Jurnal Ilmiah Sekolah Dasar
Volume 4, Number 4, 2020 pp. 596-603
P-ISSN: 2579-3276 E-ISSN : 2549-6174
Open Access: ttps://ejournal.undiksha.ac.id/index.php/JISD/index

# Natural Science Problem Solving in Elementary School Students Using the Project Based Learning (PjBL) Model

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ARTICLEINFO
*Article history:*
25 December 2019
Received in revised form
01 January 2020
Accepted 25 January 2020
Available online 03 November 2020

*Kata Kunci:*
*Pemecahan Masalah, IPA, Project Based Learning*

*Keywords:*
*Problem Solving, Natural Science, Project-Based Learning*

**ABSTRAK**

Penelitian ini dilatar belakangi oleh rendahnya pemecahan masalah pada pembelajaran IPA disekolah dasar. Selain itu diketahui banyaknya permasalahan yang terjadi pada pembelajaran IPA. Tujuan Penelitian ini untuk mengetahui skenario dan implimentasi pemecahan masalah IPA dengan menggunakan model PjBL, respon guru dan siswa, serta kesulitan-kesulitan yang dialami siswa. Metode penelitian yang digunakan adalah deskriptif kualitatif. Subjek dalam penelitian ini adalah siswa kelas IV SD dengan jumlah siswa sebanyak 30 orang yang terdiri 14 orang siswa perempuan dan 17 orang siswa laki-laki. Hasil penelitian menunjukan bahwa terdapat peningkatan kualitas pembelajaran ketika diterapkannya model PjBL. Dengan demikan dapat disimpulkan bahwa hasil penelitian menujukan skenario dan implemtasi pembelajaran ditunjukan dengan hasil skor rata-rata guru 77,89% dan siswa sebesar 78,33% yang termasuk kategori baik, respon guru memperoleh 82% dan respon siswa memperoleh 84% termasuk kategori sangat baik, serta kesulitan yang dialami siswa dengan rata-rata 27% yang terdapat pada indikator memahami masalah dan membuat rancangan strategi.

**ABSTRACT**

This research is motivated by the low level of problem-solving in science learning in elementary schools. Also, it is known that many problems occur in science learning. This study aimed to determine the scenario and implementation of science problem solving using the PjBL model, teacher and student responses, and students' difficulties. The research method used is descriptive qualitative. This study's subjects were students of grade IV SDN in Cimahi with 30 students consisting of 14 female students and 17 male students. The results showed an increase in the quality of learning when the PjBL model was applied. Thus, the study results aimed at the scenario and learning implementation were shown by the teacher's average score of 77.89% and students of 78.33%, which was in the good category, the teacher's response got 82%. The student's response got 84%, which was well categorized and the difficulties experienced by students with 27% in understanding the problem and making strategy designs.

## 1. Introduction

Natural Science (IPA) is essentially a process, product, attitude, and technology. IPA means the study of events that occur in nature (J. B. Kelana & Pratama, 2019; Samatowa, 2011; Widiana, 2016). Therefore, science learning should be carried out by scientific inquiry to foster the ability to think, work and have a scientific attitude and communicate this as an aspect of life skills. In the implementation of science, learning six principles must be fulfilled: motivation, background, discovering, learning by doing, learning while playing, and social (J. B. Kelana, 2018; Nugraha, 2018; Rofiah et al., 2018). Science learning emphasizes the many memorizing concepts and facts and provides more direct experience and problem-



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solving (Sumartini, 2018). It aims to scientifically find out and understand the natural surroundings (Samsudin et al., 2019; Yuliati, 2017). Lawson (in Hidayah et al., 2016) states that teachers must equip students with problem-solving skills.

Problem-solving is one of the important abilities to be developed for students. Polya in (Hadi & Radiyatul, 2014; Yani, Muhammad. Ikhsan, 2016) problem solving is a process that requires logic to find a solution to a problem. It implies that it is not said to solve the problem without a thought process and a full effort. Polya (Astuti et al., 2020; Yani, Muhammad. Ikhsan, 2016) offers a strategy consisting of four steps, understanding the problem, compiling a problem-solving plan (devising a plan), implementing a problem-solving plan (carrying out the plan), and checking problem-solving (looking back). Problem-solving is a competency that must be possessed by individuals and goals to be achieved in learning. In this case, students gain experience using the knowledge and skills they already have to solve problems that are not routine. Thus, educational institutions can improve and develop learning to improve student abilities, problem-solving abilities. According to Andreson in (Schunk, 2012), one type of cognitive processing important during learning is problem-solving. Problem-solving has been a research topic for a long time. Some theorists consider problem-solving to be a key learning process, especially in science and mathematics.

Facts in the field, the problem-solving ability of Indonesian students is still low. The results of the PISA study highlighted the weak problem-solving abilities of Indonesian students. Indonesian students are not familiar with the complex problems presented (Mita et al., 2019). The learning carried out has not touched the development of optimal problem-solving abilities. The research conducted (Suciati et al., 2018) explains that teachers tend to use conventional methods so that students are passive when learning occurs. Students find it difficult to understand the material presented. The teacher only explains the material in front of the class so that students often feel bored. Students want fun activities in learning.

A learning model is needed to encourage students to solve problems and achieve the expected competencies to solve the above problems. One of the many relevant science learning models is the Project Based Learning (PjBL) learning model. Project-based learning is generally considered an alternative to traditional teacher-led institutions (Chen, Cheng-Huan; Yang, 2019). Learning with the PjBL model is carried out to deepen the knowledge and skills acquired by students. Students must make work or projects related to teaching materials/competencies expected to appear in the learning process. PBL students demonstrated their ability to systematically formulate designs and produce quality design outputs (Kuppuswamy, Ramesh; Mhakure, 2020). Through these activities, students can focus on finding answers to the teacher's questions so that students can find their answers. DePorter, et al (Kelana *et al*., 2019) stated that we learn 10% of what we read, we learn 20% of what we hear, we learn 30% of what we see, we learn 50% of what we hear and see, we learn 70% of what we discuss with others, we learn 80% of what we experience ourselves, we learn 95% of what we teach others.

Students transform the knowledge they find with their activities so that the understanding they get is more meaningful. Learning does not always require students to memorize facts. Still, it encourages students to construct knowledge in their minds to foster creativity and activity and solve the problems they face. PjBL is a model that involves students working on a project that is useful for solving problems (Sani, 2014). This learning allows students to develop their creativity in creating and designing projects that can be used to solve problems in learning. Based on the research results (Surya et al., 2018), science learning using the project-based learning (PjBL) model is better than using ordinary learning. It proves that the project-based learning (PjBL) model can be used for science learning. Another research conducted by (Muhammad, 2018) states that the Project Based Learning (PjBL) learning model can improve fluency thinking skills in science learning. It also proves that the project-based learning (PjBL) model can be used in science learning. The project-based learning model helps students in increasing activities and achieving better learning outcomes in science lessons (Sumarni, 2020). It proves that the project-based learning model can be used in science learning. Science learning in elementary schools aims to make students master knowledge, facts, concepts, principles, and discovery and have a scientific attitude that will help students study the natural surroundings. One of the materials in SD science material is about energy sources. Energy sources are a concept in science learning in the fourth grade in semester II. The energy sources concept discusses various energy sources, changes in energy forms, and alternative energy sources (wind, water, sun, geothermal, organic fuels, and nuclear) in everyday life.

From this explanation, researchers are interested in researching "Solving Natural Science Problems in Elementary School Students Using the Project Based Learning (PjBL) Model". This research aims to examine: 1) Scenarios and the implementation of problem-solving using a project-based learning model. 2) Teacher and student responses to problem-solving using a project-based learning model. 3) Difficulties experienced by students in completing learning. The combination of ways of solving science problems

using project-based learning (PjBL) in energy sources is the difference between this study and previous research. It is interesting because students can explore knowledge by doing projects and finding out problems that have been determined from a project.

## 2. Method

This research is a research with a qualitative descriptive method. The qualitative descriptive method is a method used by researchers to find knowledge or theory of research at a certain time (Mukhtar, 2013; Ristiyani & Bahriah, 2016). This study aims to describe the teacher's efforts in improving the quality of problem-solving of energy sources in fourth-grade elementary school students using a project-based learning model. This study's subjects were fourth-grade elementary school students with 30 students consisting of 14 female students and 17 male students. The research procedure that the authors do is as follows: 1) The preparation stage in the preparation stage, the researcher conducts a preliminary study to determine the research sample, the lietratur study, instruments in the form of questionnaires, observations, and pretest and posttest questions which are then tested. Creating a Learning Implementation Plan (RPP) and learning media that will be used. 2) The implementation phase of activities is carried out based on a learning scenario that has been planned and designed specifically so that the learning carried out can develop and improve problem-solving of energy sources according to predetermined and agreed subjects to be assessed with the Project-Based Learning learning model. In the research stages above, the researcher divided into research steps, : Students were given a preliminary test of energy source problem solving to determine students' problem-solving abilities, Students received learning material according to the learning scenario using the PjBL learning model for 3x meetings by filling out the observation sheet by the researcher after the learning process is complete, an evaluation is carried out in the form of giving written tests to students to measure student problem solving according to the subject matter and then analyzed descriptively to determine student achievement using the PjBL learning model. 3) Evaluation stage to collect data, process and analyze data that has been collected. Then compare the pretest and posttest obtained by each student. If there is a difference in test scores, it is assumed to be a result of teaching treatment using the PjBL model. A descriptive analysis was carried out to determine students' energy sources' problem solving through the PjBL model. The data that has been obtained will be analyzed qualitatively and described in descriptive form.

Qualitative data analysis is inductive, an analysis based on the data obtained, and then a specific relationship pattern is developed. The data that has been obtained will be analyzed qualitatively and described in descriptive form as well as Ms. Excel. The qualitative data analysis is inductive, an analysis based on the data obtained, and then a certain relationship pattern is developed. All data in this study were processed using a qualitative analysis of the teacher and student questionnaire results. It aims to determine the solving of scientific problems in fourth grade elementary school students using the project-based learning (PjBL) model. Problem-solving indicators used in research are understanding problems, planning, solving problems, and re-check.

## 3. Result and Discussion

The results of science learning on problem-solving using a project-based learning (PjBL) model with several research stages. Among them are providing a pretest, giving a PjBL model, and a final or posttest. Scenarios and implementation of problem-solving using the PjBL model were measured using a research instrument of teacher and student observation sheets. The observation sheet was used during the PjBL model implementation, the implementation of 3 times. With the implementation of learning using the steps of the PjBL model as follows: 1) Determination of Fundamental Questions in this step, the teacher gives problems that are around, regarding concrete objects, including giving some pictures of energy sources in the surrounding environment, then the teacher practices a table being hit and make a sound, why the object can make a sound. 2) Compiling a Project Design in this step, the teacher makes groups of two or five people. 3) Arranging a schedule in this step, students make projects of energy sources, changes in energy forms, and alternative energy that have been described by the teacher. The goal is that students can solve the problems given by the teacher in these projects. 4) Monitoring students in the project's progress in this activity, the teacher collects information from each group during the project making activity whether there are obstacles in this activity or there are no obstacles and provides solutions to each of these obstacles. 5) Testing the results in this step, the students make a group presentation. 6) Evaluation of Experience in this step concludes the material studied. The teacher and students carry out this stage at the end of the lesson. The following are the results of the teacher and student observation scores shown in Table 1.

**Table 1.** Results of Teacher and Student Observations

| Application | Teacher | Interpretation | Students | Interpretation |
|---|---|---|---|---|
| 1 | 64,21 % | Baik | 63 % | Good |
| 2 | 77,89 % | Baik | 77 % | Good |
| 3 | 91,57 % | Baik Sekali | 95 % | Very Good |
| Average | 77,89% | Baik | 78,33% | Good |

Based on Table 1 of the teacher's and student's observations, it can be concluded that the overall scenario and implementation of problem-solving using the project-based learning model is in a good category.

Teacher and student responses to problem-solving using a project-based learning model are measured using a research instrument in the form of a questionnaire or attitude scale. After being analyzed, the teacher's response was very good. It can be seen from the teacher's response questionnaire calculation, which addressed an average percentage of 77.89%, meaning that from a maximum score of 100 teachers produced a score of 77.89. Meanwhile, fourth grade elementary school students' responses to energy source problem solving using a project-based learning model are listed in the questionnaire calculation or student attitude scale. This is shown in Table 2.

**Table 2.** Results of Student Response Questionnaire

| No | Questionnaire Score | Percentage | Interpretation | The number of students |
|---|---|---|---|---|
| 1 | 80 | 80% | Baik | 9 |
| 2 | 81 | 81% | Sangat Baik | 21 |
| **Average** | **84,3** | **84%** | **Sangat Baik** | **30** |

Table 2 above shows that the student's average score is 84.3 with a percentage of 84% seen from the questionnaire score interpretation criteria. This questionnaire score indicates that the student's response to problem-solving using a project-based learning model is very good. Based on the results of the analysis of teacher and student responses to problem solving energy sources using the project-based learning model that has been described, it can be concluded that the teacher's attitude scale shows a percentage of 77.89% and the average percentage of student attitude scale is 84%, these results indicate that the response of teachers and students to learning using the PjBL model is very good.

Problem-solving learning is a quite difficult indicator for students, because problem-solving learning includes higher-order thinking skills. The questions given will not be as simple as knowledge and understanding. Still, they will make you repeatedly think because there are stages that must be completed first before getting the right results from problem-solving questions. This difficulty can be seen from the students' answers in completing the assignments given by the teacher. Recapitulates the results of each pretest and posttest item can be shown in Table 3.

**Table 3.** Research Results for Each Item Problem-Solving Energy Sources

| Question number | AverageScore | | Percentage | | Improvement |
|---|---|---|---|---|---|
| | ***Pretest*** | ***Pos-test*** | ***Pretest*** | ***Pos-test*** | |
| 1 | 52 | 81 | 52% | 81% | 29% |
| 2 | 54 | 77 | 54% | 77% | 23% |
| 3 | 39 | 67 | 39% | 67% | 28% |
| 4 | 55 | 78 | 55% | 78% | 23% |
| 5 | 50 | 78 | 50% | 78% | 28% |
| 6 | 53 | 79 | 53% | 79% | 26% |
| 7 | 36 | 69 | 36% | 69% | 33% |
| 8 | 36 | 63 | 36% | 69% | 27% |
| | | **Average** | | | **27%** |

Based on Table 3, the recapitulation of research results for each problem solving the energy source, it can be concluded that students' difficulties are found in items 2 and 3. However, solving problems using

the project-based learning model has increased from pretest until posttest to as much as 27%. It is evidence of a better quality of problem-solving using the PjBL model.

In this discussion, the researcher will discuss more clearly the research results. The study results relate to scenarios and implementation of problem-solving using a project-based learning model, teacher and student responses to problem-solving using a project-based learning model, and students' difficulties in completing learning.

First, the scenario and implementation of problem-solving using the project-based learning (PjBL) model went well. It is inseparable from the learning design process that is compiled. Learning using the PjBL model is transferring knowledge and developing students' abilities optimally through project-based activities. Sagala (in Rahayu, 2018; Uno, 2010) states that the process of teacher-student interaction is to develop students' creativity and ability to construct new knowledge. A teacher must be able to make learning that can provide opportunities for students to be directly involved in learning. The PjBL model allows students to explore all their potential through working, thinking, and problem-solving. In implementing learning using the PjBL model, students are given a basic question about problem-solving topics, discussing problem-solving project plans, compiling a project completion schedule according to the agreement, monitoring project progress, testing project feasibility and presenting the final project report. One of the PjBL model goals is to foster independence and improve student participants' ability in project problem solving (Eliza et al., 2019; Pratiwi et al., 2018). Wena (in Kurniawan et al., 2018) explained that the PjBL model's advantages are that it can improve students' ability to solve ordinary or complex problems and increase student motivation and activeness.

Meanwhile, the shortcomings of the PjBL model, according to Warsono (in Winarni, 2019) are that it requires skilled teachers, a long time, and adequate facilities, and it is difficult to involve all students in group work. From several explanations regarding the PjBL model's application, this model can make a positive contribution to student problem-solving. In use, it also requires careful planning to get the expected results.

Second, the teacher and student responses to solving science problems using a project-based learning model have been very good. The teacher questionnaire sheet, which got 77.89% and the student questionnaire sheet, got an average of 84%. Student response to the project making energy sources, energy changes, and alternative energy using media or concrete objects is very good. In line with (Rahmazatullaili et al., 2017; Wijanarko et al., 2017), in general, student responses to learning using a project-based learning model are very good. Students seemed happy during the learning process because they were directly involved in the activities and carried out their thinking and cooperation results. The PjBL model helps students solve complex problems that can challenge students to understand problems, develop plans, solve problems, and check back based on the data or information. Every child has different abilities in communicating, thinking, and solving problems. Often students learn about things that do not catch their attention, which makes learning meaningless. It goes against the wishes and interests of children in general. Children will learn things they want with a cheerful heart to build their knowledge and understanding based on their experiences. Through the PjBL model, students designed to do something fun. These activities encourage students to solve given problems and relate them to what they learn and how they will be used and utilized in their lives. So that the learning carried out can provide meaning. In line with Hill's constructivism theory (in Suparlan, 2019), learning can create meaning from what is learned. How to produce something from what he learns teaches how to integrate learning with doing or practicing in his life.

Third, the difficulties that students experience are in understanding the problem and making strategic plans. Students are not familiar with the questions given, so they cannot understand the truth and make the right strategy design of a problem. For this reason, appropriate learning, learning resources, and teaching materials are need so that students have good problem-solving abilities (Purnomo & Mawarsari, 2014). Overall, problem-solving using the project-based learning (PjBL) model has increased from the pretest to the posttest by 27%. It is evidence of an increase in the quality of learning towards problem-solving using the PjBL model. In line with (Laksana & Wawe, 2015) in their research stated that initially, students' understanding of the concept of science was very low. Researchers try to make learning interesting and fun through the help of learning media based on local culture. The involvement of material related to students' daily lives is a positive thing that is no less important. It will have an impact on the acquisition of meaningful learning experiences in the learning process. Following Ausubel's learning theory (Muamanah, 2020), it is explains that the learning process that students learn is structured. According to their cognitive structure, this is to help students relate new information to their cognitive structures.

## 4. Conclusion

The scenario and implementation of problem-solving using a project-based learning model have met the criteria. Researchers' findings based on field observations, students, understand learning using a project-based learning model. It happens because the teacher provides the learning process using concrete objects. The teacher also provides opportunities for students to ask questions, and during learning, the teacher deals with the material with daily life. Teacher and student responses to problem-solving of energy sources using a project-based learning model based on filling out a questionnaire on the teacher's response to learning are very good, and student responses following the questionnaire to learning using a project-based learning model very well. It can be seen from student activities during learning activities. The difficulties experienced by students for problem-solving are in the indicators of understanding problems and making strategic designs. It is an illustration for improvement efforts in further research.

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