The effects of a teaching factory learning model on students’ competency: an empirical study at the department of automotive engineering education of Universitas Negeri Yogyakarta

B Sulistyo1, I Siswanto2, Tawardjono3, and N Widodo4

Yogyakarta State University, Yogyakarta, Indonesia

E-mail: bambang_sulistyo@uny.ac.id

Abstract. Vocational education is expected to serve the function of preparing competent and skilled graduates to meet the needs of industries. Therefore, this study aimed to determine the effects of implementing a teaching factory learning model integrated into the subject of Vehicle Body Painting on the students’ competency. Using the research design of an experimental approach, this study involved two research groups that consisted of Automotive Engineering students following the subject of Vehicle Body Painting. The control and the experimental groups were treated respectively with a training based learning model and a teaching factory learning model. Indicators to be observed were the results of the competency test and the feasibility of the students’ work. The data were collected through a competency test and documentation. The findings of this study suggested that the teaching factory learning model had significant effects on the students’ competency (83.82) compared to the students treated with the training-based learning model (77.87).

1. Introduction

The Directorate of Vocational Secondary Education which is also known as Direktorat Pembinaan SMK/PSMK has the vision, as stated in the roadmap of the Directorate General of PSMK 2010-2014, to establish Vocational High Schools that produce passionate, intelligent, competitive graduates with national identity and entrepreneurial spirit who are able to develop local excellence and to compete in the global market (Directorate of Vocational Education, 2009). To achieve this vision, the formulated mission are improving access, expansion and equity in high quality Vocational High Schools for all levels of society; improving the quality of Vocational High Schools through the application of disciplinary attitudes, noble character, and environmentally friendly, ICT-centered, and contextual based learning; empowering Vocational High Schools to produce entrepreneurial and skilled graduates by working collaboratively with relevant industries and business entities in the form of "teaching industry" (PSMK, 2009). In the roadmap of SMK 2010-2014, it is targeted that at the end of 2014, 70% of Vocational High Schools has a business learning unit in the form of teaching industry or teaching factory (PSMK, 2009).

Teaching factory is a learning activity where students directly perform production activities either in the form of goods or services within the school environment (Indrayana, 2007; Isnandar, 2008). The resulted goods or services are of very high quality thus they are worth selling and accepted by costumers (Triatmoko, 2009). This benefits the school by increasing the source of funding for the
school to support educational activities (PSMK, 2008). Teaching factory presents the real world of industries within the school setting to produce work-ready graduates (Chryssoulouris, Mavrikios, & Mourtzis, 2013; Sampurno & Siswanto, 2015). Furthermore, teaching factory is also very compatible with the philosophy of vocational education delivered by Prosser (1950: 217) that vocational school will be effective if the learning process is conducted in an environment that is a replica of the actual work environment.

The main goal of vocational education is to produce graduates equipped with expertise and competence in accordance with industry needs (Agrawal, 2013). However, the teaching factory as a supportive program in achieving this goal, in reality, faces many difficulties in its implementation. Siswanto (2011) reported a study in 8 favorite Vocational High Schools in Yogyakarta that revealed that Vocational High Schools in Yogyakarta had difficulties in the implementation of teaching factory. These difficulties have mostly occurred in the field of technology and tourism. For example, Vocational High Schools for technology including SMKN 2 Yogyakarta, SMKN 2 Depok Sleman, and SMKN 2 Wonosari and Vocational High Schools for Tourism that consisted of SMKN 5 Yogyakarta and SMKN 4 Yogyakarta.

Based on the background of the problem above, a model or an example of teaching factory implementation in vocational schools was required. This model was implemented in the Department of Automotive Engineering Education, Universitas Negeri Yogyakarta in the subject of Vehicle Body Repair and Paint. This subject was selected since the competency taught in the subject meet the needs of the industries with an average suitability level of 86.75% (Tawardjono, Widodo, Siswanto, & Sulistyo, 2016). While the achievement of students' competency in this subject was categorized as very good with the number of students with scores above B were 37 students (84.09%) in 2013 and 70 students (88.61%) in 2014 respectively (Tawardjono, et al., 2016).

2. Method

This study was designed with a quasi-experimental approach since it is not possible to control all the variables that might influence the students’ learning outcomes (Cohen, Manion, & Morrison, 2007). It was intentionally conducted by giving certain treatment to the research subject to analyze the impact or effect of the treatment (Fraenkel & Wallen, 2008). This was in accordance with the objective of this study to determine the effect of the teaching factory model on the students’ competency in the subject of Vehicle Body Repair and Paint.

Population in this study included all students in the Department of Automotive Engineering Education in the entry year of 2014 that consisted of 80 students. The students were divided into 2 groups, the experimental group, and the control group. The number of students in the experimental and the control groups were 41 and 39 respectively.

This study was conducted in the Department of Automotive Engineering Education, Faculty of Engineering UNY. This study also involved practitioners from the industry. The research design is presented in Table 1.

Table 1. Research Design

| Group       | Pretest | Treatment | Posttest |
|-------------|---------|-----------|----------|
| Control     | -       | X1        | T1       |
| Experimental| -       | X2        | T1       |

where: X is Training based learning model; Y is Teaching factory learning model.
The research variables consisted of free variable and dependent variable. The free variable consisted of teaching factory learning model and training-based learning model. While the dependent variable was the student's competency in the subject of Vehicle Body Repair and Paint.

Data collection techniques were a competency test and documentation. The competency test assessed the effects of the implementation of the learning models to the improvement of students' competency. Documentation was used to determine the learning models implementation process. The data were analyzed descriptively to describe the implementation of the learning process and the students’ achievement. In addition, an inferential analysis was performed to test the research hypothesis with an a.na.

3. Result and Discussion

3.1 Result

3.1.1 Preparation.

In the preparation stage, a cooperation agreement with industry partners was established. The class for the experimental test of the teaching factory teaching model was prepared. The industry partners consisted of car body repair and paint workshops located in Yogyakarta area. The experiment was conducted on bachelor program’s students in the Department of Automotive Engineering Education UNY. It was performed by dividing the class into 2 groups, the experiment group, and the control group. The experimental group followed the learning process according to the developed teaching factory model. In contrast, the control group followed the learning process in accordance with the existing learning method where the students did practice sessions using tools and materials without any demands to meet costumers’ needs.

To ensure the validity of the experiment, the following steps were performed: (1) Both groups got the same subject (2) The students of both groups had completed the same number of credits so they were expected of having the same initial ability to follow the subject of Vehicle Body Repair and Paint (2) The evaluation system for both groups used the same instrument.

3.1.2 Implementation.

Students who did the vehicle painting practice with the teaching factory model were divided into 8 groups with 5 to 6 members each group. The learning model was implemented with a block system. Each group did the practice sessions in the industry in accordance with a predetermined schedule. It was carried out in the effective period of the semester so that the students who followed this program had to leave lectures and practice sessions in the campus.

Practice sessions in the industry included handling costumers’ complaints, estimating the process and the cost of the repair, and do the process of vehicle body painting. Within 1 semester, each group carried out a practice session for 3 x 8 hours.

As for the control group, the students performed the practice session in the workshop of the department. The control group was also divided into 8 groups with 4 to 5 members. The students used practical materials in the form of one vehicle that had been prepared to be used as the practical tool. Each group of students got the responsibility to do the painting process on one part of the vehicle. The painting process was done for 3 x 8 hours.

3.1.3 Evaluation.
Evaluation is an important aspect of the learning process (Bowman, 2015). The purpose of the evaluation is to obtain information on overall learning outcomes in accordance with the design (Bergstrom, 2011). The evaluation of the implementation of the teaching factory teaching model in this painting practice was conducted through an 8-hour competency test. Students performed painting process to a panel of a vehicle. Based on the result of the competency test, the achievement data of students’ competency showed that the mean score of ME experimental group was 83.816 higher than the mean score of the control group with MK: 77.868 (ME> MK). Thus it proposed that learning with teaching factory was better than the conventional learning method confirmed by the significant difference calculated using SPSS of t = 3.547 with 99% confidence level.

Supporting and inhibiting factors in implementing the teaching factory learning model in the subject of body repair and paint.
In its implementation, there were supportive factors including (1) Cooperation from the industry who provided the location for the Teaching factory activities and bought products produced by the students; (2) The ease of collecting the necessary data, especially about the achievement of students’ competency in the subject of body repair and paint; and (3) Support and assistance from lecturers who taught the subject of body repair and paint. In general, the implementation of the study ran smoothly in accordance with the plan, but there was one obstacle. The obstacle was the students had to leave several subjects because of the implementation of the Teaching factory with a block system. The implementation of a block system was carried out by sending each group that consisted of 5 students to work on teaching factory products in the effective period of the semester. To overcome this problem, the step were to provide socialization for the lecturers in charge of those subjects and to strongly suggest the students make up the lessons that were missed due to absence at a later point.

3.2 Discussion
The implemented learning model was a learning model developed through a preliminary study, a focus group discussion, and also had been presented in an international seminar (Tawardjono, et al., 2016). This learning model helps students to achieve higher learning outcomes than students treated with regular learning models because the students gain real experience in the workforce according to expected learning targets (Jonassen, 2009, Lamancusa, 2008). This is also supported by previous studies conducted by Rentzos, Doukas, Mavrikios, Mourtzis, and Chryssolouris (2014) which reported that teaching factory provides benefits to students by giving better outcomes to the project provided by the teacher. In addition, the students in the experimental group also gained experience in working in groups, received input from instructors directly in the workshop, as well as used industry standard practical tools and materials that support the learning objectives so that the achievement was higher than the students in the control group (Inayat, ul Amin, Inayat, & Salim, 2013).

The teaching factory learning model can be conducted properly if there is support from the industry. This is also in accordance with the previous study by Hanushek, Schererd, Woessmann, and Zhang (2015) which stated that countries that combine vocational education with apprenticeship programs in industries are able to produce graduates who are more adaptable to the world of work. A successful apprenticeship program is resulted from supports of the industry to accommodate and provide opportunities for students to learn directly in the world of work (Siswanto, 2012). Therefore the purpose of vocational education to prepare graduates with a certain degree in accordance with the needs of professional careers in the future can be achieved (Lunev, et al., 2016).
4. Conclusion

This study suggests a teaching factory learning model in the field of vehicle body repair and painting developed in the form of painting practices integrated with activities in a workshop and directly related to customers. This model is able to improve the students’ competency. The implementation of a teaching factory learning model will be more effective with a block system, therefore the school should arrange a learning schedule that enables the implementation of teaching factory with a block system without reducing the time allocation for other subjects.

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