International Journal of Innovation, Creativity and Change. www.ijicc.net
Volume 11, Issue 4, 2020

The Implementation of Power Electronics Training to Enhance Student Learning Activities in the Power Electronics Learning Process

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This research reveals the enhancement of student learning activities in the learning process of power electronics after the implementation of the Power Electronics training as a practical learning media. Student learning activities are performed by students during the learning process practicum which consists of several indicators listed on the research instrument. These include preparation, implementation, closing, and the application of occupational health and safety. The research instrument used is the Performance Assessment Rubric which has been tested for validity and reliability. The research subjects consists of 18 students who undertook the Power Electronics Practicum Learning Process. The results show that there is a significant enhancement in student learning activities in the learning process after the implementation of Power Electronics Training in the learning process compared to before . This is indicated by the value of gain score (g = 0.81). Therefore, it can be concluded that the implementation of power electronics training in the Learning Process of Power Electronics Practicum can enhance student learning activities at a high rate.

Keywords: *Power Electronics Trainer Kit, Student Learning Activities, The Learning Process of Power Electronics Practicum.*

Introduction

The learning process is a set of activities where there is an interaction between educators and students which aims to achieve learning objectives. The goal of the learning objective is to change students' mindset and behaviour in a particular field in accordance with the learning

material. The aim of the learning process is to run optimally with the intention that the learning objectives can be achieved properly and at an optimal level (Choi, Lee, & Kim, 2019; Koivuniemi, Järvenoja, & Järvelä, 2018). However, in the final learning outcomes it is not only learning objectives that must be considered , it is also important to consider the process as well. If the final result includes one of the indicators of successful decision making from the implementation of the learning process, then the process is one of supporting factors for optimising the final learning outcome in the learning process. A practicum learning process aims to strengthen students' theoretical understanding of the learning material, particularly abstract content (Yanto, Sukardi, & Puyada, 2017), (Yanto, 2019). The strengthening of this material is conducted through direct experience by observing, testing, measuring and analysing. The practicum learning process focuses more on student learning activities in following the learning process, not just on final abilities and results. The practicum learning process requires students to be more active in following the learning process, independently carrying out learning processes such as analysing basic theories, testing, measuring and observing according to the demands of the theoretical material (Chu et al., 2017; Huizenga, et. al. , 2019; Volet, Jones, & Vauras, 2019; Jalinus, Syahril and Nabawi, 2019). Rather, the role of the practicum learning process is to help students prove abstract theoretical learning material so that that it can be more concrete and enhance students' understanding of the learning material.

In its implementation, the practicum learning process also requires learning media as a means or tool used to help students participate in the learning process and assist in the delivery of information between lecturers and students so that an effective interaction process can occur. In addition, learning media also play a role in determining the level of student learning activities or student performance during the learning process practicum which is one indicator of success in achieving learning objectives. Effective learning media can improve student learning activities that will affect student learning outcomes and the achievement of practical learning goals (Najid et al., 2019). Similar to the learning process in general, the practicum learning process also has several types of learning media that are designed, built, and selected according to the characteristics of the learning material to be studied. These include presentation media, tools and laboratory materials, trainer kits, simulation software and later on. One of the learning media that can enhance student learning activities and is efficient in its use is the trainer kit. A trainer kit is a facility or equipment which is the combination of several tools and practicum materials that are designed to be made into a single unit, so that it can be used efficiently without the requirement for additional time to search for practicum tools and materials separately and one by one. The trainer kit has also been designed in accordance with the characteristics of the learning material and helps students to make observations, tests, and measurements using only one set of equipment without having to collect tools and materials which require a relatively long time (Huizenga et al., 2019; Rozgonjuk, et. al. , 2019; Rizal, et al., 2019).

Power Electronics Practicum is one of the practical learning processes that must be followed by Industrial Electrical Engineering students. The purpose of learning is to strengthen students' theoretical understanding of learning power electronics, most of which are abstract and require evidence and direct observation to be well understood by students. The Power Electronics Practicum for Industrial Electrical Engineering students in the Electrical Engineering Department, Faculty of Engineering, Universitas Negeri Padang, Indonesia, in its implementation so far still uses practical tools and materials which are remain separated between each component. Hence, during the learning process, students will identify the tools and materials needed and then collect them to be assembled, tested, observed and measured. The process creates inefficiency in the implementation period of the learning process as requires more time for students to identify and collect separate tools and materials. Moreover, this kind of learning process has also not been able to significantly improve learning activities or student performance during the learning process. This is indicated by the results of the measurement of student performance during the learning process, which is still low (Koivuniemi et al., 2018; Ulupınar, Şenyuva, & Küçük Yüceyurt, 2019). Based on these facts, a study is conducted on the use of one of the practicum learning media in the form of Power Electronics

The Trainer Kit that has been designed and built according to the characteristics of learning material in the Power Electronics Practicum Learning Process for Industrial Electrical Engineering students in the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang. The purpose of this study is to reveal and enhance student learning activities during the Learning Process of Power Electronics Practicum by using the Power Electronics Trainer Kit as a learning medium. There are several methods that can be used to enhance student learning activities such as comparison of student learning activities from the experimental class and the control class using the t-test formula,(Morales & Benitez, 2019) analysis of the increase between before and after the application of certain media in the learning process using the normalised gain score formula (g). In this study, enhancing student learning activities is revealed by comparing student learning activities between before and after the use of the Power Electronics Trainer Kit in the process of learning electronic power practicum using a pretest-post test research design (Huizenga et al., 2019), (Ashworth, Thompson, & Mercer, 2019). This method is chosen because it is considered to be relevant to the characteristics of the study and the research objectives to be achieved.

Methods

The research method used is quantitative quasi-experimental type. This method was chosen because in this study several aspects are ignored, namely aspects that do not greatly affect the research results . Those aspects that became reference points and the main research focus are the dominant aspects that influence research results .

Research Design

One group of Pretest-Post test Design is a research design that is applied in this study. This research was conducted on a group of research subjects consisting of 18 students. These students are Electrical Industrial Engineering students from the Faculty of Engineering, Universitas Negeri Padang who participated in the Learning Process of Power Electronics Practicum. At the beginning of the study, the measurement of student performance was carried out during the Learning Process of Power Electronics Practicum using commonly used learning media such as separate tools and materials (non-trainer). Subsequently, student performance is measured following the use of the Power Electronics Trainer Kit as a learning medium (Amamou & Cheniti-Belcadhi, 2018; Yanto, Hidayat, & Hamdani, 2018). Then, the results of the measurement of the two student learning activities are compared in order to determine how to enhance student learning activities that occur between before and after the implementation of the Power Electronics Trainer Kit in the Learning Process of the Power Electronics Practicum. The research design used in this study is presented in table 1(Sukardi, et. al. , 2017).

Table 1: Research Design

Pretest	Treatment	Post test
O_1	X	O_2

Information:

O_1 = Measurement of student performance before using the trainer kit
X =Implementation of the learning process using the trainer kit
O_2 = Measurement of student performance after using the trainer kit

Research Instruments

The research instrument used in this study is the rubric of performance appraisal that has been tested for validity and reliability. This performance appraisal rubric was developed through several key indicators in the practical learning process, namely the preparation phase, the implementation phase, the closing stage, and the application of occupational health and safety. A performance evaluation rubric is used by observers to measure student learning activities during the learning process. Indicators of preparing the performance appraisal rubric are presented in table 2.

Table 2: Indicator of Performance Test Rubrics

Indicator	**Total Item**
Preparation Phase	5
Implementation Phase	10
Closing Phase	2
Implementation of Occupational Health and Safety	3

Techniques of Data Analysis

The data analysis technique used to enhance student learning outcomes during the Power Electronics Practicum Learning Process using power electronics trainers as a practical learning medium in this study consists of a comparative analysis between before and after the use of the trainer kit in the Power Electronics Practicum Learning Process. The analysis formula used is the normalised gain score as follows (Revelle, 2019)(C. Chen & Yang, 2018).

$$Normalized\ gain\ (g) = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

The results of calculations using the gain score are then interpreted with the interpretation table of the gain score data to determine the level of improvement that occurs. This interpretation is a reference in the decision making of the study's research results . The normalised interpretation score table is presented in Table 3(C. H. Chen & Yang, 2019; Revelle, 2019).

Table 3: Interpretation of Normalised Gain Score

Normalised Gain Score	Interpretation
-1,00 < g < 0,00	Decrease
g = 0,00	Stable
0,00 < g < 0,30	Low
0,30 < g < 0,70	Average
0,70 < g < 1,00	High

Data and Discussion

The results of this study were divided into two data: pretest data and post test data. Both these data are the result of student performance measurements during the practical learning process between before and after the use of the Power Electronics Trainer Kit as a learning medium in the Power Electronics Practicum Learning Process.

Pretest Data

Pretest data is data obtained from the results of student performance measurements before the use of the Power Electronics Trainer Kit as a learning medium in the Learning Process of Power Electronics Practicum. The learning process is still carried out using learning media in the form of tools and materials that are sremain fragmented (non-trainer). The distribution of results from the pretest data is presented in Table 4.

Table 4: Distribution of Pretest Data

N	Minimum	Maximum	Mean	Std. Deviation
18	48	78	62	9,788

Post test Data

The post test data measures student performance during the Power Electronics Practicum Learning Process after using the Power Electronics Trainer Kit as a learning medium in the Power Electronics Practicum Learning Process. The post test data distribution results are presented in Table 5.

Table 5: Distribution of Posttest Data

N	Minimum	Maximum	Mean	Std. Deviation
18	68	95	85	6,752

Based on the results of descriptive distribution analysis, the learning activities of students during the practicum learning process using the Power Electronics Trainer Kit are higher when compared to before the use of the Power Electronics Trainer Kit as a learning medium in the Learning Process of Power Electronics Practicum. This indicates an enhancement in student learning activities after using the Power Electronics Trainer Kit as a learning medium. However, in order to reveal the improvement that occurred, further analysis is needed by using a normalised gain score.

Improved Learning Activities

Enhanced student learning activities were analysed using normalised gain score analysis between student performance results before and after the use of the Power Electronics Trainer Kit as a learning medium in the Power Electronics Practicum Learning Process. Before analysing the normalized gain score, an analysis of the test requirements is performed, namely the normality test data for the two types of data using the Kolmogorov-Smirnov Z test. (Tascı, 2015)(Ergül & Keskin, 2014). The results of the normality of pretest and post test data are presented in Tables 6 and 7 respectively.

Table 6: Normality Test of Pretest Data.

		Pretest Results
N		18,00
Normal	Mean	62,00
Parameter[a,b]	Std. Deviation	9,788
Most Extreme Differences	Absolute	0,100
	Positive	0,073
	Negative	-0,100
Kolmogorov-Smirnov Z		0,534
Asymp. Sig. (2-Tailed)		0,935
a. Test Distribution is Normal		
b. Calculated From Data		

Table 7: Normality Test of Post test Data.

		Pretest Results
N		18,00
Normal	Mean	85,00
Parameter[a,b]	Std. Deviation	6,752
Most Extreme Differences	Absolute	0,136
	Positive	0,077
	Negative	-0,136
Kolmogorov-Smirnov Z		0,733
Asymp. Sig. (2-Tailed)		0,644
a. Test Distribution is Normal		
b. Calculated From Data		

Table 6 and Table 7 show that the significance value of the test was 0.935> 0.05 for pretest and 0.644> 0.05 for post test data. Thus, pretest and post test data are normally distributed and meet the test requirements for further analysis using normalised gain scores. Normalised gain score analysis results for pretest and post test data are presented in Table 8.

Table 8: Results of Normalised Gain Score Test.

	Maximum		Mean		Normalised Gain Score
	Pretest	Post test	Pretest	Post test	
Pretest-Post test Results	78	95	62	85	0,812

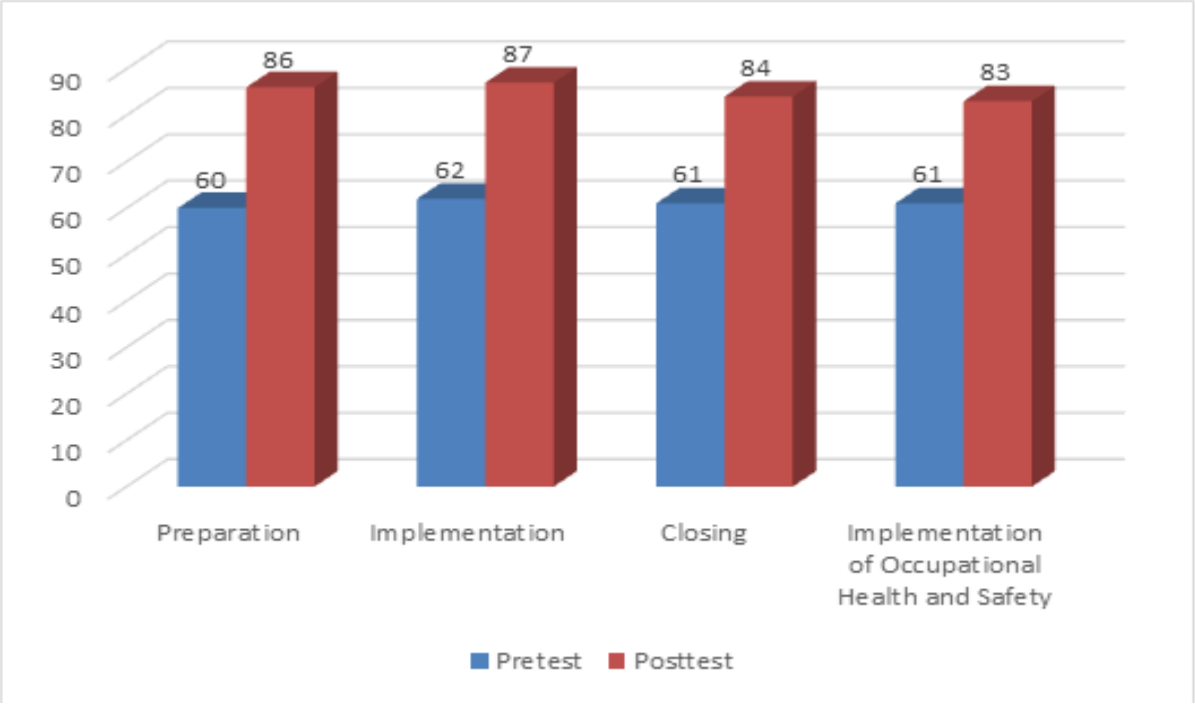
According to the results of the data analysis presented in Table 8, the average normalised gain score for 18 students is 0.812 (g = 0.81). This result, if interpreted by the interpretation score table, indicates that enhancement occurs at a high level. Thus, the Power Electronics

Trainer Kit can improve student learning activities during the Learning Process of Power Electronics Practicum at a high level. If considered in each of the main indicators of student performance, the greatest enhancement occurrs in the indicators for the preparation and practical phases. The results of the analysis of the enhancement in student learning activities for each of the main indicators are presented in table 9. A graph indicating the enhancement in learning activities for each indicator are presented in Figure 1.

Table 9: Results of Normalised Gain Score Test.

Indicator	Maximum		Mean		Normalised Gain Score
	Pretest	Post test	Pretest	Post test	
Preparation	78	96	60	86	0,830
Implementation	76	96	62	87	0,834
Closing	80	90	61	84	0,794
Implementation of Occupational Health and Safety	84	88	61	83	0,790

Figure 1. Graph showing Improvement of Student Learning Activities



Conclusion

The implementation of the Power Electronics Trainer Kit in the Learning Process of Power Electronics Practicum is able to enhance student learning activities at a high level and can

enhance the efficiency of time usage when compared to previous learning media (non-trainers). Thus, the Power Electronics Trainer Kit can be used as an alternative choice for practicum learning media in the Power Electronics Practicum Learning Process. The use of the Power Electronics Trainer Kit is able to help to optimise the achievement of learning objectives specifically the Learning Process of Power Electronics Practicum for Industrial Electrical Engineering students.

Acknowledgements

Thanks to the Rector of Universitas Negeri Padang (UNP) and Chairman of the Institute for Research and Society Dedication (LP2M) UNP who have assisted and facilitated the implementation of this study.

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