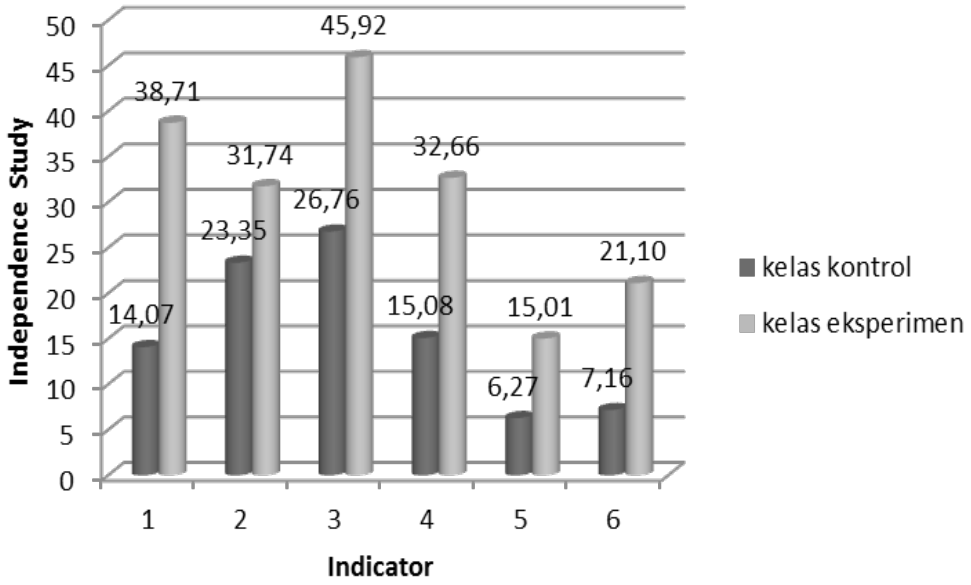


Figure 3. The comparison of the mean score percentage of the pretest, posttest, and N-Gain of the students' independence learning between experimental and control group



Indicators :
1 = Being independent
2 = Having self confident
3 = Deciding goal/target of the study
4 = Desire to get high achievement
5 = Behaving based on own initiative
6 = Evaluating the process and learning result

Figure 4. The N-Gain Comparison on Independence Study between the Experimental and Control Group Based on Each Indicator

a group of study can increase the students' independence in studying a lesson.

CONCLUSION

Based on this research, it can be concluded that the implementation of PBL teaching method and the use of handout for the rotational dynamic material increase the learning independence and the students' concept understanding. The result shows the male students can master the rotational dynamic material faster and more independent than the female students. The female students need some time to comprehend the material.

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