The Effect of Project-Based Learning Model on High School Physics Learning

Nining Fitriani¹, Putu Ayas Ditha Apsari¹, Saadila Hayati¹, Sri Yulianti¹*, Sukmawati¹, Widia Wati¹, Yunita Istiarini¹

¹Department of Physics Education, FKIP, University of Mataram, Mataram, Lombok, West Nusa Tenggara. Indonesia.

Abstract: This study aims to determine the effect of the PjBL (Project Based Learning) learning model on high school physics learning. The problem that often arises in the world of education is the weak ability of students to use their thinking skills to solve problems. Given that each student has a different learning style, PjBL (Project Based Learning) provides opportunities for students to explore content (material) using various means that are meaningful to themselves. The research method used is the research method and development (research and development/R&D) is a research method used to research to produce new products and then test the effectiveness of these products. The results of student learning using PjBL influence several things, such as creative thinking skills, elaboration, and even students can learn on their own without the help of others. Data collection in this study was carried out by observing and reviewing several journals through Google Scholar.

Keywords: PjBL (Project Based Learning); Physics; High School; Quasi Experiment,

Introduction

Education is one of the important needs for improving the quality of human resources (Human Resources). Knowledge is the main provision in developing one's potential or developing one's achievements, that's why education is very important to fulfill. The purpose of education, in general, is to develop potential and better educate individuals (Yosi, 2019). Education covers a fairly broad meaning, seen from various perspectives of each individual. On the other hand, education has an understanding that education is an effort to educate the nation. In addition, education also has a goal to improve the quality of society in Indonesia (Putri et al., 2020). Project-based learning (PjBL) is a learning model with a special characteristic of designing and carrying out a project in it to produce a product. Learning that involves students actively needs to be done to minimize students' inability to solve problems. Learning activities by designing and creating a project will increase the potential development of each student.

At the high school education level, especially the Mathematics and Natural Sciences major, there is a dissemination of science subjects that were previously combined into a single unit, consisting of physics, chemistry, and biology. Physics learning studying matter and its motion and behavior in the scope of space and time, based on concepts in the existing laws of physics (Suranti et al., 2016). According to the Ministry of National Education (2008), learning physics is related to how to find out about nature systematically, so physics is not only mastering a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery. The problem that often occurs in the physics learning process is the use of learning models that are not optimal. The assumption that complicated physics causes students' enthusiasm to actively participate in learning is still not optimal and even less attractive to students.
The physics learning process is often associated with student actions and behaviors that lead to creativity and problem solving, so an appropriate learning model is needed (Rukayah, 2020). The current state of the Covid-19 pandemic has resulted in learning being conducted online for all levels of education. With the enactment of the 4.0 revolution era, it indirectly requires both teachers and students to be proficient in using technology that includes various kinds of internet media as an intermediary for teaching and learning activities, so that learning can still take place despite obstacles, namely a pandemic. Some of the obstacles or problems faced during online learning include the lack of skills and innovation of teachers in developing learning media with the use of existing technology, incompatibility between the physics material being taught and the learning model applied to students, the character or behavior of students is difficult to monitor by the teacher, absorption of physics subject matter by students is minimal, learning time is reduced so that teachers cannot fulfill the burden of teaching hours, and several other problems. These problems must be found a solution so that it can make physics learning more interesting and meaningful, not only emphasizing learning outcomes but covering all components of physics learning (Yulia et al, 2018). Project-Based Learning (PJBL) on physics learning, is one of the learning models with special characteristics, namely the activity of designing and carrying out a project in it to produce a product. This learning model provides direct learning experiences to students through physics project creation activities that lead to the creation of a product. The emphasis of learning with the PJBL model lies in student activities to solve problems by applying the skills of researching, analyzing, creating, and presenting learning products based on real experiences (Rukayah, 2020).

The 2013 curriculum used today applies every learning model with a scientific approach. One of the learning models referred to in the 2013 curriculum is the Project-Based Learning model (PJBL). The existence of activities to design and create a project will support the development of potential and practice the scientific approach of each student. Because learning in the 21st century emphasizes four skills that must be possessed by a student, namely critical and creative thinking skills teachers must be wise in applying learning models that are in accordance with the Physics material to be taught. Knowing this and the emergence of several problems due to online learning, this study was conducted with the aim of knowing the effect of the Project-Based Learning (PJBL) model on high school physics learning (Mika et al, 2018).

Method

In this study, the Project-Based Learning approach became the main theme raised. The method used is research method and development (research and development (R&D)) is a research method used to research to produce new products and then test the effectiveness of these products. One type of method used by Hutapea and Simanjuntak, (2017) uses quasi-experimental research involving two classes that are given different treatments where the experimental class uses the PJBL model and the control class uses conventional learning, while Desnylasari and Mulyani, (2016) use a method that refers more to on problem-solving skills.

Results and Discussion

The application of the project-based learning (PJBL) model with a science edutainment approach in learning has a positive influence on the creativity of students. Project-based learning (PJBL) can encourage students to increase their creativity through activities to produce products in a tangible form, which can increase students' creativity. The application of the project-based learning (PJBL) model invites students to produce products so that they can increase students' creativity. Creativity is the ability to see the possibilities that can be done in solving problems and finding new concepts. Mastery of concepts is the ability of students in the form of mastering a number of subject matter where students not only know or remember the concepts learned, but are able to express them in other forms that are easy to understand, provide data interpretation, and are able to apply concepts according to their cognitive structure.

Improving the quality of teacher assessment on students must be through increasing student involvement, process, and follow-up on the results of the assessment. In improving the quality of planning what teachers need to do is increase the transparency of the assessment criteria. Based on data from research by Hidayat and Muhardjito, (2018), it is stated that students who use project-based learning models are increasing. Based on the results of the study, it can be said that the KPM (Problem Solving Ability) of students in dynamic fluid material with the application of the PJBL model is more improved than conventional. The KPM score of students using the PJBL model is higher than the conventional model. Students still have difficulty at the stage of connecting some physics concepts that have been studied previously and are being studied, as well as difficulties in determining solutions. The improvement of students' problem-solving abilities in the research conducted by Hidayat and Muhardjito (2018) is inseparable from the stages of the project-based learning model applied to the experimental class.
According to Desnylasari and Mulyani, (2016), student achievement using the Project-Based Learning (PjBL) learning model shows no significant difference but produces a higher average than the Problem Based Learning (PBL) model. This is possible because of the high active role of students in observation activities. project preparation. In addition, students gain learning experience and practice in organizing projects and making time and equipment allocations in completing their assignments. Learning experiences that involve students in the real world make the learning atmosphere fun so that students' knowledge develops. It is shown by the average achievement value of the attitude aspect of students who are taught using the Project-Based Learning (PjBL) model is 3.46 while the Problem Based Learning (PBL) model is 3.37. In addition, Sari, (2018) stated that students experienced a strong improvement in creative thinking skills after conducting PjBL, which indicates that PjBL affects students' creative thinking skills. This is indicated by the results of data analysis, where creative thinking skills at the time of the posttest have increased as indicated by the d-effect size value of 0.853892 shows that PjBL learning has an influence on students' cognitive learning outcomes with the strength of the difference between the posttest and pretest scores in the criteria being quite strong (moderate effect). Meanwhile, the N-gain of 0.444015 also shows that students have increased creative thinking skills with moderate criteria. This shows that students' creative thinking skills (CBC) experienced positive changes after working on projects on static fluid materials. The indicators of creative thinking that must be achieved by students are elaboration, fluency, originality, and flexibility. N-Gain 0.444015 also shows that students experience an increase in creative thinking skills with moderate criteria. This shows that students' creative thinking skills (CBC) experienced positive changes after working on projects on static fluid materials. The indicators of creative thinking that must be achieved by students are elaboration, fluency, originality, and flexibility. N-Gain 0.444015 also shows that students experience an increase in creative thinking skills with moderate criteria. This shows that students' creative thinking skills (CBC) experienced positive changes after working on projects on static fluid materials. The indicators of creative thinking that must be achieved by students are elaboration, fluency, originality, and flexibility.

Based on data from other research results Datu, et al., (2020) also obtained student learning outcomes can be seen in the results of the pre-test and post-test has increased, this proves that project-based learning is successful in improving student learning outcomes. The increase in student learning outcomes after using the Project-Based Learning learning model which can be seen from the average student is with an N-Gain percentage of 51% and is included in the medium category. Yulia, et al., (2018) also stated that in their research they also used students' pretest and posttest scores, where the posttest average score was higher than the pretest average value. Seen in the average posttest score of students, which increased by 84. Oktadifani and Lesmono, (2016) explain that by applying the Project-Based Learning model to physics learning, the results of science process skills are better than learning using conventional learning models, indicated by the average value of science process skills in the experimental class of 86.8235 compared to the control class which only has an average value of 78.2941. Furthermore, for student learning outcomes after learning physics using the Project-Based Learning model compared to students who are taught by the model commonly used in high school, it is determined from the cognitive value of the product which is manifested in the form of post-test scores and then tested using the Independent Sample T-Test test. with the help of SPSS software. Yulianto (2017) stated that the average observation result in the implementation of the PjBL model was 67% with the predicate of good implementation and 89% in the implementation of Lesson Study, which means that it has increased with the predicate of very good implementation. So, the implementation of teacher actions in Project-Based Learning increased by 22% and was in accordance with the expected target.

Research conducted by Kristanti, (2016) that the results of the analysis of student learning activities obtained an average value of the experimental class of 85.84% including the very active criteria. In the experimental class that uses a project-based learning model, the highest student learning activities are discussing and doing assignments. The student learning response questionnaire has a percentage of 73.27%. Based on the percentage criteria for the response questionnaire results that the student's learning response using the project-based learning model is "good enough" it can be seen that the analysis of each statement gets a sufficient percentage of students. Rukayah, (2020) explained that with the Project-Based Learning model the students' cognitive learning outcomes applied in the experimental class could be seen from the average posttest scores of students which showed differences in cognitive learning outcomes between classes using project-based learning models and those using conventional learning models. The class that uses the project-based learning model as the experimental class gets an average posttest score of 77.09, while the control class that uses the conventional learning model gets an average posttest score of 77.39. The difference in the average post-test scores is due to the learning model used, students using the project-based learning model have a higher average post-test score.
Research by Azmi, (2018) also states that the average value of the percentage of student learning outcomes is 81.17 using a project-based learning model with a high category. The results of testing the hypothesis that the use of project-based learning models on business and energy materials can have a positive and significant impact on student learning outcomes. Hutapea and Simanjuntak, (2017) describes the acquisition of the average learning outcomes of the experimental class taught with the PJBL model of 56.1 and the control class taught using the conventional model obtained learning outcomes with an average of 38.9 and shows that count > table (4.54 > 1.99), student learning outcomes using the PJBL model, especially on dynamic fluid materials, gave an average value with a fairly good category. Hikmah and Agustin, (2019) stated that the data obtained from the pretest value of the experimental class can be seen from the maximum value which is lower than the posttest score of 55 < 90 with 20 students, while the pretest value of the experimental class is seen from the standard deviation (SD) which is higher than the posttest value is 9.67 > 7, 54 with 20 students. Based on the results of the pretest, which shows that the average value of creative thinking skills for experimental class students is higher than the average value of creative thinking skills for control class students, it is still very low. The low average score in students' creative thinking abilities is triggered by an inconsistency between the material being taught and the material issued by the teacher during the exam, even the teacher issues test material that has not previously been taught to students so that students answer the exam questions according to their understanding of events. their daily. However, after the two classes were given different treatments regarding the use of the learning model, the average posttest result of the experimental class students' creative thinking abilities was higher than the control class. This is because the project-based learning model is applied to the experimental class which can help students develop students creative thinking abilities. So, it can be concluded that the Project-Based Learning model emphasizes student activities to search and find, in other words, the Project-Based Learning learning model is not only limited to listening activities but students are also directly involved in expressing and doing activities.

The project-based learning tool developed presents all the characteristics of the physics learning model using a project-based learning syntax, especially in terms of materials, learning activities, and assessments. The project-based learning model can direct students to develop collaborative learning skills, thinking skills, and learning strategies so that students can learn on their own without the help of others.

Conclusion

Based on the research that has been done on the effect of the Project-Based Learning (PJBL) model on high school physics learning, it can be concluded as follows: (1) The use of the Project-Based Learning (PJBL) Model in physics learning has an important role as the originator of creativity in solving problems and finding new concepts in high school students; (2) The scoring system is carried out in two stages, namely validation and test questions that are tested empirically and reliably. Empirical instruments are instruments that can be used to measure what should be measured, while reliable instruments are instruments that, when used several times to measure the same object, will produce the same data.

References

Azmi, A. (2018). The Effect of Project-Based Learning Model on Physics Learning Outcomes of Class X Students of SMA Negeri 1 Rambah Hilir. Scientific Journal of Edu Research. 7 (1).

Datu, H.R., Qadar, R., & Junus, M. (2020). Application of Project-Based Learning (PJBL) Learning Model to Improve Physics Learning Outcomes of Class XI Students of SMA Negeri 5 Samarinda. Journal of Physical Education Literacy. 1(02).

Desnylasari, E., & Mulyani, S.M.B. (2016). The Influence of Project-Based Learning and Problem-Based Learning Models on Thermochemical Materials on Student Achievement in Class XI of SMA Negeri 1 Karanganyar in the 2015/2016 Academic Year. Journal of Chemistry Education (JPK). 5(1). 134.

Hidayat, A.M., & Muhardjito, M. (2018). The Effect of Project-Based Learning Model on Problem-Solving Ability of Dynamic Fluids. Journal of Education: Theory, Research, and Development, 3(7).

Hikmah, L.N., Agustin, R.D. (2019). The Effect of Project-Based Learning Model on Students’ Creative Thinking Ability. Jurnal Pendidikan Sains Indonesia. 1(1).

Hutapea, J. & Simanjuntak, M.P. (2017). The Effect of Project-Based Learning (Pjbl) Learning Model on High School Student Learning Outcomes. Journal of Physics Learning Innovation (INPAFI). 5(1). 48-55.

Kristanti, Y.D. (2016). Project-Based Learning Model in Physics Learning in High School. Journal of Physics Learning. 5 (2).

Mika, DP, Irwan, K., & Indra, S. (2018). The Effect of the Project-Based Learning Model on Interest in Learning Physics and Critical Thinking Ability of State High School Students 1 Bengkulu City. Journal of Coil Physics. 1(1).
Ministry of National Education. (2008). Education Unit Level Curriculum. Jakarta: Ministry of National Education.

Oktadifani, U., & Lesmono, A.J. (2016). The Effect of Project-Based Learning Model on Science Process Skills and Student Learning Outcomes in Physics Learning in High School. *Journal of Physics Learning*. 5(2), 109-114.

Putri, N.S.Y., Rosidin, I., & District, I.W. (2020). The Influence of the Implementation of Performance Assessment with the Pjbl Model on the Critical and Creative Thinking Skills of High School Students. *Journal of Physical Education*, 8(1), 58-69.

Rinta, D.Y., Ermaniati Ramli2, and Fatni Mufti. 2013. The Effect of Application of Project-Based Learning (Pjbl) Model on Physics Learning Outcomes of Class XI Science Students at Sma Negeri 1 Batipuh, Tanah Datar Regency. *Pillars of Physics Education*. 1. 48-54.

Rukayah, M.R. (2020). The Effect of Project-Based Learning Model on Cognitive Learning Outcomes of Class XI Science Students at SMA Negeri 1 Angsana on the Concept of the Coordination System. *Journal of Biological Education*. 6 (4).

Sari, W.P., Hidayat, A., & SKusairi, S. (2018). High School Students' Creative Thinking Skills in Project-Based Learning (Pjbl) on Static Fluids. *Journal of Education*. 3(6). 751-757.

Suranti, N.M.Y., Gunawan, Sahifu, H. (2016). The Effect of Virtual Media Assisted Project Based Learning Model on Students' Concept Mastery on Optical Instrument Material. *Journal of Physics and Technology Education*. 2(2).

Yosi, A.D., Festiyed & Asrizal. (2019). Meta-Analysis of the Effect of Project-Based Learning on the Critical Thinking Ability of High School Students. *Pillars of Physics Education*. 12(4). 881-888.

Yulia, M., Mayub., Afrizal., & Purwanto, A. (2018). The Effect of Project-Based Learning (PJBL) Model on Mastery of Physics Concepts in Class X Students of SMA Negeri 1 Bengkulu City. *Journal of Coil Physics*, 25-30.

Yulianto, A., Fatchan, A., Astina, I.K. (2017). Application of the Project-Based Learning Learning Model Based on Lesson Study to Improve Student Learning Activities. *Proceedings of the 1st Progress in Social Science, Humanities and Education Research Symposium (PSSHERS 2019)*. 2(3).