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The Effectiveness of Lean -Based Learning Model to Improve Work Skills of Vocational High School Students

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ABSTRACT:
Several studies have proven that the low work skills of graduates of Vocational High School (VHS) in mechanical engineering resulted in many problems in the world of work. The purpose of this research is to determine the effectiveness of the Lean manufacturing-based learning model to improve the work skills of mechanical engineering students in VHS. This study was categorized by experimental research that used the posttest-only control group design. The population of this study was the VHS students who joined an industrial internship course treated with a work shadowing strategy using the Lean manufacturing-based learning model. There were thirty students chosen as the sample through the cluster random sampling technique. The data were collected by developing a test-performance. The data were analyzed with an independence t-test. Based on the research results, the application of the Lean manufacturing-based learning model showed better results than the conventional instruction model in the VHS of mechanical engineering. It can be concluded the Lean manufacturing-based learning model is one of the recommended alternatives to improve students' work skills of vocational high school students to fulfill the world of work demands.

Keywords: *Lean Manufacturing-Based Learning Modesl, work skills, Learning outcome, VHS*

Introduction

The low achievement of competency among vocational high school (VHS) graduates has impacted the poor absorption of the recent graduates in the world of work and the escalation of educated unemployment rates. The data from Statistics Indonesia (BPS) in February 2020 show that the rate of open unemployment is still dominated by VHS graduates with 8.49% followed by 6.77% of high school graduates and 6.76% of Diploma III (BPS, 2020). The core job competencies and skills are determined by the integration of hard skills and soft skills. Hard skills refer to the technical skills and knowledge needed to perform a certain job, while soft skills play a crucial role in one's career and social life (Suryo. Hartanto, Arifin, Ratnasari, Wulansari, & Huda, 2020), (Majid, Liming, Tong, & Raihana, 2002). Soft skills accompany hard skills to be more flexible and positive to meet workforce demands (Suryo. Hartanto et al., 2020), (Sousa, 2001). Soft skills and hard skills are listed as a part of work skills that must be managed optimally in vocational education to prepare competent graduates according to their fields of science and the demand of the world of work or entrepreneurship.

Efforts are needed to reduce the unemployment rates of VHS graduates by aligning their hard skills and soft skills as the core of work skills. Effective and efficient performance in the world of work or industry is greatly determined by the work skills. The learning process should integrate between the educational aspects and the world of work to enhance students' work skills. The integration of the real world of work in the learning process provides great benefits towards the vocational competencies (Sousa, 2001). Integrated learning has been considered as a problem-solving of today's problems in vocational education. The VHS students will have meaningful learning experiences if they learn directly from the experts in the workforce (Sousa, 2001), (Lubis, 2010). In the industry, one of the popular methods called lean manufacturing has been proven successful to improve the effectiveness and the productivity of the work. This method is then implemented in the learning process or often called a lean manufacturing-based learning model, (Suryo. Hartanto et al., 2020). This learning model has been declared valid and has met the feasibility aspect as a learning model (Suryo. Hartanto et al., 2020), (Suryo Hartanto, 2020). Practically, students are taught to understand the processes in the world of work through the direct application of the work shadowing strategies. The application of lean manufacturing-based learning models among vocational students with an

integrated learning process can create a balance between hard skills and soft skills to support the achievement of work skills. Considering the importance of this method, this study aimed at determining the effectiveness of lean manufacturing-based learning models as an integrated teaching and learning process with industrial domain to improve the work skills among VHS students.

Theoretical review

Work skills as the integration of hard skills and soft skills must be possessed by individuals in the work process (S Hartanto, Langgeng Ratnasari, & Arifin, 2019). Hard skills are defined as special skills needed in the industrial world where these skills may change based on developmental requirements (Hartanto, 2017). Meanwhile, hard skills are abilities that can be learned through education which aims at improving intellectual abilities (Coates, 2006). Related to the soft skills of this section, work skills are defined as the abilities possessed by each individual that cannot be seen directly but plays a major role in one's life, especially in career and working performance (Hartanto, 2017). For future careers, employers' opinion tends to prefer soft skills as a better predictor than technical skills to determine a person's success, for example in the aspects of salary, graduation rate, homeownership. (Pritchard, 2013) since soft skills are intangible, non-technical skills related to a person's personality where it will determine one's ability as a leader, facilitator, mediator, or negotiator (S Hartanto et al., 2019), (Robles, 2012). Work skills in this study refer to the current needs of the industrial world. To know exactly what types of work skills are suitable for the needs of the workforce, a needs analysis was done with the Dacum approach. This approach can be used in various methods to determine the accuracy of the learning and competency mapping based on practitioners or experts based on their areas of expertise (Robert. E, 2004) (Hartanto, 2017). Based on the data results of the analysis, it was revealed the gaps in the competency of hard skills and soft skills between the VHS learning process and the work process in the industry. It indicates that the competencies taught in VHS are no longer relevant to the required skills in the world of work. There are 27 competencies of soft skills and 67 competencies of hard skills that must be taught to the students in the mechanical department (S Hartanto et al., 2019), (Suryo. Hartanto et al., 2020). To achieve the competency of work skills that are relevant to the industrial needs, the lean manufacturing learning model should be put forward to provide an appropriate learning process.

The lean manufacturing-based learning model is a system used in industry or production processes to achieve maximum benefits through effective and productive working performance with sustainable improvement (Fagerlind .S, Gustavsson, K., J., & Ekberg, 2015), (Sundar, Balaji, & Satheesh Kumar, 2014). Lean is a continuous effort to eliminate waste and increase the added value of a certain product to customers (Bill Carreira, 2005)(Wilson, 2010). It is called Lean because, the process can be run using less material, small investment, very minimal inventory, uses minimal space and, does not require a lot of labor. (Wilson, 2010). Implementation of lean manufacturing is outlined in five steps that thoroughly analyze an entire process, i.e. identify value, identify value streams, make the value stream flow, establish pull, and achieve perfection, (Sundar et al., 2014). The learning model is a structured guide used in the learning process to achieve effective, practical, and efficient learning objectives that bridge students in the active and interactive learning process to achieve optimal abilities based on their competencies. It is important to pay close attention to the dynamic changes in the industrial world so that a learning process can accommodate industrial standards (Hartanto et al., 2020). Vocational education in producing a competent workforce must meet these standards. The most appropriate learning is the integration with the industrial world. The main principle implemented in the industry is to achieve high efficiency and productivity by applying Lean. Lean Manufacturing as a reliable method in the production process to achieve effectiveness and efficiency has been adopted in vocational learning. The concept of lean manufacturing learning model is created to meet the achievements of vocational work skills. This learning model has been measured to achieve the learning objectives of vocational education. Lean manufacturing learning model has been declared valid to improve vocational students' work skills that are supported by the syntax of (1) stimulus, (2) identification, (3) reflective observation, (4) monitoring, (5) proof, (6) assessment and (7) reflection, (Hartanto et al., 2020).

Method

This research can be categorized as a quantitative model with an experimental method using the posttest-only control group design.The population of this study was vocational high students majoring in mechanical engineering. The research sample was selected using cluster random sampling technique, i.e. 30 students who were carrying out an industrial internship program in 11 companies of machining or manufacturing. They were divided into two groups, the experimental and the control group. The control group was those who were performing industrial practices with usual (conventional) conditions, while the experimental group was given different treatment by implementing a lean manufacturing-based learning

model with a work shadowing strategy. The instruments to determine the success of work skills development used action tests and observations that had been tested for its validity and reliability aspects.

Results and Discussion

Based on the research findings, to determine the effectiveness of the lean manufacturing-based learning model in integrated learning can be seen through the following data results.

a. Data description

Table 1. Description of the research data

		control	experiment
N	Valid	15	15
	Missing	0	0
Mean		69.73	79.33
Median		68.00	82.00
Mode		65[a]	76[a]
Minimum		61	67
Maximum		83	89
Sum		1046	1190

Based on Table 1. The distribution of the effectiveness test for the lean manufacturing-based learning model in the implementation of industrial internship in the control class showed the maximum student competency score of 87, the minimum score of 61, and the average value of 74, respectively. Meanwhile, for the experimental group, the highest student competency score was 93, the minimum competency score of 62, and the average competency score of 81, respectively.

To determine the effectiveness of the learning model, a t-test was done preceded with a prerequisite test, namely normality and homogeneity. The calculation results are presented below.

Table 2. Data normality test

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
nilai1	.215	15	.061
nilai2	.164	15	.200*

The calculation of the normality test was expressed with a significance level above 0.05. The control group obtained a significance of 0.200 and the experimental group gained a significance level of 0.061. It means that the data can be declared as normally distributed.

b. The effectiveness of lean manufacturing based learning models

Table 3. The effectiveness results of lean manufacturing-based learning models

			Scores	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		5.846	
	Sig.		.228	
t-test for Equality of Means	t		4.314	4.314
	df		28	22.603
	Sig. (2-tailed)		.000	.000
	Mean Difference		12.667	12.667
	Std. Error Difference		2.936	2.936
	95% Confidence Interval of the Difference	Lower	6.652	6.587
		Upper	18.681	18.747

Based on Table 3 above, the F test results stated that the experimental group was homogeneous at the significance level of 0.228 which was bigger than 0.05. For the calculation of the T-test, the t_{cal} was 4.314 for the control group, while the experimental group was 4.314 and the t_{table} score with df of 14 at the 5%

significance level was 1.761. If the score of $t_{count} > t_{table}$, (4,314> 1,761), Ho is rejected and Ha is accepted (significant). The experimental test results in the control and the experimental class showed the gap between the two classes. It means that learning with lean manufacturing-based learning models is effective to be used in the teaching and learning process to enhance students' work skills.

The accuracy in choosing a learning model will greatly affect the success of teachers in performing their tasks. The learning model has a series of steps or phases to help students to achieve specific learning goals (Eggen. P; D.Kauchak, 2012), (Suryo Hartanto, Huda, & Fordiana, 2019). The lean manufacturing-based learning model provides a real learning experience based on the learning needs by linking the school learning process with the direct process from the field experts or called the integrated learning with the world of work. Learning should be integrated with the workforce that directly the professional world of work to provide meaningful experiences for students. This learning model provides an opportunity to combine theoretical knowledge from classroom learning with direct application in the world of work (Melo, 2013). Beneficial learning experiences will support students' competency that supports the basic concept of vocational learning. The lean manufacturing-based learning model is proven to be a suitable effort to improve students' work skills. Vocational education emphasizes the learning process to prepare people to work. To realize this objective, the instructional strategies should be directed to all procedures and actions required in the world of work. The students should learn the knowledge, skills, attitudes, and values that are essential for doing certain jobs as applications in real work settings. (Lubis, 2010), (Suryo. Hartanto et al., 2020).

Conclusion

Based on the research, the application of a Lean manufacturing based learning model in industrial apprenticeships with a work shadowing strategy shows that there is a difference between the experimental class and the control class. It means that the Lean manufacturing-based learning model can be effectively used as a learning model that can be used by teachers or schools in an effort to improve VHS students' work skills in mechanical engineering expertise.

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