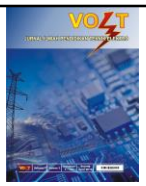
P-ISSN: 2528-5688
E-ISSN: 2528-5696

VOLT
Jurnal Ilmiah Pendidikan Teknik Elektro
Journal homepage: jurnal.untirta.ac.id/index.php/VOLT
Vol 3, No. 2, Oktober 2018, 68 – 77



DEVELOPMENT OF PROJECT BASED LEARNING TOOL USING PLC TRAINER TO IMPROVE CREATIVITY AND SELF-RELIANCE

Elsanda Merita Indrawati [1]✉, Kuni Nadliroh[2]

[1]Department of Electronics Engineering, Faculty of Engineering
Universitas Nusantara PGRI Kediri, Kediri 64112, Indonesia
✉Corresponding author e-mail: elsanda@unpkediri.ac.id

[2]Department of Mechanical Engineering, Faculty of Engineering
Universitas Nusantara PGRI Kediri, Kediri 64112, Indonesia

DOI: 10.30870/volt.v3i1.3039

Received: September, 29th 2018. Received in revised form: October, 8th 2018. Accepted: October, 10th 2018. Available online: October, 10th 2018

Abstract

This research aims to analyze: (1) quality of project based learning tool with trainer PLC, (2) the creativity of students after following the learning to use project based learning tool with trainer PLC, and (3) self-reliance learn student after following learning using project based learning tools with trainer PLC. This research is a research and development (R&D) using One Group Pretest Postest Design. The results showed that (1) the learning tools of project based learning with PLC trainer shows excellent quality with a score of 81.4%; (2) the creativity of students after implementing learning using learning tools of project based learning with PLS trainer has increased with the average value of N-gain of 0.60 criteria medium; (3) the self-reliance of the student learning increased after implementing learning using project based learning tools with PLC trainer, indicated by the average value of N-gain of 0.55 with medium criteria.

Keywords: creativity, learning tools, PLC trainer, project based learning, self-reliance.

INTRODUCTION

External factors serve to provide a stimulus for the internal factors of students. External factors should be a complete package in order to realize the success of students in learning, so teachers are instrumental to develop methods, tools and instructional media as supporting factors for the success of the learning process. The success of the children in the study can be seen from the high low levels of independence and creativity of students in learning

Creativity is a process in creating an idea and new idea in solving a problem, so it has a high student creativity is expected easily to find alternatives in solving a problem in the process of learning. Creativity is important because it shows the personal qualities needed to become a professional (Louca, Varnava-marouchou, Mihai, & Konis, 2014: 131). In addition to the creativity of self-reliance is also influential in the success factors of students in learning this because the independence of the study related to the attitude of the students in having initiative, confidence and responsibility toward what he did included in the learning activities and learning achievement.

Through the independence of the students were able to learn at its own initiative without help from others, low levels of self-reliance that is lack of confidence against capabilities caused by an overly dominating teacher learning activities (Maga, 2016: 37). This agreed with (Aini & Taman, 2012: 51) which declared the independence of learning is indispensable to enhance learning and achievements will have an effect on the passion for learning.

Teachers as organizers of the learning in the classroom have a duty to help enhance the creativity and independence of student learning through the process of learning tools, methods, and media for good quality learning, but that happens in the school is focused more towards learning outcomes without paying attention to the aspects of creativity and independence student learning.

Based on the results of interviews and observations early in high school vocational Electricity Installation Engineering (TITL) in Kediri Regency on lessons of programming PLC, students understand the material and the difficulty in solving the problem it is because the lack of responsibility, confidence, motivation, communication, task based on real implementation, the willingness of students to learn as well as media learning did the stimulus of students to think creatively. Based on the results of interviews and observations that can be drawn the conclusion that the creativity and independence of learning students are still low.

The main factors cause it happened, among others, namely learning methods are less precise, the lack of learning and learning media device that can arouse the creativity and independence of students in learning, so as to overcome the problems the teacher as the organizer of learning must be processed using methods with innovating, developing learning and learning the right media as well as quality of programming PLC on subjects, so that it can improving the independence and creativity of students.

Learning tools that can enhance creativity and independence of students in learning programming PLC device, i.e. learning tools with project based learning, this is because the model of project based learning is a model of learning which gives the task based on the working project so students more challenging, demanding the students to be able to communi-

cate, collaborate, make decisions, and solve problems.

A learning model of project based learning can help students in learning through some things, (1) a solid knowledge and skills and meaningful (2) extent of knowledge through a process of learning activities; (3) build knowledge through experiential learning in the real world and discussions between cognitive, personal, which took place in an atmosphere of collaborative work (Santi, 2011: 77).

This agreed with (Cuma, 2013: 1908) stating that the model of learning project based learning can make the students have a good learning experience and acquired skills through practical and effective action-oriented with project. Likewise, according to Ferro, Caroline, Gonçalves, Oliveira, & Silva (2018: 481) stating project based learning involves students to solve a relevant problem or project and allows students to work independently so can build knowledge development based on projects that involve the actual situation (Hamid, 2016)

Learning tools project based learning will be more complete if equipped with appropriate learning media on subjects programming of PLC. Learning media trainer PLC-based microcontroller that is media of learning that has the configuration and principle of the same work with PLC but at much cheaper. PLC with its own form of PLC programmed microcontroller software use LD Micro is suitable for applied educational institutes are concerned with cost efficiency (Rifa'i & Putri, 2013: 114).

Based on the background, the researchers to developed a learning tools project based learning with media trainer PLC-based microcontroller for training the creativity and self-reliance learning of vocational high school students at department of electric power installation engineering in Kediri District.

This research aims to analyze: 1) quality of project based learning tools with PLC trainer, (2) the creativity of students after following the learning to use project based learning tools with PLC trainer, and (3) the self-reliance of students learning to use learning tools after following the project based learning with PLC trainer.

METHOD

This research is a research and development (R&D). The results of the development form of the syllabus, learning implementation plan (RPP), modules, student worksheets, PLC trainer media-based microcontroller, tests the ability of creative thinking, and student learning self-reliance question form sheet.

The research design used One Group Pretest Postest Design that uses one group without the use of comparison group given the treatmen using project based learning tools with PLC trainer-based microcontroller.

RESULTS AND DISCUSSION

Research development is divided into several procedures, (1) preliminary studies and data collection, including observation, interview, documentation, literature studies, and the preparation of framework research; (2) research planning, including needs analysis, determining strategy and model of learning, the determination of the learning media, the development of a learning tools, development of learning an instrument, development of learning media; (3) product design, including the design tool of learning, research instrument, and PLC trainer media; (4) expert validation, tools validation, instrument and PLC trainer learning media validation (4) small-scale trials or trials

1, conducted to know the quality of the tools and instruments of learning before test 2; (5) revision of the product, to correct the shortcomings found in the trial phase 1; (6) the limited scale of the test or test run 2, conducted on vocational high school students majoring in electricity installation engineering in Kediri Distric that consists of a Chanda Birawa Vocational High School Pare, Putera Harapan Vocational High School Plemahan, and Vocational High School 1 Purwoasri; (7) the final product, consists of a project based learning tools, PLC trainer media, creative thinking ability test instruments, and questionnaire of self-reliance of student learning.

The results of the analysis of the quality of learning tools.

Validation of learning tools carried out by experts validator from Department of Electrical Engineering Education Universitas Negeri Surabaya, Department of Electrical Engineering Universitas Nusantara PGRI and PLC subjects teachers in vocational high school in Kediri. The validation of the results that have been filled by experts, and then the results of the validation of the rating is calculated for each indicator. The rating results categorized by the criteria of assessment scale is presented in table 1.

Tabel 1. The results of the validation of the quality of learning tools by validator

No	Learning tools and instruments	The Results of Rating	Category
1	Syllabus	78%	Good
2	Learning implementation plan (RPP)	85%	Very good
3	Student worksheet (LKS)	75%	Good
4	Module	79%	Good
5	Learning media	84%	Very good
6	creative thinking ability test	82%	Very good
7	Questionnare of self-reliance of student learning	85%	Very good
Average		81,4%	Very good

The validity, reliability, and difficulty level of creative thinking ability test

On creative thinking ability test prior to student of vocational high school Department of electric power installation engineering in Kediri District, creative thinking ability test question tested to students majoring in electrical engineering, it is aimed to know the validity of the grain problem, reliability, and difficulty level of creative thinking ability test grains.

A trial analysis of the grain of matter as much as 5 creative thinking ability tests given to 17 students. Based on the product moment table $R_{xytabel}$ values for N = 17 with $\alpha = 0.05$ obtained results 0.482. items reserved were declared valid in has $R_{xycalculation} > R_{xytable}$. The validity of the question creative thinking ability test can be seen in table 2.

Table 2. The validity of the question creative thinking ability test

$Rxy_{calculation}$	Rxy_{table}	Question	Description
0,776	0.482	1	very significant
0,658	0.482	2	significant
0,656	0.482	3	significant
0,407	0.482	4	Not significant
0,791	0.482	5	Very significant

Based on table 2. the validity of the question creative thinking ability test known 4 question were declared invalid while the 1 question were declared invalid or fall. Reliability ability test problem grain creative thinking revealed reliability if the results $Rxy_{calculation} > Rx_{table}$, based on the results of the calculations using the anatesV4 $Rxy_{calculation} = 0.51 > Rxy_{table} = 0482$, so that the grains of matter revealed reliability. The results of the calculation of the level of difficulty of the question creative thinking ability test using anatesV4 are presented in table 3.

Tabel 3. Degrees of difficulty item creative thinking ability test

P	Interpretation	items	Total
P<0.30	Hard	3	1
0.30<P≤0.70	Middle	2,4,5	3
P>0.70	Easy	1	1
Total			5

Based on table 4 degrees of difficulty item creative thinking ability test known the proportion of reserved creative thinking ability tests (1:3:1).

The results of the creativity of students

Analysis of the students' creativity is measured by using creative thinking ability tests executed before and after the learning activities learning using project based learning with PLC trainer. The results of the analysis of creativity of students is divided into 3 on (1) Chanda Bhirawa Vocational High School Pare, (2) Putera Harapan Vocational High School Plemahan, and (3) Vocational High School 1 Purwoasri. The results of the analysis of the students' creativity can be seen in table 4.

Table 4. The result of creative thinking ability

No	Aspect	∑pretest	Criteria	∑pos test	Criteria	N-Gain	Criteria
	Chandra Birawa Vocational High School Pare						
1	Fluently	63	Good	91,5	Very Creative	0,8	High
2	Flexibility	61,9	Good	88,6	Very Creative	0,7	High
3	Original	62,5	Good	88,6	Very Creative	0,7	High
4	Elaboration	61,4	Good	84,1	Very Creative	0,6	Middle
	Putra Harapan Vocational High School Plemahan						
1	Fluently	64,7	Good	80,9	Very Creative	0,5	Middle
2	Flexibility	64	Good	83,1	Very Creative	0,53	Middle
3	Original	63,2	Good	82,3	Very Creative	0,52	Middle
4	Elaboration	61,8	Good	83,1	Very Creative	0,56	Middle
	Vocational High School 1 Purwoasri						
1	Fluently	62,2	Good	83,8	Very Creative	0,57	Middle
2	Flexibility	60,8	Good	83,8	Very Creative	0,59	Middle
3	Original	64,9	Good	85,8	Very Creative	0,60	Middle
4	Elaboration	60,8	Good	81,1	Very Creative	0,52	Middle

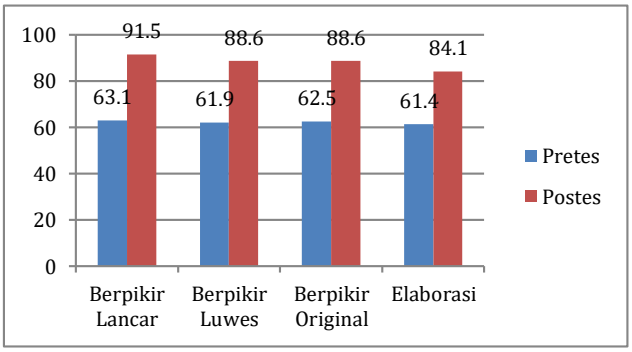


Figure 1. Creative thinking capability analysis charts in Canda Bhirawa Vocational High School Pare

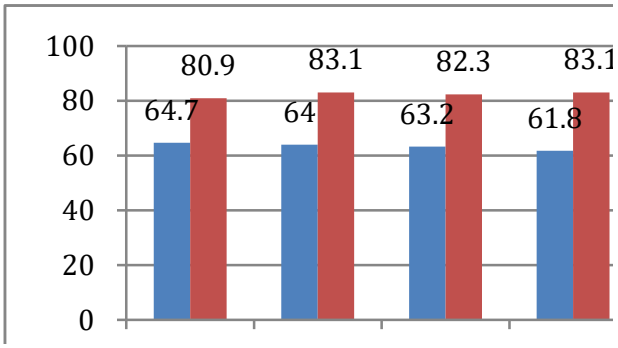


Figure 2. Creative thinking capability analysis charts in Putra Harapan Vocational High School Plemahan

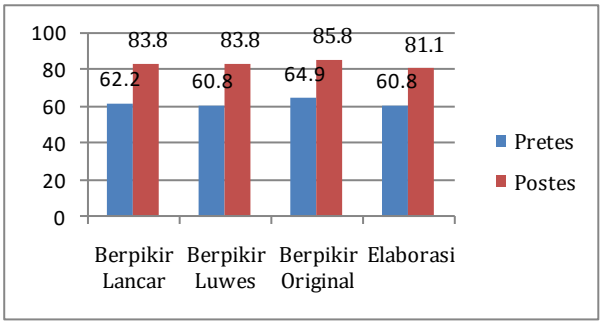


Figure 3. Creative thinking capability analysis charts in Vocational High School 1 Purwoasri

(3) pada SMK Negeri 1 Purwoasri mendapatkan skor N-gain berfikir lancar sebesar 0,57 dengan criteria sedang, berfikir luwes sebesar 0,59 dengan criteria sedang, berfikir original sebesar 0,60 dengan kriteria sedang, elaborasi sebesar 0,52 dengan kriteria sedang.

Analysis results in table 4 shows that the ability of the creative thinking of learning to use the tools after following the project based learning with trainer PLC is divided on three schools, namely (1) on the Chanda Bhirawa Vocational High School Pare gain score N-gain thought smoothly of 0.77 with high criteria, flexible thinking of 0.70 with high criteria, original thinking of 0.70 with high criteria, elaboration of 0.60 with middle criteria; (2) on Putra Harapan Vocational High School Plemahan Pare gets her on score N-gain thought smoothly of 0.46 with the middle criteria, flexible thinking of 0.53 with middle criteria, think of original of 0.52 with middle criteria, elaboration of 0.56 with middle criteria; (3) on Vocational High School 1 Purwoasri gain score N-gain of 0.57 with middle criteria, fluent thinking with middle criteria, flexible thinking of 0.59 with medium criteria, original thinking of 0.60 medium criteria, elaborations of 0.52 with medium criteria.

Based on the results of the analysis of the students' creativity in Vocational High School electric power Engineering Techniques in the Kediri Regency consisting of Chanda Bhirawa Vocational High School Pare, Harapan Putera Vocational High School Plemahan, and Vocational High School 1 Purwoasri, then experience increased creativity demonstrated by an average score of N-gain the ability to think smoothly get 0.60 with medium criteria, flexible thinking get a score of 0.61 with medium criteria, original thought get score 0.61 with medium criteria , elaborations get score 0.56 with medium criteria.

Reliability and validity of student learning self-reliance

Questionnaire of Student learning self-reliance tested to students majoring in electrical engineering bachelor degree to know the validity and reliability Student learning self-reliance. Questionnaire of Student learning self-reliance given to 17 students Universitas Nusantara PGRI electrical engineering majors. Questionnaire of Student learning self-reliance provided as many as 30 items. The calculation results of the validity of the Questionnaire of Student learning self-reliance by using SPSS 17. Based on product moment table Rxy_{tabel} values for N = 17 with α = 0.05 get result of 0.482. The items of questionnaire of Student learning self-reliance stated to be valid if the independence had $Rxy_{calculation} > Rxy_{table}$.

The results of the calculation of validity Questionnaire of Student learning self-reliance using SPSS 17 presented at table 5

Table 5. validity of questionnaire of Student learning self-reliance

No items	$r_{calculation}$ Value	r_{table} Value	Criteria
1	0,827	0.482	Valid
2	0,697	0.482	Valid
3	0,494	0.482	Valid
4	0,252	0.482	Not Valid
5	0,618	0.482	Valid
6	0,590	0.482	Valid
7	0,618	0.482	Valid
8	0,737	0.482	Valid
9	0,258	0.482	Not Valid
10	0,655	0.482	Valid
11	0,597	0.482	Valid
12	0,827	0.482	Valid
13	0,835	0.482	Valid
14	0,495	0.482	Valid
15	0,485	0.482	Valid
16	0,618	0.482	Valid
17	0,068	0.482	Not Valid
18	0,618	0.482	Valid
19	0,737	0.482	Valid
20	0,303	0.482	Not Valid
21	0,684	0.482	Valid
22	0,578	0.482	Valid
23	0,597	0.482	Valid
24	0,530	0.482	Valid
25	0,583	0.482	Valid
26	0,486	0.482	Valid
27	0,671	0.482	Valid
28	0,749	0.482	Valid
29	0,087	0.482	Not Valid
30	0,497	0.482	Valid

Based on table 5. The validity of the question form of student learning self-reliance i.e. 25 items self-reliance declared valid and can be used in the research, while the 5 items self-reliance is declared invalid or cannot be used in the research. Reliability of the question form of student learning self-reliance declared reliability if the results $Rxy_{calculation} > Rxy_{table}$. The calculation result of reliability question form the student learning self-reliance using SPSS 17 presented in table 6.

Table 6. The Reliabilility of the question form the student learning self-reliance

Cronbach Alpha	Cronbach Alpha Based on Standardized items	N of Items
.745	.745	30

Based on Table 7. The reliability of the question form the student learning self-reliance retrieved that $Rxy_{calculation}$= 0.745 > Rxy_{table}= 0.482, so the question form the student learning self-reliance can study revealed reliability.

Analysis of the student learning self-reliance measured using creative thinking ability tests which was carried out before and after using the project based learning activities with PLC trainer. The results of the analysis of student learning self-reliance divided into 3 on (1) Chanda Bhirawa Vocational High School Pare, (2) Putera Harapan Vocational High School Plemahan, and (3) Vocational High School 1 Purwoasri, the results of the analysis to the student learning self-reliance can be seen in table 7.

Table 7. The results of student learning self-reliance question form

No	School	∑Pretest	Criteria	∑*Posttest*	*Criteria*	*N-Gain*	*Criteria*
1	Chanda Bhirawa Vocational High School Pare	60	Enough	80	Good	0,50	Middle
2	Putra Harapan Vocational High School Plemahan	61	Good	82	Very Good	0,53	Middle
3	Vocational High School 1 Purwoasri	64	Good	86	Very Good	0,61	Middle

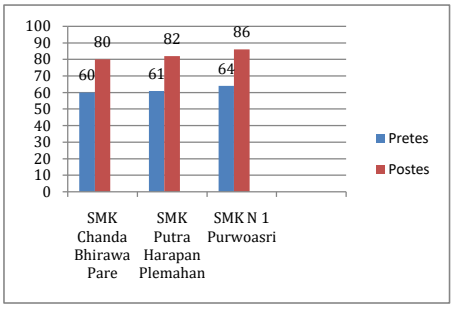


Figure 4. Graphic analysis of student learning self-reliance question form on Canda Bhirawa Vocational High School Pare, Putra Harapan Vocational High School Plemahan, dan Vocational High School Purwoasri

Analysis results in table 7 shows that the student learning self-reliance using learning tools after following the project based learning with PLC trainer is divided on three schools, (1) Chanda Bhirawa Vocational High School Pare N-gain score of 0.50 with high criteria; (2) on Putra Harapan Vocational High School Plemahan get N-gain score of 0.53 with middle criteria; (3) on Vocational High School Purwoasri get score N-gain of 0.61 with middle criteria. Based on the results of the analysis of the student learning self-reliance in electric power engineering (TITL) Vocational High School in Kediri District, the creativity of students experience increased demonstrated by an average score of N-gain of 0.55 score with middle criteria.

CONCLUSION

Based on the findings of the research results can be drawn some conclusions, (1) the project based learning with PLC trainer shows shows excellent quality with a score of 81.4%, making it feasible for use in learning activities; (2) the creativity of students after implementing learning using project based learning with PLC trainer experience increased demonstrated by an average of N-gain score of 0.60 with the middle criteria; (3) the student learning self-reliance after carrying out the study using a

learning tools of project based learning with PLC trainer experience increased demonstrated by an average of N-gain score of 0.55 to the middle criteria.

It is recommended the following things (1) Tools model of Project Based Learning can enhance the student learning self-reliance and student learning outcomes, then to the teacher should model the study tested on other subjects; (2) then for the next research for those interested in researching can use media trainer PLC other types; (3) in this study only measured the creativity and student learning self-reliance in learning using Project Based Learning with trainer PLC-based mikrokontroller Atmega32, then for the next research needs can be measure the effectiveness of learning tools in improving the cognitive learning results, affective and psychomotor.

ACKNOWLEDGEMENT

Thanks to Lembaga Penelitian dan Pengabdian Pada Masyarakat (LPPM) Universitas Nusantara PGRI Kediri that has funded research Research grants in Hibah Penelitian Dosen Pemula 2018 with research contract number:248.05/LPPM.UN PGRI Kd/V/2018.

Thanks also to Vocational High School in Kediri District Electricity Installation Engineering (TITL), Canda Bhirawa Vocational High School Pare, Putra Harapan Vocational High School Plemahan, and Vocational High School 1 Purwoasri who gave a chance on researchers in conducting research on the agencies concerned with the number of letter: 87.05/LPPM. UN PGRI Kd/II/2018.

REFERENCES

Aini, P. N., & Taman, A. (2012). Pengaruh Kemandirian Belajar dan Lingkungan Belajar Siswa terhadap Prestasi Belajar Akuntansi Siswa Kelas XI IPS SMA Negeri 1 Sewon Bantul Tahun Ajaran 2010/2011. *Pendidikan Akuntansi Indonesia*, *X*(1), 48–65.

Cuma, F. I. (2013). Project-based learning in teaching with the DAF Montessori method. *Social and Behavioral Sciences*, *70*, 1901–1910. https://doi.org/10.1016/j.sbspro.2013.01.268

Ferro, E., Caroline, B., Gonçalves, M., Oliveira, K. B. De, & Silva, M. B. (2018). Project Based Learning Applied to Technical Drawing. *Creative Education*, *9*, 479–496. https://doi.org/10.4236/ce.2018.93034

Hamid, M. A. (2016). Pengembangan Instrumen Penilaian Hasil Belajar Siswa Berbasis TIK pada Pembelajaran Dasar Listrik Elektronika. *VOLT : Jurnal Ilmiah Pendidikan Teknik Elektro*, *1*(1), 37–46. https://doi.org/10.30870/volt.v1i1.822

Louca, E. P.-, Varnava-marouchou, D., Mihai, S., & Konis, E. (2014). *Teaching for Creativity in Universities*. *3*(4), 131–154. https://doi.org/10.15640/jehd.v3n4a13

Maga, Y. (2016). Peningkatan Kemandirian dan Hasil Belajar Matematika Melalui Strategi Metakognitif Berbasis Tutor Sebaya Bagi Siswa Kelas V SD YPK Persiapan Kampung ANNY. *Jurnal Surya LPMP Provinsi Papua Barat*, *XIV*(September), 37–42.

Rifa'i, M., & Putri, R. I. (2013). Desain dan

implementasi PLC berbasis mikrokontroler ATmega8. *Jurnal ELTEK*, *11*, 115–128.

Santi, T. K. (2011). Pembelajaran Berbasis Proyek (Project Based Learning) Untuk Meningkatkan Pemahaman Mata Kuliah Fisiologi Tumbuhan. *Jurnal Ilmiah Progresif*, *7*(21), 74–83.