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The Effect of Project-Based Science Learning on PGSD Students' Creative Thinking Ability

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Abstract

This study aims to determine the effect of project-based learning on creative thinking skills toward preservice teachers in primary teacher education programs in electricity material and the great improvement of creative thinking skills. This research was a Quasi-Experiment toward students in the fourth semester amounted to 2 classes. The data collection was done in the form of observations and creative thinking skills test. Analysis of the data using the Mann Whitney U Test. The results showed: 1) Project-based learning has significant effects on the creative thinking skills of students; 2) Improvement of students' creative thinking skills using free project-based learning is better than guided project-based learning.

Keywords*: Project-Based Learning; Creative Thinking Skills; Electricity*

1. Introduction

Dynamic electrical material is one of the abstract science materials and is one of the material that is considered the most difficult for PGSD students. This is based on the results of interviews and questionnaires which show that 87% of electrical material is difficult to understand. Some of the reasons that make electrical material difficult to understand are abstract material, lack of training in circuit analysis, and less optimal practice. Based on this, there needs to be innovation in science learning to make it more interesting, challenging, and fun. One of the innovative science learning in electricity materials is project-based learning (PjBL).

Paul Suparno (2007) explains that the project method is a project method is learning science with students forming groups and being asked to make or do a joint project and present the results of the project that are constructive in nature that students build their understanding / discover science concepts with group assistance. Therefore project-based learning can develop students' thinking skills either independently or in groups. According to Lattimer and R. Riordan in Chiang and Lee (2016), project methods are learning methods where students respond to questions about the real world or solve a problem with the inquiry process. Continued by Bédard in Chiang and Lee (2016) states that the project method can develop students 'thinking skills, develop students' creativity, and encourage students to collaborate on a team. Hendrik Pratama and Ihtiari (2016) explained that the project learning model assisted by learning media of micro hydropower plants could improve students' critical thinking skills. Followed by the results of the research Ndaru Wicaksono and Totok Heru (2016) found that the project learning method was more effective in improving learning achievement than using the lecture method. Dian Novita Sari, et al (2015) produced findings that project-based learning affects the level of creativity of students by making simple electroscopes. Based on this explanation, the project method can be used as a method that can be used in developing the ability to think creatively on electrical material. Marlina (2010) in her research suggests that there are differences in creative thinking skills between groups of students who learn by using a project-based learning model with groups of students studying with conventional learning models.

Puskur (in Suparya, 2010: 28) states that "science learning should be carried out in scientific inquiry and constructivist to foster the ability to think, work, and be scientific and communicate it as an important aspect of student life skills". Project-based science learning has a strategic role in developing creative thinking skills. This is because project-based learning is based on challenging questions and makes students have a central role in the process of designing, problem-solving, and decision making to allow students to work

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independently. Woro Sumarni (2015) explained through the project, students do not have to memorize any theory or equation (formula), but rather analyze and think critically by analyzing the information gathered to solve problems through the project. This pragmatic approach concentrates more on processes than content. The effort to develop students' creative thinking skills is to provide freedom in designing projects that begin with problems in the real world. Sugiastini (2013) states that creative thinking, in this case, is a mindset of students who can produce many varied ideas that were not there before. Redhana (2015) said in his research that some teachers did not know if there were tests that could measure someone's creative thinking skills and the teacher had never made a test of creative thinking skills.

This is following the characteristics of the Acting Committee explained by Woro Sumarni (2015) that the principle of project learning is to provide real-world problems to be the object of an investigation to help students develop thinking skills, problem-solving skills, and intellectual skills create. The Guat See, et al. (2015) mention five skills that were trained during the PjBL process, namely, understanding of the basic design of the project; problem-solving skills; use sources/references effectively to find information; communication skills; and teamwork. Furthermore, Amanda Harper (2014) mentions an important element in PjBL besides focusing on teaching knowledge and skills

2. Research Methodology

This type of research was a Quasi-experiment using the non-equivalent pretest-posttest Design. Table 1 shows that class A was given treatment using free project-based learning and class B used directed/guided project learning (Guided Project Based Learning). Each class was given a pre-test and post-test.

Table 1. The non-equivalent pretest-posttest design

Groups	Pretest	Treatment	Posttest
Classes A	O_1	X_1	O_2
Classes B	O_1	X_2	O_2

The population in this study were all IV semester students. The sampling technique used was a saturated sample technique that was using the entire population as a sample. The instruments used in this study were in the form of a test sheet to obtain data on creative thinking skills in the form of description questions and observation sheets. Hypothesis testing uses the Wilcoxon test with the provision that if the p-value is <0.05, the null hypothesis is rejected. To find out how much improvement in creative thinking skills is tested using the N-Gain equation, namely:

$$\text{N-Gain} = \frac{skor\ post\ test - skor\ pre\ test}{skor\ maksimum - skor\ pre\ test}$$

Table 2. N-Gain Classification

N-Gain Average	Qualification
0.70 < N-Gain ≤ 1.00	High
0.30 < N-Gain ≤ 0.70	Moderate
N-Gain ≤ 0.30	Low

3. Findings and Discussions

The learning process in this study follows the steps/syntax of PjBL which consists of six steps, namely (1) Starts With the Essential Question, (2) Design a Plan for the Project, (3) Creates a Schedule, (4) Monitor the Students and the Progress of the Project, (5) Assess the Outcome, (6) Evaluate the Experiences (Woro Sumarni, 2015). This learning begins with brainstorming by giving open questions about the real world along with videos about the use

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of Redondo trees as an alternative source of electricity. The video aims to motivate students to make a work/product that can later benefit the community. Furthermore, students are grouped and directed to design and make projects related to electricity. Classes that use free project-based learning are given the freedom to determine and design projects.

Themes determined by each group must be sourced from scientific references such as journals/proceedings / final assignments. While the class that uses guided project-based learning is given direction and guidance in determining and designing the project. In the next step, each group is directed to arrange a schedule for completion of the project with a completion time limit of 1 month. Educators provide direction to each group to report project completion progress every 1 week.

The last step is to present the final project results by providing an evaluation of each project that has been made. Figure 1 is an example of an alternative energy source project from durian skin.

Figure 1. Process of peeling durian skin

Figure 2. Result of the project

Figure 2 explains that durian skin can be used as an alternative energy source. Based on the project produced, four battery stones are needed to produce bright lights. In addition to making alternative energy sources, some groups make alarms, such as earthquake alarms, flood alarms, and fire alarms. Figure 3 is an example of a simple flood alarm project.

Figure 3. Design of simple flood alarm project

Furthermore, a post-test was conducted to measure students' creative thinking skills including fluency, originality, elaboration, and flexibility.

Table 3. Summary of Mann Whitney U Test.

Test Statistics

	Creative Thinking
Mann-Whitney U	360.000
Wilcoxon W	990.000
Z	-2.977
Asymp. Sig. (2-tailed)	.003

a. Grouping Variable: kelas

Based on Table 3, project-based science learning has a significant influence on students' creative thinking abilities, namely with a significance value of 0.003. Furthermore, the increase in students' creative thinking skills can be seen in Figure 4.

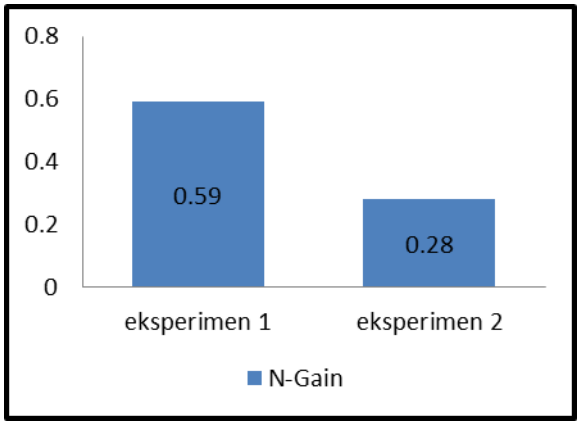

Figure 4. Comparison of Experiment Classes' N-Gain average

Figure 4 explains that the increase in creative thinking skills in class A (free project-based learning) shows a moderate category while the creative thinking ability in class B (guided project-based learning) shows a low category. This proves that project-based learning (free project-based learning) is better for improving students' creative thinking skills than guided project-based learning on the dynamic electrical matter.

Project-based learning provides greater opportunities for students to think and explore the ability or skill in completing a task and finding the right concept. This is in line with the research of Rohana and Wahyudin (2017) explaining that project-based learning can improve students' creative thinking skills. This is because project-based learning trains students in asking questions, in thinking about different ways to solve problems, trains students to categorize data, trains students to think about things that are not expected by others, and can train students expressing his own opinion on a problem. Furthermore, Mihardi et al. (2013) stated that project learning was able to improve students' creative thinking skills. Project-based learning can train students to design, analyze, and apply students' ideas in making a project.

The literature search is an important point in project-based learning so students can read and choose literature from trusted sources to find the right concept. The literature search is one effort for students to solve a problem (problem-solving) and to answer the hypothesis that has been made. The literature search will also provide opportunities for students to gain broad insights.

Sumarni (2015) who explained that PjBL will increase the ability of students to find and obtain information. Morgil in Sumarni (2015) states that in finding solutions for project tasks, students can search from various sources such as online, library, field trips, observations, etc. where the literature search process is used by students to obtain knowledge and processes to find solutions to project tasks that are. This literature search becomes the initial

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capital to develop students' creative thinking skills in project-based learning. See et al. (2015) mention five skills that were trained during the project-based learning process (PjBL), namely an understanding of the project's basic design; problem-solving skills; use sources/references effectively to find information; communication skills; and teamwork.

The next step is the presentation and evaluation of project results. Presentation activities can train students to have communication skills and maintain the arguments they have. In presentations, students are directed to explain scientifically based on scientific journals/references that have been obtained, both in terms of presenting material or in terms of questions and answers. According to Rais (2010), PjBL can foster the values that will be built in soft skills such as communication and presentation skills. Harper (2014) that PjBL has important elements that can train 21st-century skills, one of which is communication skills. Furthermore, William (2017) explained that project-based learning provides opportunities for students to be involved in active learning and opportunities to learn new soft skills such as communication and negotiation.

Overall this project-based learning can provide new knowledge and skills. Based on the results of interviews with several students, project learning with this theme is something new, fun, challenging, and can motivate students. This is because this theme is one of the themes that are quite complicated but can be applied in science learning in elementary schools and is beneficial to society. Suparno (2007) explains that one of the characteristics/characteristics of a project is that the theme must be challenging and generally make something/product that is not yet commonly done. Although the project must be challenging, it is also required not to be too difficult because it will have an impact on the time and outcome of the project completion. Besides, the project must produce works that are useful for the community and the students themselves.

Evaluation in learning this project is limited time so that the tools that have been made are less than optimal. For example, a fire alarm that has been made by a student alarm sound indicator / light lights waiting after the fire goes out / touches the metal. This has an impact on the length of the alarm sound indicator/light on d

4. Conclusions and Suggestions

The results of data analysis show that: 1) project-based science learning influences the creative thinking ability of PGSD students in dynamic electricity material with a significance value of 0.003; 2) the improvement of students' creative thinking abilities using free project-based learning is better than those using guided project-based learning with the average N-Gain values in each class 0.59 and 0.28. Subsequent research on project-based learning can measure critical thinking skills, problem-solving skills, and scientific literacy skills.

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