JISE 8 (1) 2019 : 43 - 48

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

Problem Based Learning with Metakognitive Strategy to Improve Concept Understanding

Noor Hidayah✉, Fatimah Primadian Farumananda, Ngurah Made Darma Putra, Sugianto

Graduate School Universitas Negeri Semarang, Indonesia

Article Info

Article History:
Received January 2019
Accepted February 2019
Published April 2019

Keywords:
Concept Understanding, Metacognitive Strategy,PBL.

Abstract

Understanding concepts is one of the abilities students must possess to solve problems. PBL can improve understanding of concepts. One strategy that can be used in learning is metacognitive strategies. Metacognitive strategies help students in thinking about solving problems. This study aims to examine the effect of PBL with metacognitive strategies on the concept of understanding. The study used a qualitative method, while the research design with the type of pre-test post-test control group design. Data retrieval uses reasoned multiple choice questions to measure understanding concepts in optical device materials. The results showed that PBL with metacognitive strategies had an effect on improving understanding of physical concepts. The metacognitive strategies used in PBL learning train students for planning, information management, monitoring, improvement and evaluation in solving physical problems. Concept understanding in the control class using PBL increases with low criteria and the experimental class uses PBL with metacognitive strategies increasing with the medium criteria.

✉ Alamat korespondensi:
Kampus Pascasarjana Jl Kelud Utara III, Semarang 50237
E-mail: noorhidayah1993@yahoo.co.id

p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

Physics learning cannot be separated from a foundation or principle. The basis or principle of knowledge is called the concept. The aim of studying physics in the 2013 curriculum is to master the concepts, principles, have the skills and confidence as a provision for continuing higher education and developing science and technology (Depdiknas, 2006).. Based on these objectives students must understand a concept that is being studied and have problem solving skills to get a knowledge.

A student must also have a good understanding of the concepts learned during learning. Understanding is finding the meaning of teaching messages in the form of oral, written and communication charts (Krathwohl, 2002). The indicators used in the process of understanding the concepts of students include interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. Understanding the concept of a person can be seen from the way of explaining the concept that was received, then using the concept in accordance with circumstances that can have an impact or phenomenon for students.

Research related to understanding concepts is not something new. Most students can solve problem solving in a mathematical form but do not understand the underlying concept (Ratnasari, 2017). The low understanding of students' concepts leads to the emergence of misunderstandings in understanding physical material. Understanding the wrong physical concepts will result in errors in understanding other concepts.

A good understanding of concepts can be done by providing positive beliefs at the beginning of learning (Sahin, 2009). Positive beliefs have a high impact on students' attention to learning physics. According to Gaigher et. al (2007) concept understanding can be improved by providing problem-based learning. Contextual problems that are close to students' lives. Activities in PBL use student activities and scientific thinking processes so that they become logical, orderly, and rigorous which impact on understanding concepts (Belland et al., 2006). Setyorini et al. (2011) show that PBL consists of stages of a process that can improve students' critical thinking skills, student independence, and work together in heterogeneous groups. The heterogeneous group discussion process facilitates students to be active and there is a scaffolding process that optimizes students' critical thinking skills.

Problem solving can be improved by using metacognitive strategies. The use of metacognitive strategies helps students in planning learning, monitoring learning activities, and evaluating learning outcomes (Shareeja & Gafoor, 2014).

According to Hidayati (2010) shows that metacognitive strategies enhance understanding of concepts by motivating students to learn, cooperate, be independent and stimulate curiosity. Metacognitive strategies can improve understanding of scientific concepts that cause students to possess declarative knowledge and procedural knowledge (Wagaba, 2016). The use of metacognitive skills refers to mental processes that are organized systematically, logically, and full of self-reflection so that students can use knowledge well.

Metacognitive strategies in learning are helping students design, monitor and control what is known, what needs to be done and how to do it (Maulana, 2008 & Namira et al., 2014). Learning by using a metacognitive model can make students carry out metacognitive processes such as planning, monitoring, and reflection which lead to increased understanding of concepts (Ariwahyuni et al., 2014). Students also get skills in counting and fostering interest in learning.

Research on PBL and metacognitive strategies has been carried out. PBL and metacognitive strategies are effective in enhancing concept understanding. However, research on PBL with metacognitive strategies is still rare. Based on the background of the above problems, research was conducted using the Problem Based Learning (PBL) model with metacognitive strategies to develop an understanding of physics concepts.

METHODS

Research uses qualitative method. The study was conducted at SMA Negeri 1 Kudus on the material of optical equipment. The study used Pretest-Posttest Control Group Design. The population in this study were students of class XI SMA Negeri 1 Kudus in the academic year of 2017/2018. XI MIPA 8 as a control class with a total of 31 students using PBL learning, while XI MIPA 9 as an experimental class with a total of 31 students using PBL learning with metacognitive strategies.

The instrument used in the study is a reasoned multiple choice test to measure students' conceptual understanding. Pretest and posttest scores obtained by students are obtained from the total number of student answers. More complete calculations are obtained from following equation.

$$Score = \frac{Correct\ score}{Maximum\ score} \times 100\%$$

The correct score obtained by students shows the ability to understand the concept. Calculation of normalized gain values using the following equation.

$$g = \frac{Post\ Score - Pre\ Score}{Max\ Score - Pre\ Score} \times 100\%$$

The gain of the gain score uses a score obtained from the pretest and posttest scores. The results of normalized gain scores are then categorized into three categories. The following results of the Gain Criteria in Table 1.

Table 1. Normalized Gain Criteria

Percentage	Criteria
$0\% < g \leq 30\%$	Low
$30\% < g \leq 70\%$	Medium
$70\% < g \leq 100\%$	High

The N gain criteria obtained from the control class and the experimental class show the increase obtained from both classes. The pretest and posttest values of both classes were also tested for normality and homogeneity tests to find out that both classes were normally distributed or not and had the same variance or no. Furthermore, the average similarity test (t test) is used to determine the differences between the two classes.

RESULTS AND DISCUSSION

Data retrieval begins with giving a pretest in the control class and experimental class to find out the initial conditions of the two classes. The treatment of both classes used PBL for the control class and PBL with metacognitive strategies for the experimental class. The material provided is the material of optical equipment. At the last second meeting the class was given a posttest to find out the achievement and improvement of the concept understanding due to the treatment of each class.

Normality test uses the Kolmogorov-Smirnov test with the help of SPSS. Here are the results of the normality test in Table 2.

Table 2. Normality Test

No	Data	Sig
1	Pretest	0,066
2	Posttest	0,052

The significance obtained at the pretest and posttest has different values. In Table 2 shows the significance value of pretest and posttest data > 0.05, and the significance level of 5%. So the data comes from a population that is normally distributed, then the data is analyzed using parametric statistics. The homogeneity test used in this study is the Levene test with the help of SPSS. The following results of the homogeneity test in Table 3.

Table 3. Homogenity Test

No	Data	Nilai Sig
1	Pretest	0,083
2	Posttest	0,058

In Table 3 shows the significance value of pretest and posttest data > 0.05, and the significance level of 5%. So both groups have the same (homogeneous) variance. The average equivalence test used was using the Independent t-test with the help of SPSS. Following are the results of the average similarity test in Table 4.

Table 4. Average Equation Test

No	Data	Sig
1	Pretest	0,121
2	Posttest	0,018

Table 4 shows the significance value of the pretest data > 0.05, and the significance level of 5%. So the two classes are in the same condition (not significantly different) at the beginning of learning. The significance value of the postttest data < 0.05, and the significance level of 5%. So both classes have significant differences. The average value of understanding the concept of the control class and experimental class can be seen in Figure 1.

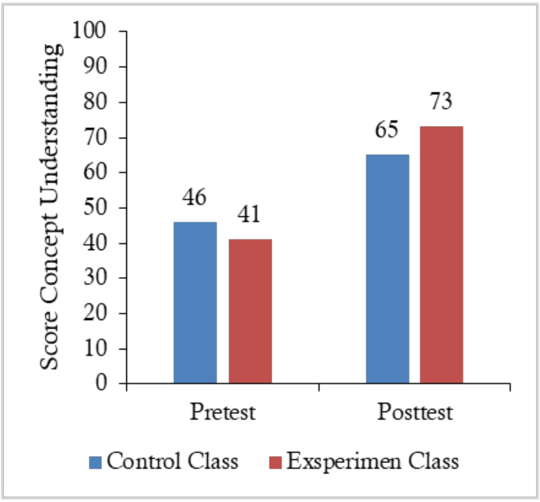

Figure 1. Concept Understanding Value

Figure 1 shows that the value of understanding the concept of the control class and the experimental class. The pretest value shows that concept understanding in both classes has the same ability, while the posttest value shows that the understanding of the concepts of the two classes is not the same. This is because there are different learning treatments in both classes.

The influence of PBL with metacognitive strategies on understanding concepts is that students become more active in solving the main problems. Metacognitive strategies help students understand physical material from simple to complex by solving simple problems. According to Mariati (2012) shows that metacognitive strategies are aware of fulfilling intellectual needs by finding lots of information in dealing with problems by finding solutions. The collection of information carried out applies analytical skills such as representing, comparing, classifying, comparing and concluding. Understanding of the concepts being studied becomes directed and students know which ones must be understood or not understood. In PBL the control class is not asked to solve simple problems before solving the main problem. Students learn to solve the main problem becomes un directed. The increase in each class can be seen in Figure 2.

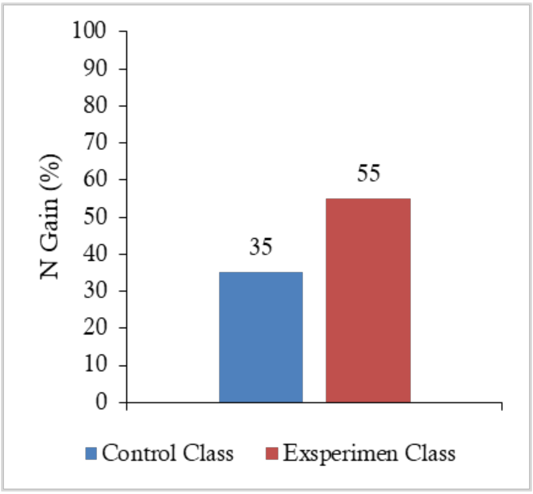

Figure 2. Increased N Gain

Figure 2 shows that the increase in N gain of the control class is 0.35 with a low criterion and the experimental class 0.55 with the criteria being medium. The effect of treatment on both classes shows an increase. In line with Mariati (2012) & Faizah (2013) research which shows that PBL learning can improve understanding of concepts with medium criteria.

Increased gain shows PBL with effective metacognitive strategies applied in the learning of optical equipment materials to improve understanding of physics concepts. This is in line with the research of Dwi et al. (2013) which shows the use of strategies in PBL learning is more effective than ordinary PBL in improving concept understanding.

PBL with metacognitive strategies in physics learning is a problem-based learning model using the metacognitive strategies of students. The learning process involves teacher guidance so students can understand the concept of physics. PBL with metacognitive strategies helps students to receive physical knowledge during the learning process. This is in accordance with the research of Rahayu & Azizah (2012) showing that PBL with metacognitive strategies can improve students' metacognition knowledge by implementing the learning syntax that has been adjusted between PBL and metacognitive strategies. High school students can already realize well their abilities and control their learning process from planning to evaluating themselves after solving problems (Sukowati et al., 2017).

PBL with metacognitive strategies improves understanding of physics concepts by solving problems found in teaching materials. Problems presented in the form of questions can improve students' metacognitive skills (Jamaluddin, 2009). The problems that are solved cause students to get an understanding of physics. PBL contributes to understanding concepts by knowing the principles of physics (Tasoglu & Bakac, 2014; Shishigu et al., 2018).

CONCLUSION

Based on the results of the research and discussion above, there is a significant difference in concept understanding between students who use PBL and PBL with metacognitive strategies. Improved understanding of concepts in the control class is in the low criteria and the experimental class is in the medium criteria.

REFERENCES

Ariwahyuni, Japa, & Sumantri. (2014). Pengaruh Model Pembelajaran Metakognitif Terhadap Pemahaman Konsep Matematika. e-Jounal Mimbar PGSD *Universitas Pendidikan Ganesha*, 2(1), 1-10

Belland, B,. Ertmer, K., & Klein, A., (2006), Perception of The Value of Problem-Based Learning Among Students with Special Needs and Their Teachers. *The Interdisciplinary Journal of Problem-based Learing*, 1(2), 1-18.

Depdiknas. (2006). *Peraturan Menteri Pendidikan Nasional (Permendiknas) No 23 Tahun 2006 tentang Standar Kompetensi Lulusan Untuk Satuan Pendidikan Dasar dan Menengah.* Jakarta: Badan Nasional Standar Pendidikan Nasional (BNSP).

Dwi, I. M., arif, H., & Sentot, K. (2013). Pengaruh Strategi Problem Based Learning Berbasis ICT Terhadap Pemahaman Konsep dan Kemampuan Pemecahan Masalah Fisika. *Jurnal Pendidikan Fisika Indonesia*, 9(1), 8-17.

Faizah, Miswadi, S. S., & Haryani, S. (2013). Pengembangan Perangkat Pembelajaran Berbasis Masalah untuk Meningkatkan Soft Skill dan Pemahaman Konsep. *Jurnal Pendidikan IPA Indonesia*, 2(2), 120-128.

Gaigher, E., Rogan, J. M., & Braun, M. W. H. (2007). Exploring the Development of Conceptual Understanding through Structured Problem-solving in Physics. *International Journal of Science Education*, 29(9), 1089-1110.

Jamaluddin. 2009. Pemberdayaan Berpikir Melalui Pertanyaan dan Strategi Kooperatif untuk Meningkatkan Keterampilan Metakognitif Siswa. *Jurnal Ilmu Pendidikan*, 16(3), 191-200.

Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory Into Practice*, 41(4), 212-218.

Mariati, P. S. (2012). Pengembangan Model Pembelajaran Fisika Berbasis Problem Solving untuk Meningkatkan Kemampuan Metakognisi dan Pemahaman Konsep Mahasiswa. *Jurnal Pendidikan Fisika Indonesia*, 8(2), 152-160.

Namira, Z. B., Kusumo, E., & Prasetya, A. T. (2014). Keefektifan Strategi Metakognitif Berbantu Advance Organizer untuk Meningkatkan Hasil belajar Kimia Siswa. *Jurnal Inovasi Pendidikan Kimia*, 8(1), 1271-1280.

Rahayu, P. & Azizah, U. (2012). Students' Metacognition Level Through of Implementation of Problem Based Learning with Metacognitive Strategies at SMAN 1 Manyar. *Unesa Journal of Chemical Education*, 1(1), 164-173.

Ratnasari, D., Sukarmin, S., & Suparmi, S. (2017). Effect of problem type toward students' conceptual understanding level on heat and temperature. *Journal of Physics*, 909 (012054), 1-10.

Shishigu, A., Hailu, A., & Anibo, Z. (2018). Problem-Based Learning and Conceptual Understanding of College Female Students in Physics. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(1), 145-154.

Sahin, M. (2010). Effects of Problem-Based Learning on University Students' Epistemological Beliefs About Physics and Physics Learning and Conceptual Understanding of Newtonian Mechanics. *Journal Science Education Technologi*, 19, 266-275.

Setyorini, U., Sukiswo, S. E., & Subali, B. (2011). Penerapan Model Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan Fisika Indonesia*, 7(1), 52-56.

Shareeja, A. M. C. & Gafoor, A. K. (2014). Does the Use of Metacognitive Strategies Influence Students' Problem Solving Skills in Physics?. *IOSR Journal Of Humanities And Social Science,* 19(11), 48-51.

Sukowati, Rusilowati, A., & Sugianto. (2017). Analisis Kemampuan Literasi Sains dan Metakognitif Peserta Didik. *Physics Communication*, 1(1), 16-22.

Tasoglu, A. K. & Bakac, M. (2014). The Effect of Problem Based Learning Approach on Conceptual Understanding in Teaching of Magnetism Topics. *Eurasian Journal of Physics and Chemistry Education*, 6(2), 110-122.

Wagaba, F., Treagust, D. F., Chandrasegaran, A. L., & Won, M. (2016). Using Metacognitive Strategies in Teaching to Facilitate Understanding of Light Concepts Among Year 9 Students. *Research in Science & Technological Education*, 34(3), 253-272.