

IMPLEMENTATION OF PROBLEM BASED LEARNING IN DYNAMIC FLUID LESSON TO INCREASE PROBLEM SOLVING SKILL STUDENT'S CLAS XI ON SMAN 1 JEMBER**Elfandari Anindito Kartika Putri, Budi Jatmiko**Physics Education, Faculty of Mathematics and Natural Sciences, State University of Surabaya
Email: elfandari.elfandari@gmail.com**Abstract**

This research aimed to describe the student's problem solving skills on dynamic fluid topic after applied problem based learning model. The pre experimental research adopted one group pre-test post-test design applied to 106 student at 11th grade in SMAN 1 Jember. This research use three class (XI MIA 1, XI MIA 2, and XI MIA 3) totaling 106 students. Before applying the problem based learning model, student were given a pre-test to measure the initial condition of the students, Pre-test given in the form of problem-solving problems. Then apply the problem learning model on the dynamic fluid material. After applying the learning model, the student was given a post-test in the form of problem solving problem. The data obtained were analyzed using paired t-test, n-gain, and ANAVA. The results showed that learning was done with good category. Problem solving skills in all three classes experienced consistent and significant improvement at $\alpha = 5\%$ and n-gain for each category indicator. Positive response is shown by all students in all three classes to the learning model based on the problem that has been implemented.

Keywords: Problem Based learning, student's Problem solving skill, Fluid Dynamic, Senior High school students

INTRODUCTION

The development of various fields of life in the 21st century very rapidly causing the competition becomes tight. It make individuals must have competencies or skills. One of the skills required is a problem-solving skill. Marjohan,(2013) education in the 21st century is emphasized in critical thinking skills and problem solving, creativity and innovation, communicating, working together. Education is conscious and planned effort to change human behavior through learning and training. The learning challenges in 21st century require teachers' pedagogical skills to create learning innovations that can support and improve student's problem-solving skills.

Problem is situation faced by individuals or groups when they can not solve in general way. Every individual will always face problems with various forms in his life. Problems in life not only a simple problem but also a very complex problem. If a problem is given to the student and the student immediately knows how to solve it correctly, then the problem can not be said as a problem.

Learning physics can not be separated from daily life, because this is where the basic knowledge students gained. The concepts contained in Physics are not only to be memorized but also to be understood and practiced. learning Physics learning is closely related to problem-solving skills. Almost all aspects of Physics learning

require problem-solving skills, both practical and theoretical. The purpose of the subject of physics is that students can develop reasoning abilities in analytical thinking by using physics concepts to explain natural events and solve problems both qualitatively and quantitatively.

In learning Physics should emphasize in thinking skills and practice to solve problems. (Amelia, 2014) explains that problem-solving skills can improve skills more than basic skills so students can face new problem situations. Problem-solving skills are important to develop. This is because the most of the learning activities involve the problem-solving process. The importance of Physical problems is inseparable from its role in life, which is to develop the skills and knowledge of a person in facing a problem. Besides, According to the results (Rokhmawati , 2016; , Choi, E, 2012; Maria F, 2012) the application of PBL can increase students' self-actualizes in communication in the classroom, critical thinking, and self.

Indicator of Physics problem solving skills using I SEE. The I-SEE solving indicators are (1) identifying relevant physics issues and concepts (identify); (2) plan for problem solving (set up); (3) implementing and developing an execute plan; (4) evaluate the completion of the problem (evaluation) (Young, 2012).

Learning physics in Curriculum 2013emphasize learning-oriented students, students are required to be

actively involved in learning and take responsibility for themselves in solving a problem to understand the concepts and facts in physics. The curriculum 2013 expect students to solve the problems given during the learning activities. Under these conditions, teacher should be able to create lesson plans which can make students can improve problem solving skills.

During the observation at SMAN 1 Jember, thirty two students were given a test of twelve questions in accordance with indicators of problem solving skill on dynamic fluid material to 36 students to know problem solving skill. This test uses a scale of 0-100. Results show that the average score of 36 students is (1) identifying problems and concepts of 17.25%, (2) planning problem solving 12.73%, (3) implementing and developing a settlement plan of 11.51%, (4) evaluate the completion of 12.17%. Based on the test result, it can be seen that the level of problem-solving skills of students at SMAN 1 Jember still low.

Based on the facts in the field, the results of observations and interviews with physic teacher showed that almost of learning physics using discussion and direct instruction method.. This is because direct instruction (teacher-centered) does not spend much time and lots of physics material being taught. Submission of physics material is given directly to the students making learning less memorable which will cause the problem solving skills of students not increased or trained. It is also in line with the research that has been done by Duong[8] which states that students' problem solving skills at three universities are influenced by the way educators teaching.

One alternative solution to solve this problem is applying student-centered learning model which can improve their problem-solving skills. This is supported by several researchers including Selcuk, (2013) which states that there is a significant difference between the application of the problem-based learning model to the a(pplication of the conventional learning model. Riati, 2015) reveals that by applying the problem-based learning model (PBL) to the material of the pythagoras theorem, each phase of the solving skills problems have improved. (Henk G. Schmidt et al, 2011; Yew et al, 2016; Puspita, 2016) show that each phase of the problem-based learning model can improve student learning outcomes and problem-solving skills. In addition, (Destianingsih, 2015) said that there is an influence of Problem Based Learning model of learning on student problem solving skills.

The Problem-Based Learning Model (PBL) is learning model which is presenting a problem, asking questions, facilitating an investigation, and opening a dialogue. Problem based learning is designed to achieve

learning objectives such as solving problems, investigating, understanding and helping students become active and independent learners. (Sani, 2015). Developing collaborative skills among students and helping each other is needed in the implementation of problem-based learning (PBL) to investigate and solve problems together. Students are taught to be active investigators that make them think about problems and skills By applying the problem-based learning model so students are skilled in solving problems, both related to academic problems and daily life. Based on the problem solving skills indicator revealed by (Young, 2012) (1) identifying the problem (identify); (2) plan for problem solving (set up); (3) implementing and developing an execute plan; (4) evaluate the completion of the problem (evaluation) in accordance with the syntax of the problem-based learning model.

From the introduction, it is necessary to conduct research on "implementation of problem based learning in dynamic fluid lesson to increase problem solving skill student's class XI on SMAN 1 Jember". This research aimed to describe the improvement of student problem solving skills on dynamic fluid material after the application of learning model based on the problem.

METHOD

This research uses pre experimental design with one group Pretest-Posttest Control. The research design is shown in Figure 1.

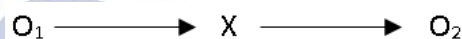


Figure 1. Research design

Description:

O₁: The pre-test value (before being given)

O₂: Post-test value (after treatment)

X : Application of Problem-Based Learning Model

The research design uses three classes, namely, XI-MIA 1, XI MIA -2 and XI MIA-3 by providing the same treatment that the delivery of dynamic fluid materials with the application of problem-based learning. In general, the design of this study is illustrated as shown in Table 1

Table 1. Research design

Class	Pre-test	Variabel Bebas	Post-test
XI MIA 1	O ₁	X	O ₂
XI MIA 2	O ₁	X	O ₂
XI MIA 3	O ₁	X	O ₂

Description:

O₁: The pre-test value (before being given)

O₂: Post-test value (after treatment)

X : Application of Problem-Based Learning Model

The subjects of the research were students of SMAN 1 Jember class XI MIA 1, XI MIA 2, and XI MIA 3 with total student number 106 students. Data collection methods used consisted of observation method, test method (pre-test and post-test) and questionnaire method (student response questionnaire).

Before taking the data research, firstly tested the problem solving skill on the students who have received the dynamic fluid material, the students of class XII. The test questions are done to determine the feasibility of the questions that will be used for pre-test and post-test. This feasibility test covers the level of difficulty, item sensitivity, validity, and reliability. A decent question, used as a matter of pre-test and post-test, consists of 40 multiple choice questions according to the problem solving skills indicator.

Data obtained from this research are the data on the assessment of the implementation of learning, the results of students' problem solving skills assessment, and student responses. Implementation of learning is the consistency of the way of learning by teachers in accordance with the syntax or stages of learning models based on the problems that have been planned and listed in the RPP (Learning Implementation Plan). Learning is said to be accomplished when the phases or stages in the problem-based learning model get the grades in good category according to the Lesson Plans (RPP). The data on the implementation of learning is obtained by observation at the time of learning is in progress. In the learning that acts as a teacher is a researcher. The observations were made by two observers: physics teacher and physics student. Observations were assessed by using the observation sheet of learning implementation and carried out from the beginning to the end of the learning activities using a problem-based learning model.

The data of problem solving skills is obtained by giving pre-test and post-test questions to the students. The pre-test and post-test issues are the same. The problem form used in the pre-test and post-test is a multiple choice with 40 questions corresponding to the problem solving skills indicator. The pretest question is given to the students prior to the learning with the problem-based learning model to determine the students' initial ability. After learning, students are given post-test questions to measure students' problem solving skills. The students' pre-test and post-test values were then analyzed using paired t-test, n-gain and ANOVA.

Student response is obtained by fill out student response questionnaire. The questionnaire filled by all students after the learning is complete. In the student response questionnaire there is a statement of teaching

and learning activities, students are asked to express their opinions on learning by problem based learning.

RESULTS AND DISCUSSION

The implementation of learning is assessed by the observation sheet that is filled by the observer. The result of the recapitulation of problem based learning is shown in Figure 2

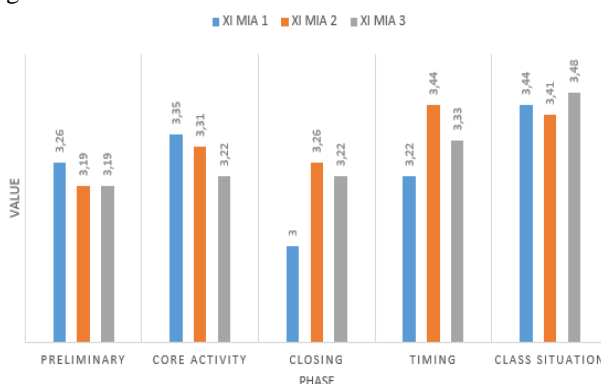


Figure 2 Implementation learning model

In Figure 2, it is known that learning with the problem-based learning model in the preparation stage of the three classes has been well implemented, teachers and students have prepared everything necessary for learning well.

In the preliminary stage teachers get good categories in all three classes. This is because in this phase the teacher displays the video of learning motivation and is able to guide the students to ask questions related to the displayed video. Do not forget also the teacher also convey the purpose of learning to be achieved. In this introductory phase, with students motivated in learning will be able to cause students to feel involved and involved in the learning process.

In the core activities aspect, learning progresses smoothly in accordance with the plan that has been made in the implementation plan of learning. The core activities correspond to the phases of the problem-based learning model, covering the problem-oriented phase, organizing the students, individual and group investigations, developing and presenting the work, and evaluating the process of solving. This means students' problem-solving skills have been well trained.

In the closing aspect the teacher provides an opportunity for students to ask questions about learning materials that have not been understood and also summarize the material that has been taught. At the end of the learning the teachers and students pray together. Based on Figure 2 class XI MIA 1 get the lowest score, this is because the students of class XI MIA 1 less able to conclude the material already taught. At this stage the teacher gets a good predicate on the three classes.

In the aspect of time allocation the teacher is able to arrange the learning in accordance with well-defined time. Observation aspects of the classroom atmosphere of teachers get a good predicate in conditioning the classroom atmosphere, so that students become active but still conducive. Thus, the teacher has been able to provide guidance to the students well so that problem solving can be trained well.

Problem solving skills student can be determined from the pre-test and post-test scores of students analyzed using paired t-test, n-gain, and ANAVA. The result of t-test analysis is shown in table 2

Table 2. The result of paired t-test

class	T_{calc}	t_{table}	conclusion
XI MIA 1	18,13	1,70	H_0 rejected
XI MIA 2	23,59	1,70	H_0 rejected
XI MIA 3	15,46	1,70	H_0 rejected

Paired t-tests were performed to find out the significance of improving student problem-solving skills. Based on Table 4.2, the t_{table} for three classes is equal to 1.70 and t_{calc} class XI MIA 1 for 18.13, for class XI MIA 2 for 23.59, and class XI MIA 3 of 15.46. Obtained $t_{calc} \geq t_{table}$ on the three classes with a real level of 0.05 so it can be concluded that H_0 rejected and H_1 accepted. Based on this, there is a significant difference between the pre-test and post-test after applying the learning model based on the problem, where the post-test value is better than the pre-test value. (Becerra, 2012; Klegeris 2013; Sihalo, 2017; Abdullah, 2010) which stated that students' problem solving skills improved significantly after applying the problem-based learning model.

Based on the knowledge aspect to know the improvement of problem solving skill, the students get the pre-test and post-test value through the average score of each class. In Table 3 is the result of a recapitulation of a gain index analysis.

Table 3. Index Gain Analysis

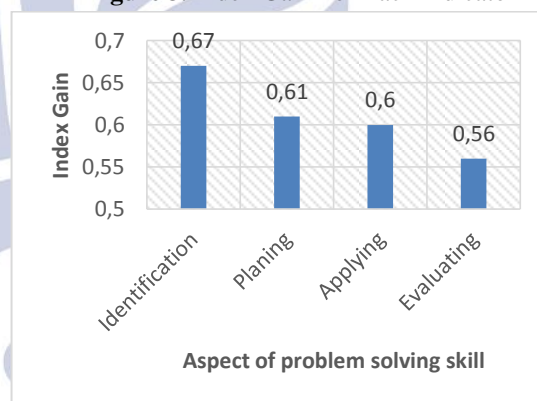
Class	Index gain	Category
XI MIA 1	0,60	Medium
XI MIA 2	0,63	Medium
XI MIA 3	0,58	Medium

Based on Table 2 it is known that the three classes have medium improvement. These results indicate that in class XI MIA 1, XI MIA 2, and XI MIA 3 have an average N-gain of 0.60, 0.63, and 0.58 respectively. The

N-gain results in all three classes have no significant differences. According to Sahyar (2017) this is due to differences in students' problem-solving skills in each class, may affect pre-test and post-test results. According to Hake (1998) shows $0.7 > \langle g \rangle > 0.3$ is included in the medium category. So it can be concluded that the application of problem-based learning model can improve students' problem solving skills in all three classes significantly with medium improvement category. This result is in accordance with the research conducted by Özcan (2014) and Kadir (2016) found that by applying the problem-based learning model the problem-solving skills increased significantly. As well as research from a study conducted by Aziz (2014) it was found that the application of problem-based learning model can understand thermodynamic material better than using conventional learning model. (Hariyanto, 2015) the improvement of learning outcomes with the category is due to the interest of students in learning fluid dynamics is quite good, because the interest of students in learning or motivation to learn can also affect student learning outcomes themselves.

The result of N-gain analysis of each indicator solving the problem in the three classes is shown in Figure 3.

Figure 3. Index Gain For Each Indicator



Based on Figure 3, it is known that all the aspects of problem solving skill's students in three classes are increase. For the aspect of identifying the problem the three classes are in the highest category of the three other aspects. This is possible because in that aspect the student is able to categorize and recognize a problem well so that most of the students can answer the given problem well.

In the planning aspect of problem solving, the three classes also experienced an increase in their pre-test and post-test values. The highest percentage for pre-test and post-test values is in class XI MIA 1. In this aspect of planning the problem solving is related to the student's ability to identify problem solving. In this case the problem relates to daily problems and demands the ability of students to be able to identify problem solving so that they can answer the questions given correctly.

On the aspect of applying problem-solving on the implementation of predefined troubleshooting. For this aspect the highest percentage of pre-test value in Class XI MIA 2 whereas for the highest percentage of post-test value in Class XI MIA 1.

In the evaluation aspect and concludes with regard to the ability in describing from a perception or ability in concluding a breaking problem. The type of problem associated with the explanation requires a high level of thinking. According to Bloom version, this aspect of evaluation is in the realm of C5 so that students in all three classes get a low percentage for the pre-test but increase in post-test value. Class XI MIA 1 gets the highest percentage for pre-test and post-test values.

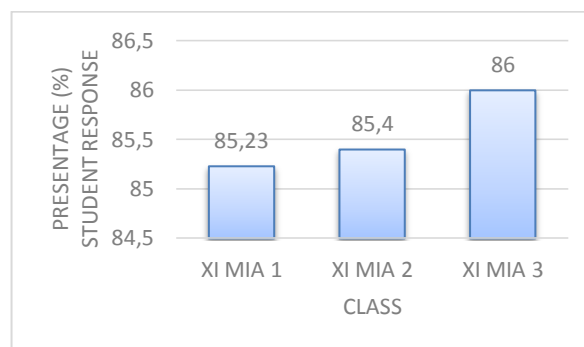
To know consistency of student problem solving skill, consistency test was done using variance analysis (ANOVA). The results from ANOVA are shown in Table 4.

Table 4. ANAVA

Variation Source	Dk	Sum of square	Mean Kuadrat (MK)	F_{calc}	F_{table}
Total	105	2,99	-	0,022 0,028 = 0,78	Lihat tabel untuk 5% (3,07)
Between Group	2	0,044	$MK_{ak} = \frac{0,044}{2} = 0,022$		
In Group	103	2,946	$MK_{ak} = \frac{2,946}{103} = 0,028$		

Based on the table 4, $F_{calc} < F_{table}$. This means that students' problem solving skills are consistently improved in the XI class MIA 1, XI MIA 2, and XI MIA 3. Learning models are said to be effective when there is increase significant with $\alpha = 5\%$, N-gain is at least moderate and consistent. Thus problem-based learning model is applied to improve students problem solving skills. The problem-based learning model has been proven to improve problem-solving skills because students have the opportunity to work independently to construct group comprehension with the problems given by teachers. This corresponds to one of the advantages of the (Arends, 2012) that problem-based learning models can improve problem-solving skills with understanding while working on teacher-provided learning problems. The problem presented is a relevant issue. Argaw (2017) stated that the problems presented to the students contributed in influencing and improving problem-solving skills. consistent with student problem solving skills.

Student response was obtained from student response questionnaire tested after learning process by all students in class XI MIA 1, XI MIA 2, and XI MIA 3. Result of student response shown by Figure 4.



Based on Figure 4, the percentage of student responses is high. (Ridwan, 2010) the higher percentage of student responses obtained indicates a positive student response to the learning that is being performed. Although the three classes have different values but are still in the same category that is very good. The high response of these students supports that the learning model is based on effective problems to be applied in physics learning.

In principle the whole series of this learning process is to help students to see the meaning of matter, in this case is dynamic fluid by way of linking the concept of subject matter with real life everyday. Linking issues with everyday life can make it easier for students to master concepts and problem-solving skills.

CONCLUSION

Based on research data, analysis, and discussion can be concluded that firstly. The results of the implementation of learning management using the problem-based learning model on dynamic fluid materials in class XI MIA 1, XI MIA 2, and XI MIA 3 performed well. The problem-based learning model applied to the dynamic fluid material improves students' problem solving skills significantly at $\alpha = 5\%$ and the improvement is consistent for each indicator with moderate mastery across the three classes. Learning using the problem-based learning model on dynamic fluid material received good response in all three experimental classes.

Based on the research that has been done, there are some suggestions as follows: (1) to more attention for the time when learning takes place so that all information and learning objectives can be delivered properly ;(2) ive attention to the selection of materials, not all can use problem-based learning.

REFERENCES

- Abdullah, N. I. (2010). The Effects of Problem Based Learning on Mathematics Performance and Affective Attributes in Learning Statisticsat Form Four Secondary Level". *Procedia Social and BehavioralSciences*, 370-376.

- Amelia, Ririn, Nora Susanti, Desi Areva. 2014. *Pengaruh Kreativitas, Intensitas Belajar, dan Motivasi Belajar terhadap Hasil Belajar Akuntansi Kelas XII IPS SMA Negeri 2 Sijunjung*. Jurnal Program Studi Pendidikan Ekonomi, STKIP PGRI Sumatera Barat. Vol.4 Nomor 2
- Argaw, A. S. (2017). Effects of Problem Based Learning on Prospective Science Teachers' Problem Solving Skills. *Journal of Mathematics Science and Technology Education*.
- Arrends. (2012). *Classroom Instructional Management*. New York: McGraw Hill Companies.
- Aziz, Majed Saleem. 2014. The impact of PBL on Undergraduate Physics Students' Understanding of Thermodynamics. Dipetik dari [http://eprints.usm.my/29853/1/\(Final\)_Ph.D._Thesis_Majed_Saleem_Aziz_November_2013.pdf](http://eprints.usm.my/29853/1/(Final)_Ph.D._Thesis_Majed_Saleem_Aziz_November_2013.pdf)
- Becerra, Carlos dkk. 2012. *Effects of a problem-based structure of Physics contents on conceptual learning and the ability to solve problems*. International Journal of Science Education. Volume 34, Issue 8. Halaman 1235-1253
- Choi, E. (2012). *Effects of problem-based learning vs. traditional lecture on Korean nursing students' critical thinking, problem-solving, and self-directed learning*. Nurse Education Today. doi:10.1016/j.nedt.2013.02.01
- Destianingsih, Emi. 2015. *Pengaruh Model Problem Based Learning Terhadap Kemampuan Pemecahan Masalah Siswa Pada Pembelajaran Fisika Kelas XI Di Sma Negeri 1 Tanjung Lubuk*. Jurnal Inovasi dan Pembelajaran Fisika, Universitas Sriwijaya.
- Duong, Minh Quang. 2012. *Analytical Evaluation of College Learning Experiences on Students' Problem-Solving Efficacy among Technical and Scientific Areas*. International Journal of Evaluation and Research in Education (IJERE). Vol.1, Issue 2. Halaman 67-72.
- Hake, R. R. (1998). Interactive engagement Versus Traditional Methods: A SixThousand Student Survey of Mechanics test Data for Inductory Physics Course. *American Journal of Phisics*, 66(1), 64-74
- Hariyanto, S. (2015). *Implementasi Belajar dan Pembelajaran*. Bandung: PT Remaja Rosdakarya
- Henk G. Schmidt, Jerome I. Rotgans, dan Elaine HJ. Yew. 2011. "The Process of Problem-Based Learning: What Works and Why". *Medical Education*. Vol 45, Issue 8. Hal.792–806.
- Kadir, Z. Abdul dkk. 2016. *Does Problem-Based Learning Improve Problem Solving Skills? A Study among Business Undergraduates at Malaysian Premier Technical University*. International Education Studies; Vol. 9, Issue. 5. doi:10.5539/ies.v9n5p166.
- Klegeris, Andis. 2013 . *Improvement in Generic Problem-Solving Abilities of Students by Use of Tutor-less Problem-Based Learning in a Large Classroom Setting*. CBE Life Sci Education. Volume 12, Issue 1. doi: 10.1187/cbe.12-06-0081.
- Maria (2012). *The Impact of Problem-Based Learning (PBL) on Student Attitudes Toward Science, Problem-Solving Skills, and Sense of Community in the Classroom*. Journal of Classroom Interaction. Vol. 47 Issue 1. Halaman 23-30.
- Marjohan, 2013. Kepatuhan Siswa terhadap Disiplin dan Upaya Guru BK dalam Meningkatkan melalui Layanan Informasi. Jurnal Imiah Konseling, Volume 2, No 1, Januari 2013 (220-224)
- ozcan, Erkan dan Ali Günay Balm. 2014. *Effects of Problem Based Learning on Prospective Science Teachers' Problem Solving Skills*. The Future of Educaion. Dipetik dari <https://conference.pixel-online.net/FOE/ files/foe/ed0005/FP/1601-ITL1076-FP-FOE5.pdf>
- Puspita, Laela Dwi. 2016. *Keterampilan pemecahan masalah matematika dengan model Problem Based Learning (PBL) pada siswa kelas VIII SMPN 2 Kasihan Bantul*. Jurnal Universitas PGRI Yogyakarta. Dipetik dari <http://repository.upy.ac.id/id/eprint/1218>
- Riati, Ifut. 2015. *Upaya Meningkatkan Kemampuan Pemecahan Masalah Matematika Dengan Model Pembelajaran Problem Based Learning Siswa Kelas Viii Putra Smp It Masjid Syuhada*. Jurnal program Studi Pendidikan Matematika, Universitas PGRI Yogyakarta.
- Rokhmawati, Jessy Diah. (2016) *Implementation of Problem Based Learning Model to Improve Students' Problem Solving Skill and Self-Efficacy*. IOSR Journal of Research & Method in Education. Vol 6, Issue 3. Hal 51-55.
- Riduwan. 2010. *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfa Beta
- Sahyar. (2017). *The Effect of Problem Based Learning (PBL) Model and Self Regulated Learning (SRL) toward Physics Problem Solving Ability (PSA) of Students at Senior High School*. American Journal of Educational Research, 5(3). Dipetik 2017, dari <http://pubs.sciepub.com/education/5/3/8/>
- Sani, R. A. (2015). *Pembelajaran saintifik untuk implementasi Kurikulum 2013*. Jakarta: PT. Bumi Aksara.
- Selcuk, Gamze Sezgin. 2013. *A comparison of achievement in problem-based, strategic and*

traditional learning classes in physics. International Journal on New Trends in Education and Their Implications. Volume 4, Issue 1. Halamn 154-164

Sihaloho, R. R. (2017). The Effect of Problem Based Learning (PBL) Model toward. *Journal of Research & Method in Education*, 11-18. Dipetik 2017, dari [http://www.iosrjournals.org/iosr-jrme/papers/Vol-7%20Issue-4/Version 1/C0704011118.pdf](http://www.iosrjournals.org/iosr-jrme/papers/Vol-7%20Issue-4/Version%201/C0704011118.pdf)

Yew, Elaine H.J. dkk. 2016. *Problem Based Learning: An Overview of its Process and Impact on Learning.* Health Professions Education. Volume 4, Issue 2. Halaman 75-79

Young, H.D. & Freedman, R.A. 2012. *Sear's and Zemansky University Physics: with Modern Physics.* San Francisco: Pearson Education.

