Science process skills in learning environmental pollution using PBL models

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Abstract. Learning environmental pollution in the Problem-based learning (PBL) model allows students to improve their science process skills. This research is quasi-experimental due to students were remaining in their classes. In the experimental class, PBL models and control classes were given conventional models. The sample was chosen by simple cluster random sampling technique. Before be implemented, the research instrument was tested for its validity and reliability. Data analysis used descriptive and inferential techniques. Descriptive techniques are used to see of sample representation. Inferential techniques are used to see normality and homogeneous data. Descriptive analysis results show that the score of all indicators of science process skills consists of: observing, interpreting, predicting, using devices and materials, applying concepts, planning experiments and communicating quantitatively is higher in the PBL model group than the conventional model group. The inferential analysis results show that the data obtained is normally distributed and homogeneous. One way ANOVA test results in a significance value = 0.033 < α = 0.05, H₀ is rejected. There is a significant effect of the PBL model on science process skills in learning about environmental pollution.

1. Introduction

The learning activities in the curriculum in 2013 refers to the scientific study which is expected to form a scientific behavior, social behavior, and develop a sense of curiosity. It has been arranged through Regulation of the Minister of Education and Culture No. 103 on Learning in Primary and Secondary Education in 2014 and attachments, Scientific Learning is realized through the stages of activity observed, ask, gather information, associates, and communicate, So in class, students are required for many activities, interact, discuss, working groups, explore the science, do observe, ask questions, gather information, associate, communicate. This can be realized if the student can develop science skills.

The results of observations in grade 5 at SDN 1 Baruga Kendari can be seen that teachers use scientific learning-oriented student-centered learning but not optimal. Students reluctant tried to ask questions, observing, communicating and process information that is found so that science process skills as learning outcomes of scientific learning are not well developed. Students simply receive the
material without going to examine it more deeply and continuously. This is due to lower their science process skills. Problem-based learning (PBL) is one solution to develop the ability to think, work and behave scientifically through the development of science process skills. The PBL models provide opportunities for students to be responsible for their learning. [1,2].

The PBL models emphasize learning that associate the concept with the real situation, the ability to solve problems, gather information, inform, think critically and make decisions to improve the quality of student learning [3]. Supporting this statement, with knowledge, students are actively involved in exploring meaningful questions, observe, investigate, and improve understanding of an object under investigation. Through these activities, the students showed scientific behavior and the ability to use the scientific method [4,5]. Thus it can be interpreted PBL models not only encourages students to understand the concepts of science but also developing science process skills.

The development of science and technology facilitate human activity, but also have a global impact on the destruction of the earth. Increased human needs correlated with the increasing pollution of the environment. To contribute to the development of science and technology, students should master the knowledge of dynamic concepts [6,7]. That requires a process of learning so that students not only know the importance of the development of science but also the impact of these developments accompaniment. The study is environmental pollution-related science problems that they encounter in their everyday lives. By integrating material environmental pollution in life, students better understand the benefits and influence in the life sciences [6]. The PBL models is an instructional that is suited to the study related to real life.

Relevant research shows PBL models are influential in improving science process skills. [7–9]. In his research showed science process skills and student achievement in PBL classes had higher average scores than students in conventional classes. On the learning ecosystem and environmental pollution, PBL models show a better student achievement than guided inquiry even though guided inquiry gives a better effect than in PBL models on aspects of science process skills [10]. The novelty of this study was to learning environmental pollution in the PBL model affecting the improvement of science process skills in Grade 5 students at SDuga 1 Baruga Kendari.

2. Methods
The quasi-experimental approach is used because it is not possible to put subjects into groups. Students remain in each class divided into experimental and control classes. The experimental group was given PBL models and control is given conventional. The study design used nonequivalent-groups pretest-posttest to allow the sample given a pretest and posttest at the same time.

All students at SDN 1 Baruga Kendari are the population in this study. The samples through simple random cluster sampling are to determine the sample based on per class instead of per individual. Data on science process skills acquired through observation sheets. Before use, the instruments tend to be tested for validity and reliability. The data obtained are qualitative and quantitative. Further analysis by descriptive and inferential techniques. The descriptive technique is used to see the picture of the sample. The inferential technique is used to look normal and homogeneous data. Normality data using the Kolmogorov-Smirnov test, while homogeneous using the Levene test. Hypothesis testing using one-way ANOVA with SPSS 21. The results illustrate the influence of the PBL model of science process skills in a learning environment pollution. Testing criteria is H0 is rejected if significance value < α and H0 is accepted if significance value ≥ α (α = 0.05).

3. Results
Practicum method used by students to learning environmental pollution in PBL models. Practicum is used to determine how much students' science process skills. Students observe the worms are placed in soil contaminated used oil waste to understand soil contamination. Overview of water pollution is described with illustrations of fish that live in water contaminated with industrial waste. An understanding of air pollution is given an illustration of the dangers of cigarette smoke on the body
and the environment. Further exploration of students doing their knowledge to the cause of environmental pollution and provide a solution.

Descriptive analysis of material science process skills of environmental pollution can be seen in Figure 1. It is seen that the value of all the indicators of science process skills, observe, interpret, predict, use traditional tools and materials, applying the concept, planning and communicating quantitative experiments a higher group of students studying using the model PBL compared groups of students who use the conventional model.

The first indicator is observing skills. PBL class higher than the conventional class because the PBL model departing from the problems that exist around the students that environmental pollution soil pollution, water pollution, and air pollution. Direct observation of environmental pollution, for example, observations on household waste, waste oils, waste plant against soil pollution. These observations raise the curiosity of students to the observed object. Students will ask "what or why?" In them, so it will be more focused on observing the teacher's problems [11].

![Figure 1. Science process skills in learning environmental pollution](image)

The second indicator is interpreting. The PBL models provide worksheets filled out by the students to predict what will happen from their observations. For example, observations of the dangers of cigarette smoke on the body and the environment. Students write on a worksheet about their opinions and their views on human lung conditions and the pollution generated from cigarette smoke. PBL model requires students to solve problems and build their knowledge to stimulate critical thinking and reasoning level students [15].

The third indicator is predicting. PBL models provide group learning and practicum learning to students. In the practicum, students participate more actively in solving problems [16]. For example, experimental fish that live in water waste plastics. Students predict if the fish living conditions of continuous plastic waste dumped into the sea. Students can predict with the basic knowledge they already have. Students more easily explore their knowledge to predict what might happen on the object observed through practical activity.

The fourth indicator is using tools and materials. Students are required not only able to plan experiments but also using tools and materials for the experiment. Donnel explains the shift of
responsibility in designing experiments to the students, they should be aware of whether the design was suitable, why be so and what will happen [13]. The design of experiments, selection of the right tools and materials determine the success of the experiment.

The fifth indicator applying the concept. In PBL models students gather the findings obtained in the experiment, then associate these findings. The hope is that the findings they earn can reinforce the concept of environmental pollution that can later be applied in everyday life. In the sixth indicator is the skill grouping, PBL advantages of the conventional classroom are students identify the type, characteristics, and handling. The next grouping is based on the characteristics of each environmental pollution. Supporting this research, grouping skills can be seen from the student's ability grouping based on the constituent components of ecosystems [14]. The seventh indicator is communicating skills. PBL models held a group discussion to solve a given problem. The group discussions to give a wider opportunity to the students to reveal both verbal and written ideas. Through discussion, the students learn active to develop a minimum of scientific communication in the classroom forum [15]. Fishing Master student responses through the question he asked. This is so active and motivated students to communicate what he knew [16]. After the discussion is ended, the students present in class and provide an opportunity for other students to respond thus strengthening the communication skills of students.

**Table 1. Results of the Kolmogorov-Smirnov test**

| Data types          | Group          | Kolmogorov-Smirnov Z | P-value | H0         | Ket   |
|---------------------|----------------|----------------------|---------|------------|-------|
| Science skill       | PBL models     | 0.411                | 0.996   | accepted   | Normal|
| process             | conventional   | 0.592                | 0.875   | accepted   | Normal|

*Kolmogorov-Smirnov test* used to test the normality of the data. The result is a probability value (sig) of \( Z > \alpha = 0.05 \), then \( H_0 \) is accepted. This means that the population of a normal distribution of data. Similarly, in the test of variance test showed Levene pretest data group, n-gain, score science process skills > \( \alpha = 0.05 \), \( H_0 \) acceptable means pretest data group, n-gain, KPS scores have variances homogeneous data.

The results of the inferential analysis of data obtained showed normal distribution and homogeneous. Further testing the hypothesis using parametric statistical tests ANOVA one way. Here's a summary of hypotheses test on table 2

**Table 2. Results of the one-way ANOVA test**

| Hypothesis         | number Squares | df | On average Squares | F table | F count | Sig.    | Information      |
|--------------------|----------------|----|-------------------|---------|---------|---------|------------------|
| Between groups     | 476.01         | 1  | 476 011           | 3.98    | 4.714   | 0.033   | \( H_0 \) rejected |
| In Group           | 6765.0         | 67 | 100.970           |         |         |         |                  |
| Total              | 72,410         | 68 |                   |         |         |         |                  |

The results of the one-way ANOVA test showed that sig. = 0.033 < \( \alpha = 0.05 \), then \( H_0 \) is rejected. This means that there is a significant influence on the PBL model of science process skills in the study of environmental pollution materials. This result is supported by studies showing differences in significant science process skills between PBL and conventional graders [17,18]. Students are given the freedom to think about finding a solution to the problem by the teacher. Through practical activities, students can develop skills to the optimum process. Students are directly involved in solving the problem of environmental pollution through practical matter by observing, interpreting, predicting, planning experiments, using the right tools and materials, classify and communicate the results of the experiment.
In the model PBL students solve problems independently, the teacher only as a facilitator, so students will explore further process skills that he has to solve the problem. Factors that cause high science process skills in the model PBL is more focused on the problems that often occur in the student environment. The problems that occur in everyday life makes the students' contextual trained students formulate problems and design the resolution.

4. Conclusions

Descriptive analysis science process skills matter of environmental pollution shows that the score of all indicators science process skills, covering observe, interpret, predict, use traditional tools and materials, applying the concept, planning experiments and communicate quantitative higher in the group of students learn by using the PBL model compared groups of students who use the conventional model. Furthermore, the results of the inferential analysis of data obtained showed normal distribution and homogeneous. Hypothesis testing using a one-way ANOVA test showed that $F_{count} = 4.714 > F_{table} = 3.98$, then $H_0$ is rejected. This means that there is a significant influence on the PBL model of science process skills in learning environmental pollution materials.

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