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The Effect of Electronic Design Automation (EDA) Towards Experimental Learning Method

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***Abstract*—Experimental learning method offers more experience and knowledge for learners. Electronic Design Automation (EDA), which refers to electronic computer-aided design (ECAD), is a category of software tools for designing electronic systems such as integrated circuits. Using EDA on experimental learning with different learning motivation could result on different learning achievement. This work was related in order to investigate learning achievement on experimental learning through the use of EDA. This research used quantitative approach in quasi-experimental frame. In this research, the compared conditions were the experimental learning method with EDA and the real component and motivation, which were grouped into two, high and low motivation. The research instrument used were questionnaires and tests, while the data analysis used two ways of ANAVA. The statistical analysis showed that there was difference learning achievement in Digital Technique Subject among experimental learning with EDA and the real component. Furthermore, there was interaction among the experimental learning with EDA and the learning motivation in terms of their effect towards learning achievement.**

Keywords—EDA; learning motivation; learning achievement; experimental learning method

I. INTRODUCTION

Digital Technique Subject is a science subject which is one of the subjects of expertise in the curriculum of Air Navigation and Telecommunication Technique Department (TNU) and Airport Electrical Technique Department (TLB) in which the achievement of students learning was that the students are expected to be able to understand and apply the principles and concepts of digital as well as able to apply the procedure of design and application of digital techniques. As a vocational education in general, the provision of education in the Surabaya Aviation Polytechnic prioritizes the practice with the proportion of 70% of the entire educational curriculum. With such a dominant proportion, the students are required to master all aspects of practicum, both in terms of understanding and applying the principles and concepts of digital and able to apply procedures design and application of digital techniques properly and correctly. The experimental method is considered capable of increasing the construction of student knowledge in terms of understanding and applying the [1] digital principles and concepts.

Experiments are trials to prove a particular question or hypothesis. Experiments can be performed in a laboratory or outside the laboratory. Meanwhile, the experimental method in learning is a way of presenting the lesson material that allows students to experiment to prove themselves [2] a question or hypothesis learned.

The experimental method gives students an opportunity to experiment on something, observe the process and write down the results of the experiment, then the results of the observations are presented [3] to the class and evaluated by the teacher.

In the experimental learning method, students are given the opportunity to experience themselves or conduct the experiment themselves, follow the process, observe an object, analyze, prove and draw their own conclusions about [4] a particular object, state or process. The role of the teacher in the experimental learning method is to provide guidance so that the experiment is done carefully so that no mistakes or errors occur. From the description above, it can be concluded that the experimental learning method is a learning method that leads the participation / active role of learners in experimental activities to try and prove the truth of a theory or concept with a series of experimental steps that have been prepared with materials that have been prepared to support the target of learning.

As described above, practical work is a key component of engineering degrees and laboratory learn how [5] to apply theory. However, with the upgrading of laboratory equipment, universities and colleges [6] are increasingly using E–laboratory. (also referred to as virtual or remote labs or e-practices).

EDA stands for “Electronic Design Automation (EDA), which also refers to Electronic Computer-Aided Design (ECAD). It is a category of software tools for designing electronic systems such as integrated circuits and [7] printed

X / A	X_1	X_2
A_1	Y1	Y2
A_2	Y3	Y 4

circuit boards. The tools work together in a design flow that the chip designers work to design and analyze throughout semiconductor chips. Since a modern semiconductor chip can have billions of components, EDA tools are essential for their design. "EDA is also known as Electronic Computer-Aided Design (ECAD) or Electronic – CAD, where CAD is a technology related to the use of computer systems to assist in the creation, modification, analysis, and design optimization. The most basic role of CAD is to define geometric designs – mechanical parts, product assemble, architectural structure, electronic circuit, building layout, etc. Proteus Isis, as part of the CAD application software, is a group of electronic circuit design software automatically / Electronic Design Automation (EDA), which has the ability as an interactive electronic circuit design software / interactive circuit simulation (ISIS professional, 2009). Proteus Isis is the EDA software used in this study as well as it is a trademark of Labcenter Electronic (1989-2009).

II. METHOD

A. *Research Design (Heading 2)*

This research used a quantitative approach with experimental design. This research tried to find and test the influence of one variable or more to other variables. The variable [8] that gave effect is called independent variable and the influenced variable [9] is called dependent variables. The independent variable in this research was the learning on the subject of Digital Technique with experimental method with the EDA software and learning on the subject of Digital Technique by using experimental method using laboratory practicum with electronic component. Meanwhile, the dependent variable was the result of learning students in the subject of Digital Technique as well as the motivation as a moderator variable, which was divided into two, high motivation and low motivation, so that the research design was in the form of a 2x2 factorial design. Therefore, [10] the data analysis used two ways, ANAVA and SPSS 15.0.

To know the effect of using EDA software towards the learning achievement in Digital Technique subject, sampling was conducted on experimental group and control group. Tests were conducted simultaneously in each group after the lecture with EDA software and the lecture using laboratory practicum with electronic component had started.

In accordance with the relationship between variables mentioned in the previous chapter, then the research can be described in the diagram as follows.

Figure 1. Relationship between variables

Information:

A = Assisted media, which consists of

A1 = Simulation with EDA software

A2 = Laboratory Practicum with electronic component

X = Learning motivation, consisting of

X1 = High learning motivation

X2 = Low learning motivation

Y1 = Learning achievement by A1 and motivation X1

Y2 = Learning achievement by A1 and motivation X2

Y3 = Learning achievement by A2 and motivation X1

Y4 = Learning achievement by A2 and motivation X2

B. *Population and Sample*

The population of this research involved all students of the Air Navigation and Telecommunication Engineering Department (TNU) and Airport Electrical Engineering Department (TLB) at the Surabaya Aviation Polytechnic. In the Air Navigation and Telecommunication Engineering Department (TNU), there was one class of students of second semester with 29 students. Meanwhile, in the Airport Electrical Engineering Department (TLB), there was one class of students second semester consisting of 30 students.

C. *Data Collection*

1) Type of Data

a) Learning achievement data is the interval data

b) Learning motivation data is ordinal data

2) Data collection technique

To process the data required in this study, the following techniques were used:

a) Questionnaire

More details made dealing with the gratitude motivation in the questionnaire instrument were listed as follows:

TABEL I. GRATITUDE MOTIVATION

No	Indicator	No. Exam	Total
1.	Learning diligence	1,3,5,7,9,11	6
2.	Learning improvement	2,6,8	3
3.	Competitiveness	4,10,14	3
4.	Appreciation of the work of others	12,17	2
5	Creativity	13,15.18	3
6	Ambition	16,19,20	3
Total			20

b) Test

The learning achievement were tested based on the Component Display Theory (CDT) developed [11] by David Merrill with 30 test items.

D. Technical Data Analysis

In this research technical analysis used was two-way ANAVA. For that, previously performed hypothesis test was firstly tested following the requirements below:

1) Normality test,

Normality testing was performed through the Lilliefors test which was summarized in table II

TABLE II. NORMALITY TEST RESULTS

Variable	Lo	Lt	p_{value}	Note
Assisted media	0.077	0,140	0.200	Normal
Motivation	0.119	0,140	0.162	Normal
Learning achievement	0.121	0,140	0.141	Normal

From table II above, for all groups, it can be seen the value of Lo was smaller than the value of Lt, and the value of value for all variables were greater than the significant level of 0.05. Thus, it can be concluded that the variables in this study came from a population that was normally distributed.

2) Homogeneity Test

The homogeneity test of the population variant was done through Levene Test. Through the homogeneity test, it can be found that the similarity of variant of bound variable (learning achievement) was based on each variance score of the independent variable (EDA-assisted experimental method and experimental method with real component and Motivation). The homogeneity test summary was presented in the following table.

TABLE III. HOMOGENEITY TEST RESULT THROUGH LEVENE TEST

No	Variable	Value		*P value*	Note
		F_{count}	F_{tabel}		
1	Assisted Media Motivation	2,101	4,08	0,069	Homogeneous
2		1,302	4,08	0,309	Homogeneous

From Table III, it appears that the value of F count for both variables was smaller than the value of F table. Meanwhile, the P value for all variables was greater than the significant level of 0.05. Thus, it can be concluded that the data in the form of scores of Digital Technique learning resulted from each group had a homogeneous population variance.

III. RESULT AND DISCUSSION

A. First Hypothesis

TABLE. IV. COMPARISON OF LEARNING ACHIEVEMENT

Assisted Media	Average score	Minimum score	Maximum score	Modus
EDA	79,25	62,50	90,00	80,00
Electronic component	72,13	57,50	82,50	72,50

From the table of the average achievement, it was revealed that the students taught through EDA obtained an average score of 79.25, while the students taught through experimental method using real electronic components obtained score 72.13.

From the results of the T-Test of the two study groups obtained, the results such as the following table were obtained.

TABLE V. T-TEST ANALYSIS OF HYPOTHESIS I

T_{count}	t_{tabel}	Df	influence
3,083	1,68	38	0,665

From the table V, it can be seen that t_{values} obtained from observation or t_{count} was equal to 3,083 where the level of 0, 05 (df = 38) t_{table} is 1.68. By comparing the t_{value}, it can be seen that $t_h = 3.083$ was greater than $t_t = 1,68$ at the level of $\alpha = 5\%$. Therefore, it showed that Ho was rejected which meant that there was a significant difference in student learning achievement between the one taught through experimental method with EDA and the one taught through experimental method using electronic components on digital technique. It means that the learning outcomes of the students taught through experimental methods with EDA were higher than those students learning through experimental methods with electronic components.

The results of calculations with a simple regression also showed that the influence of the media / practical tools of learning achievement was 0.665. It means that 66,5 % improvement in learning outcomes was influenced by the media or practice tools.

B. Second Hypothesis

From the data, it was obtained that the students that had high motivation with the average score of 79.00, while those with low motivation have an average score of 72.38.

The following table shows the descriptive differences between the two groups.

TABLE VI. COMPARISON OF LEARNING ACHIEVEMENT BETWEEN HIGH AND LOW MOTIVATION

Motivation	Average score	Minimum score	Maximum score	Modus
High	79,00	70,00	90,00	75,00
Low	72,38	57,50	87,50	62,50

From the results of the T-Test of the two study groups, it was obtained results such as the following table.

TABLE VII. T-TEST ANALYSIS ON HYPOTHESIS II

t_{count}	t_{table}	Df	Influence
2,819	1,68	38	0,731

From the table, it can be seen that the value of t observation or t count was 2.819 where at the level of 0,05 (df = 38) t table

value was 1.68. By comparing the value of t, it can be seen that t count = 2.819 was greater than t table = 1, 68 at level α=5%. Therefore, it showed that Ho was rejected, which means that there was a significant difference on the learning outcomes of students who had high motivation to the students who had low motivation on Digital Technique subject. In other words, the results showed that the students have high motivation was higher in terms of learning achievement than the students who had low motivation in Digital Technique subject.

The results of the calculations with simple regression also indicated that the magnitude of the effect of motivation on the learning outcome of 0.731. It means that there was 73,1% increase in the learning outcomes which was influenced by the level of student motivation.

C. Third Hypothesis

From the results of two-way ANAVA, the value of F count was equal to 7.142 for data variants between groups. By comparing the F value, it can be seen that F c = 7.142 was greater than F t = 2, 85 at a significant level α = 5%, so it indicated that Ho was rejected which meant that there was an interaction between practice assisted media and motivation level together towards the learning outcomes in Digital Technique subject.

The table below shows the results obtained from the analysis of the two-lane ANOVA calculations.

TABLE VIII. ANAVA TABLE ON HYPOTHESIS III

Data	JK	F_{count}	$F_T(0.05)$	Influence
Assisted Media Motivation	946,719	7,142	2,85	0,796

The results of multiple regression calculation also obtained score of magnitude of influence of 0.796, which means as much as 79, 6 % interaction between practice assisted media and motivation influence on learning outcomes in Digital Technique subject.

According to the results of the first hypothesis testing, it appears that EDA software gives a higher learning result of digital technique subject compared to the use of electronic components. This indicates that the use of EDA software and the use of electronic components has a difference of influence if implemented in the teaching of Digital Technique subjects in the sequential logic circuit theme in Surabaya Aviation Polytechnic. Thus, EDA software had its own advantages according to the circumstances in which the [9] experimental method was applied.

Basically, the use of EDA software media and the use of electronic components in experimental methods were two different media when viewed from the aspect of the procedure and the risk of its implementation. At the time of practice, by using EDA software, students were given an opportunity to develop and express themselves of every concept that was already in their cognitive structure and free from the risk of equipment damage due to possible procedural errors.

Simulations of experiments were another area where [10] the use of Computer could be beneficial. The laboratory use of expensive equipment was not always available to all students. Simulations might enable students to generate them in a laboratory and could allow students to use learning by discovery methods. Making mistakes in the execution or design of experiments could be too costly or dangerous to be allowed in a laboratory. Experimental design can also be tested [5] using trial-and-error methods.

With the help of EDA software, the students would be able to develop themselves dealing with every concept that had been mastered in experimental activities as well as connecting the concept with new concepts. So, in this case, the students did not only memorize the concept of digital techniques alone, but also the relationship between concepts. Thus, the structure and relationship between concepts became meaningful.

On the contrary, in the experimental method using real components, the students were required to be more obedient to the procedures in the laboratory experimental activities because each procedural error would give an impact on the continuity of the equipment used. Therefore, the students only practice procedures without considering the abilities and conditions of students concerned that might be able to develop deeper than the concept provided.

The results of testing the second hypothesis showed that the students who had high motivation had better learning achievement of Digital Technique compared to the students who had low motivation level.

Furthermore, the third hypothesis testing result showed the interaction between learning assisted media and motivation toward the achievement of learning Digital Technique. Thus, it can be said that the effectiveness of the assisted media or practical tools used in Digital Techniques also depended on the level of motivation possessed by students, in which, EDA software was more suitable to be given to the students who had a high level of motivation. It was proven by the absence of differences between the use of EDA software for students with low motivation compared with the real use of electronic components for students with high motivation.

The appropriateness of EDA software for the students that had high motivation was essentially due to the experimental method assisted by EDA [12] software which needed creative potential. For the highly motivated students who were served a learning through experimental methods assisted EDA software could stimulate the release of ideas to develop experiments as a development concept had been given. It was because the level of motivation was constructive, meaning that the level of motivation could determine the formation of the [13] character of a person's cognitive structure.

IV. CONCLUSION

As already known that the use of EDA software in the method of experiments and the use of electronic components in experiments method turned out to make a difference results of learning Digital Technique. However, it also actually depended on the motivation of the students. Therefore, if the information about the level of students

motivation was not known, then both media could be used through certain considerations such as learning objectives to be achieved, the ability of lecturers concerned to the media, as well as [14] the topic of discussion to be presented

It is suggested for the lecturers, in the process of learning, lecturers took role as managers of students, and [15] managers of students' learning need to be active and creative. The quality of teaching will be good if the lecturer, through the media chosen and used, is able to activate students and make them actively participate in the learning process. Because in this research method of assisted experiment of EDA software and laboratory experimental method using electronic component showed difference or influence towards the Digital Technique learning result, it is suggested to hold further research by considering the weaknesses existing in this research. The selection of other independent variables may be an alternative to re-examine the effectiveness of the instructional media used in this study.

In addition, in the selection and the use of instructional media the lecturers should also consider technical and nontechnical factors. For example, the learning media to be used should be chosen carefully to fit the topic of discussion and learning objectives that have been determined. Another one is that the selection of instructional media should also be in line with the characteristics of students so that the media can optimally motivate learners to achieve the best learning outcomes. Lecturers should also create a classroom atmosphere that can provide opportunities for students to develop their motivation. Therefore, the lecturer's task is to facilitate the process which, among other things, by making the knowledge meaningful, relevant, and creative, as well as giving the students a chance to find [16] and apply their own ideas.

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