Effectiveness of Practicum-Based Project in Enhancing Students’ Learning Outcomes in Plant MicroTechnique Courses

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Effectiveness of Practicum-Based Project in Enhancing Students' Learning Outcomes in Plant Micro-Technique Courses

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ABSTRACT
This study examines the effect of practicum-based project in improving students' learning outcomes in plant micro-technique course. The research was conducted in the Biology Education Study Program at a public university in South Sumatra, Indonesia. The study involved Biology Education students (female=19; male=3), who contracted plant micro-technique courses. The research design used in this study is one-group pretest-posttest design. The data was collected using multiple choice test instruments with 25 questions that given before and after project-based practicum learning. Observations on the implementation of project-based learning processes are carried out using observation guidelines. The data of students learning outcomes were analyzed by calculating the average, percentage, and N-Gain. The results of the study showed that a practicum-based project can effectively improve students learning outcomes by an average of 70.78 (good category) and with n-gain 0.59 (moderate category). The results indicated that a practicum-based project can improve student learning outcomes in plant micro-technique courses.

Keywords: *Creative thinking, Laboratory practices, Plant-micro-technique, Learning outcome.*

1. INTRODUCTION

Practical activities are very important in science education. Educators in science education agree that practicum activities are a very important and vital component of science education [1,2]. In addition, education experts also stated that the main purpose of science education is more on teaching process skills than simply pursuing content knowledge. According to [3], practical work in the laboratory is essential in improving motivation and provides opportunities for students to collaborate with other students [4], So laboratory practices have its own appeal and are more useful and fun compared to other science learning. Even some sources mention that practical experience is a very important component for prospective teachers [2].

Although many research results showed that laboratory practices increase motivation, performance, and learning outcomes of students, however, some research has also shown that laboratory practices are not easy to understand, confusing, unproductive, and take considerable time. It is also founded in plant micro-technique courses.

The plant micro-technique course is one of chosen course for students in biology education. The demand of this course required student to understand three main components, namely (i) understanding the concepts of plant micro-technical; (ii) understand the steps of preparation plant tissue well, and (iii) produce plant tissue preparations with good quality [5]. Besides, these courses demand complex thinking skills. But learning has been using practical guidelines with cook-book models, leading to a lack of student creativity.

The balance between process and content knowledge is also not yet maximized. This is because some of the practicum activities in the laboratory are still classified as traditional. whereas this practicum activity is very important for a biology education student as a prospective teacher. The practicum activities of plant micro-technique have limited. Students simply follow step-by-step instructions to complete the experiment. This causes students to often lack a deep understanding of experimental design. Practicum activities become difficult for students, and sometimes bore because the activities carried out always follow the Steps according to the existing practical instructions. This is a challenge for lecturers to design practical learning that can engage students in full. In addition, many research results show that improving the work of practice in the laboratory has a very important role in preparing a learner to be able to exist in the community. For this purpose, it is indispensable laboratory practice for each student. But constraints showing that the process of learning micro-technique plants so far have not fully trained process skills, especially creative thinking skills.

Creative thinking in plant micro-technique relates to students' ability to design planning, carry out practicum activities in tissues preparations, and representation the results of practicum activities in various forms [5]. The resulting representation is a product of the practicum activities of plant micro-technique course. This has an impact on the learning outcomes of students who are not maximal yet, so it is necessary a practical design in the laboratory that can improve the motivation, process, and learning outcomes of students. One of the commonly used learning models is the project-based learning model.

Project-based learning (PjBL) is a student-centered learning model based on the concept of constructivism [6], involving complex tasks and producing products [7;8]. PjBL provides students with the opportunity to explore, investigate, understand, and consider problem solving alternatives, as well as apply what they have learned in real life. Further [9], that project-based learning has several components including: (i) very in accordance with the curriculum; (ii) have questions that can lead students to understand key concepts or principles, (iii) require students to conduct their own research and build knowledge, (iv) students are responsible for designing and managing their own work, and (v) authentic, focusing on real-world problems. In addition, according to [8] project-based learning can be explored in various contexts and various levels of education in schools ranging from elementary and secondary schools to higher education. From some sources can conclude that PjBL is one of the good methods in developing the general skills of students including: self-learning, creativity, problem solving, and teamwork [8; 9; 10; 11; 12].

The previous research showed that the use of PJBL in learning can improve understanding of concepts, learning outcomes [13], skills required in the 21st century [14; 15], and being able to make learning more meaningful [10]. In addition, PjBL model can improve students' creative thinking skills higher than cooperative learning [6]. The other research has also shown that students' involvement in environmental projects has a positive impact on students' environmental knowledge and science attitudes [16]. From several sources, it can be seen that project-based learning has many advantages, including: (i) PjBL directs students to find knowledge independently [17]; (ii) provide opportunities to work independently; (iii) can produce valuable and realistic products [17; 18; 19].

However, some research has not revealed specifically how laboratory practices-based project in plant micro-technical improved students' learning outcomes. So, the main focus of this paper is whether practical work in project-based laboratories can improve students' learning outcomes in plant micro-technique courses. The use of project-based learning is expected to facilitate the learning process in the laboratory on plant micro-technique courses. This project-based practical activity is expected to train creativity, self-reliance, and understanding concepts that can be applied in real life. In addition, the results of this study are expected to be used as basic data and as information in an effort to improve the process and learning outcomes of students, especially in plant micro-technique courses.

2. METHOD

This research is a pree-experimental study with One-group pretest-posttest design [20]. The study was conducted in the Biology Education Study Program at a State University in Palembang, Indonesia. This study was involved students of the Biological Education Study Program (n=22) who participated in the course of Plant Micro-technique. The focus of this research illustrates how the project-based practicum learning process improves student learning outcomes in plant micro technique courses. The final product of the project is the plant tissue preparations.

The data in this study was obtained using multiple choice question instruments (n=25). The questions given relate to (i) the concepts of plant tissue and (ii) the mechanism of making for plant tissue preparations. Data on the implementation of the project-based plant micro-technique practicum learning process was observed using observation guidelines. Observation focuses on three main indicators: (i) Preparation of tools and materials; (ii) Project Implementation; (iii) Product quality as a result of the project. Description of student activity on each indicator is shown in Table 1.

Table 1. Description of student activity in plant Micro-technique courses

Indicator	Description
Preparation of tools and materials	• Complete tools and materials • Materials use Labels • Materials used as needed • The tools are placed in the appropriate place • The plant material used is still fresh • The part of plant material used following project objectives
Project	• The procedure used is

Indicator	Description
Implementation	correct • Each stage follows the specified time • Each stage is documented, • Complete each stage on time
Product quality as a result of the project	• The Tissues preparations are thin • It is clear when observed under a microscope • Complete identity • The color of the preparation tissues is light and clear

The observations are made during the creation of project tasks in the laboratory. In addition, questionnaires are used to get students' perceptions of the practicum-based project learning process. Personal communication is done to get more in-depth information on student perception.

The data of learning outcome is analyzed by calculating the average, percentage, and n-Gain [28]. The average learning outcome (Lo) and observations of project implementation are calculated using the following formula (Lo: student learning outcome; S_i: student score; S_{max}: maximum score).

$$Lo = \frac{S_i}{S_{max}} x100$$

The result of of student learning outcome is grouped by category referring to [21] category (Table 2) Temporary, observation data of the implementation of the project is carried out by observing student activities starting from the planning stage, implementation, and end of the project. Data were analyzed by combining averages and percentages on each indicator.

Table 2. The category of student learning outcomes and project implementation in plant Micro-technique courses

Score range	Category
75 - 100	very good
61 - 74	good
51 - 60	fair
35 - 50	poor
≤ 34	worse

The calculation of the percentage *(P)* project implementation is done by comparing the score of each indicator (x_i) with the maximum score (x_{max}), using the following formulations. Percentage project implementation is grouped by category in Table 2.

$$P = \frac{x_i}{x_{max}} x100$$

3. RESULT AND DISCUSSION

3.1. Result

The result of students' learning outcomes on project-based practicum learning was analyzed by calculating posttest and n-Gain averages. The results showed that there is an increase in student learning outcomes after a practicum-based project learning process (Table 3).

Table 3. The category of student learning outcomes in plant Microtechnicque courses

Data			n-gain Category
Pretest	Posttest	n-gain	
27.13	70.78	0.59	moderate

The results showed that the learning process helped students understand the material related to the concept of plant tissue as well as the procedure of making plant tissue preparations. Based on the data, it is known that the pretest percentage was 68.2% of students were in the worse category and 31.8% were in the poor category, while at the posttest 27.3% of students were in the very good category, 68.2% of students were in good category and 4.5% were in the fair category (Figure 1).

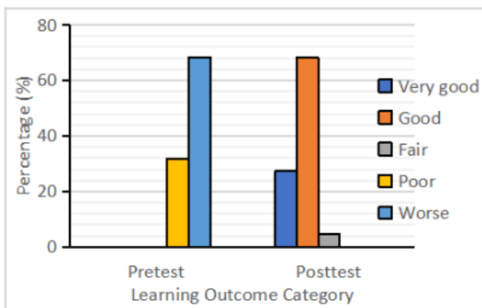

Figure 1. Percentage of student' learning outcomes category

The observations on the implementation of projects carried out by students are observed using observation guidelines that divided into three main indicators namely: (i) Preparation of tools and materials; (ii) Project implementation; (iii) Product quality as a result of the project (Table 4). Observations are made during the creation of project tasks in the laboratory.

The task of the project begins by preparing the tools and materials. In this step, the students determine for themselves the plant organs to use to make the preparation of plant tissue. The students arrange schedules according to the given grace period. The project implementation stage is in the laboratory and every progress of the project was observed by lecturers using observation guidelines. All stages are carried out by students until they get a product in the form of preparation of plant tissues that will be stored in the laboratory. The evaluation of the project results is carried out by the lecturer at the end of the activity.

The results of the observation showed that the practicum-based project activities were carried out in good categories, starting from the preparation of tools and materials, project implementation, and product quality. The average of each project implementation indicator was achieved in the very good and good categories (Table 4).

Table 4. The observations data in the implementation of Practicum based projects.

No	Indicator	Average	Category
1	Preparation of tools and materials	82.57	very good
2	Project implementation	63.63	Good
3	Product quality	71.21	Good
	Average	72.47	Good

According to Table 4, it is known that the average project task was in a good category. The lowest percentage was in the project implementation stage (63.63%). In addition, the results of observations on student activity also showed that in the first indicator, the percentage of students (72,7%) was a very good category. But in the second indicator, the highest percentage (68,2%) was in fair category (Figure 2). This is because at the project implementation stage most (86.36%) students repeat certain stages because they do not get satisfactory results. It also impacted 72.72% of students not completing tasks on time.

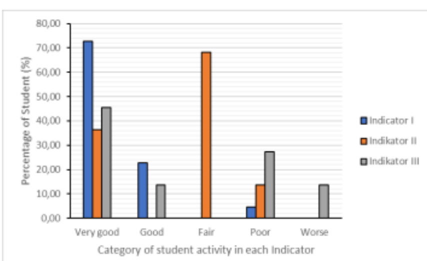

Figure 2. Percentage of student' activity category in each indicator

3.2. Discussion

Based on the data in Table 2, it is known that there was an increase in student learning outcomes after the practicum-based project learning with a posttest average of 70.78 and N-gain of 0.59 (moderate). This is believed because the learning practicum-based project allows students to explore their skills in designing, carrying out experiments to produce good products. Students design practicum activities independently ranging from preparing tools and materials, arranging work steps, and constructing products. This is accordance with the previous research [22], that involving students directly in practicum activities improves students' abilities in compiling products. The increase of learning outcomes in plant micro-technique is also caused by the project-based problem. Several previous studies have shown that problem-based learning provides opportunities for students to develop thinking skills [23], especially creative thinking [22]. The previous research also showed that project-based learning PjBL is effectively used in the learning process to improve learning outcomes [17, 18]. In addition, project demands have an impact on improving students' abilities, especially in (i) Preparation of tools and materials (82.57); (ii) Project Implementation (63.63); (iii) Product quality (preparation of plant tissue) (71.21) (Table 4). This is in accordance with previously expressed by some researchers who stated that project-based learning can train skills to the students namely: the ability to design, analyze and apply ideas in achieving project perfection [24-26].

In addition, students also analyze preparatory products. Students recognize the type of tissue and its characteristics using various sources of reference. This allows students to better recognize and understand the structure and characteristics of plant tissues correctly. This is in accordance with previously found by [27] that students who use varied reading sources will understand the concept of plant tissue better than others.

The results observation also shows that activity on three indicators classified into good criteria (Table 4). In addition, the practicum-based project in plant micro-technique course enhances students' creativity in solving problems. This is in accordance with observations that show that students can perform self-reflection and improvement their work so the students can create a good product at the end of the activity. The students can evaluate their mistakes and correct them so that the result is much better. The results of this study are similar to those expressed by [16], who stated that project-based learning is able to increase student creativity.

4. CONCLUSION

Based on this study show that there was improvement in students' learning outcomes and activity in the laboratory. students' learning outcomes improved after having experience through practicum-based project with an average 70.78 and N-Gain 0.59 (moderate category). in addition, this study improves creativity in the preparation of tools and materials, project implementation, and product quality. In the study as indicated, most of students have good activity in managing practicum in laboratory. Regarding the result, learning activity in laboratory including (i) Preparation of tools and materials; (ii) Project implementation; (iii) analysis of product (plant tissues characteristic) are factors that improved student learning outcomes.

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