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Application of Work-based Learning in Cooling Engineering Subjects

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***Abstract*—The purpose of this study is to explain that the application of Work-Based Learning can improve learning achievement of Cooling Technique in Industrial Automation Students of the vocational high school number one in Batam. This type of research is a Quasi-Experimental with the Non-Equivalent Groups Control Design method Pretest - Posttest. The sample of this research is the student of class X Industrial Automation vocational high school number one in Batam. The sampling technique was cluster random sampling. Done by comparing the performance test results between the experimental class using work-based learning methods and the control class using conventional learning methods. The analysis requirements test includes normality and homogeneity tests. Hypothesis testing using the T-test. Conclude that the experimental group student achievement is more than the control group student achievement, there is an influence on student achievement with work-based learning compared to conventional learning.**

Keywords — Work-Based Learning Teaching methods, Quasi-Experimental Design, Pretest-Posttest. Real Business

I. INTRODUCTION

The implementation of Cooling Engineering learning at vocational high school number one in Batam the learning outcomes obtained by students are low or unsatisfactory. The low prediction of learning outcomes in this training can be caused by several problems in learning, both internal and external [1]. The test used in the evaluation has a high level of difficulty which can affect success in learning [2]. Delivery of material that cannot be understood by students quickly and precisely, because the learning model carried out is not following the subject of this study can cause complexity for students and affect the level of student independence, persistence, and diligence to below [3]. Many other factors can influence student success in learning.

TABLE I. THE VALUE OF THE REFRIGERATION ENGINEERING SUBJECT FOR CLASS XII OTO2 FOR THE 2018/2019 ACADEMIC YEAR

Score	The number of students	Percentage
90-100	0	0
80-89	5	25%
72 – 79	7	28%
<70	13	52%
Total	25	100%

Overcoming these learning problems requires appropriate learning methods [4] [5]. Learning methods that have been widely used in learning include problem-solving learning methods [6], inquiry learning [7], cooperative learning [8], contextual teaching, and learning [9]. and work-based learning [10]. Learning cooling techniques has a lot to do with practice. This learning is closely related to direct practice in the world of work or independent work [11]. Therefore, the work-based learning model may be suitable to be applied in learning cooling techniques to improve student learning outcomes.

The new paradigm of education and learning is not only to change student behavior but to shape the character and mental attitude of professionals oriented to a global mindset [9]. The focus of learning is' learning how to learn and not just studying the subject matter [12]. Work-Based Learning has become an increasingly attractive area for the higher education sector or schools [13]. This is seen as a means of personal and professional support in the development of student learning who is already working and development tends to be in student activities in the workplace.

Work-Based Learning is a program where students can study in the business world and industry simultaneously with the world of education (school) [14], the Work-Based Learning program is intended to bring students to study directly in real business to apply the learning materials they have learned in the class [15]. So learning with the Work-Based Learning method is a work-based learning model that applies the work system in Industry to the learning syllabus at school.

II. METHOD

The population used was class X students majoring in Industrial Automation at Vocational high school number one in Batam, totaling 108 students consisting of three classes for the 2018/2019 academic year. The sampling technique used is cluster random sampling [16] by making 6 lottery coupons as many as the available groups, which are written as each learning group, put into one box that says the experimental group and one box that says the control group and also each learning group [17]. From the two coupon boxes, in the coupon drawing in the experimental group box, a coupon that says XL3B group is obtained, and in the control group box, a coupon that says XL3A group is obtained.

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This research is a quasi-experimental research with nonequivalent control groups pretest and posttest design [18].

$$\frac{01 \; x \; 02}{03.04} \qquad (1)$$

The work-based learning method is used as a tool used to improve student learning outcomes [19], with an approach that allows students to use the workplace to study learning material, and re-apply the learning material in the workplace [20].

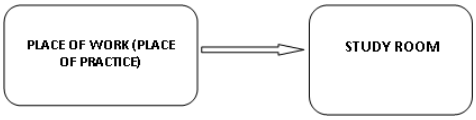

Figure 1: Learning work-based learning methods

III. RESULT

The results of the study obtained the learning outcomes of industrial automation students of Vocational high school number one in Batam by using work-based learning methods in Cooling Engineering subjects. The learning outcomes are the learning outcomes of the practical ability test (performance test) in learning AC service in class X automation 3A as the control class and class X automation 3B as the experimental class.

A. Normality Test

The normality test in the control class was also carried out using the Liliefors test and assisted by using the Product and Service Solution (SPSS) version 20 for descriptive data and the Q-Q plot [21]. Based on the Liliefors test, the sample data is said to be normally distributed if L0 < L_{table} and if L0 > L_{table} means the sample data is not normally distributed [22].

Based on testing for the experimental group, it was found that L0 = 0.1501 and L_{table} = 0.161. Because L0 < L_{table} (0.1501 < 0.161), it can be concluded that the experimental group is normally distributed at the 95% confidence level. While the test for the control group obtained L0 = 0.0242 and L_{table} = 0.161. Because L0 < L_{table} (0.0242 < 0.161), it can be concluded that the control group is normally distributed at the 95% confidence level. For a clearer calculation, see the table below.

TABLE II. NORMALITY TEST WITH THE LILIEFORS TEST

No	Class	L0	L_{table}	Conclution	Information
1.	Eksperimen	0.1501	0.161	L0 < Ltabel	Data normal
2.	Kontrol	0.0242	0.161	L0 < Ltabel	Data normal

B. Homogeneity Test

After carrying out the normality test, the homogeneity test was carried out [23]. The homogeneity test of the experimental class and sample class was carried out using the F test [24].

TABLE III. F TEST (ANOVA)

		Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	(Combined)	1072.611	12	89.384	.441	.886
	Linear Term Weighted Deviation	1.309	1	1.309	.006	.939
		1071.302	11	97.391	.481	.855
Within Groups		1012.500	5	202.500		
Total		2085.111	17			

F test obtained F_{count} < F_{table} means the sample class data has a homogeneous variance, on the contrary, if F_{count} > F_{table} and means the sample class data is heterogeneous. The value of F_{table} for the real level (α) = 0.05 and the degrees of freedom (dk) (n-1) = 17 is 1.796. So the price of F_{count} < F_{table}, (0.886 <1.796) so it can be concluded that the two sample groups have homogeneous variances.

C. Hypothesis Test

After carrying out the normality test and the homogeneity test as described above, it can be concluded that the two samples are normally distributed and the two classes have homogeneous variance [25]. To express the hypothesis that the application of work-based learning can improve the learning outcomes of students in the Industrial Automation Department at Vocational high school number one in Batam. This proof was done by using a t-test, namely the Independent samples Test [26] at SPSS20.

TABLE IV. INDEPENDENT SAMPLES TEST RESULTS

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gain Score	Equal variances assumed	4.647	.038	7.652	34	.000	22.389	2.926	16.443	28.335
	Equal variances not assumed			7.652	25.175	.000	22.389	2.926	16.365	28.412

Based on the calculation of the table in the figure above, it is obtained that t_{count} = 7,652 and the value of t_{table} based on degrees of freedom dk = (n1 + n2) -2 = 34 for one-way probability 0.005 = 2.704 From the table significance level (α1) compared to the significant level of Equal variances assumed (α2), which is 0.005> 0.00, thus Ho is rejected and Ha is accepted (significant). If the price of t_{count} > t_{table}, (7,652> 2,704) then that Ho is rejected and Ha is accepted (significant), there is a significant effect on the use of the work-based learning method on the learning outcomes of class X Industrial Automation at Vocational high school number one in Batam in-service lessons. AC compared to learning outcomes using conventional learning with the same learning material.

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IV. CONCLUSION

Learning is the most important thing that humans must do to deal with environmental changes that are always changing every time [27], therefore someone should prepare himself to face all dynamic and competitive life by learning, which includes learning to understand yourself, understand changes. , and the development of globalization [28]. By learning someone to be ready to face the times that are so fast [29]. Learning is a process of changing attitudes and behavior based on knowledge and experience [30]. Learning is a process of effort made by a person to obtain a whole new change in behavior as a result of his own experience in interacting with his environment [31] [32].

In learning by using the work-based learning method, you get knowledge and experience obtained from learning that is directly obtained from the field because this learning is carried out in the workplace itself and discussed in class, meaning that students get direct knowledge and work experience.

From the learning results, it can be proven that learning outcomes with the work-based learning method can improve student learning outcomes as proven by 100% of students who get learning with the work-based learning method get learning outcomes above the KKM. This learning is carried out with a process from practice in the field and continued in the classroom in the discussion of what happens in the field (workplace) and this learning is carried out repeatedly to get satisfactory results because the work done must have a standard of satisfaction according to customer wishes (AC service). In this learning, the aspects developed are cognitive aspects which include knowledge, understanding, application, analysis, synthesis, and evaluation. From these aspects we can see:

1. Aspects of knowledge

   In this lesson, students are taught the basic principles of cooling techniques (basic air conditioning).
2. Aspects of understanding

   Students are required to understand the basic principles of AC service according to the SOP of the AC service.
3. Application aspects

   In this learning, what has been obtained in the theory in the classroom can be directly applied in the field of work.
4. Aspects of analysis

   Students must be able to analyze shortcomings and things experienced in the field.
5. Synthesis aspects

   In this case, students must be able to apply the learning carried out in the classroom in its implementation in the workplace.
6. Evaluation Aspects

   Students must be able to evaluate the shortcomings or advantages of the practice carried out in the field with the theory that has been given.

If you look at the affective ability (the Affective domain) which is related to emotional aspects which consist of:

1. Aspects of Receiving

   In this learning, students are required to receive learning well by providing learning that is not boring by way of learning in two places and again if students cannot participate in learning properly, the results obtained in the field will make the AC machine serviced by the customer damaged or not optimal which results in customers disappointed.
2. Response Aspects

   Closed students must be responsive to the directions given when doing practice in the field.
3. Aspects of appreciation

   In this learning, students will be happy and proud of the results of the practice are carried out following the SOP or customer expectations.
4. Organizational Aspects

   In the implementation of this learning, students are expected to work together on the implementation of the practice because this practice is carried out by two students. So the collaboration between the two students is required to work together in its implementation so that there is no overlap of work between the two students in this practice. Do not let students wait for each other in every work activity.
5. Characteristics Aspects

   If students in AC service-learning must animate this learning so that it becomes a practical work skill both in AC service practice or other learning related to practice.

Refers to aspects of psychomotor abilities which are closely related to aspects of skills that involve the function of conditions and muscles, which can be categorized into aspects:

1. Aspects of Mimicking

   In practical learning, students are now required to be able to pay attention and imitate work that has good results and in practice, it is following these good practices.
2. Manipulation aspects

   Students can imagine the results of other students' work that have been good and applied to the same practice by these students.
3. Aspects of motion accuracy

   In the practice of maintaining and servicing this AC, students are led to work based on the working time because when they work directly in the field, students will do the work according to the time expected by the customer.
4. Articulation Aspects

   In practice, student AC service must comply with the SOP, so the AC service is to produce accurate work.
5. Aspects of Naturalization

   If the student is familiar with the practice of AC service, the student will work no longer need to be guided. The student will work spontaneously and get used to it because the student already knows what to do and do in AC service.

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Learning with this work-based learning method has a lot to do with direct practice with the AC itself, so with repeated practice, students dare to practice directly in the field, such as air conditioning service in their neighbors' homes. Seeing the learning that is carried out conventionally compared to learning with work-based learning methods, conventional learning should be abandoned because it cannot fulfill the cognitive, apective, and psychomotor aspects of education and is no longer following the goals of vocational education.

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