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# Evaluation on Teaching Factory Implementation: Studies in Management, Workshop, and Learning-pattern Aspects

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This study aims to evaluate the implementation of the Teaching Factory in a vocational high school in Surakarta, Indonesia using a quantitative approach. Questionnaires were used to collect data, and these questionnaires were developed based on Teaching Factory guidelines and several similar studies that had been tested for their validity and reliability aspects. Data analysis was performed with a descriptive technique comparing the perceptions of the students to those of the teachers related to three aspects of the Teaching Factory, namely: management, workshop (laboratory), and implemented learning patterns. The respondents consisted of students and teachers of the vocational high school. The results of the analysis showed that there were weaknesses in the management aspects of the structures and job descriptions of each section in which they were not clear. Regarding the workshop aspects, it is necessary to strengthen the applications of OHS (Occupational Health and Safety) and the management of laboratory equipment. Meanwhile, the entrepreneurial aspects of the learning patterns need to be maximised so that after graduating from the school, students are able to obtain jobs. Schools should not only produce workers (job seekers) but through the Teaching Factory, they are expected to encourage students to provide jobs for others.

**Key words:** *Teaching Factory, Management, workshop, Learning pattern.*

## Background

The Teaching Factory is one of the recommended methods for preparing students to face the world of work (Mavrikios, Georgoulias, & Chryssolouris, 2019). In this method, the

imitation of business is created in the lab/school workshop. Modern technology combined with relevant learning approaches is used by academic practitioners who cooperate with industries to form a two-way knowledge communication. This method aims to benefit both parties as stakeholders (Stavropoulos, Bikas, & Mourtzis, 2018). The learning process is carried out through collaborations between schools, using available materials, and technology from their business partners.

The implementation of this program broadens school networking with graduate users (Mavrikios, Georgoulias, & Chryssolouris, 2018) and is able to provide a real-life environment for engineering students (Stavropoulos et al., 2018). The presence of graduate users in schools, in which the prospective workforce are given education and training, is a concept that promotes the principle of acceptance of graduates to the users. To improve the quality of economy and social development of a country, it is necessary to increase the availability of qualified labours that can be done through vocational education (Polat et al., 2010). The aim of the vocational school is to provide a qualified workforce who are able to coincide with the development of science and technology that is needed in the world of business through vocational training (Uzmanoğlu et al., 2010).

The teaching-factory program at school is able to channel high school graduates to available industrial networking so that it helps reduce the unemployment rate at this level. The increasing need for industry and factory can be fulfilled through this Teaching-Factory-based learning program (Mourtzis, Boli, Dimitrakopoulos, Zygomalas, & Koutoupes, 2018). Unemployment in Indonesia has now reached alarming rates. According to the Indonesian Central Statistics Agency, in February 2019 open unemployment in Indonesia stood at 6.82 million people, and 8.63% of those were unemployed vocational high school graduates (BPS, 2019). In addition, Indonesia is currently ranked 113th in the world's human development index. This obviously should be a major concern to the government and all relevant stakeholders.

The development of science and technology requires educational institutions to react to all challenges in the world of work. One of the ways that institutions can respond to the challenges in technological development is digitalisation. In the Teaching Factory, digitalisation is very helpful in providing changes to the work environment in factories and also in changing the entire value-added chain (Merkel et al., 2017). This added value is related to the improvement in the quality of workers in the industrial or factory environment and also in the work environment of the factory. Furthermore, to meet the demands of technological development, educational programs in vocational schools must involve cooperation with industries. Industrial training can also be carried out using the Teaching Factory method (Işgören et al., 2009).

Industry 4.0 is the result of an ongoing process in industrial technology that began in the early 1970s (Rahayu, 2019). Industry 4.0 is a "smart factory" where industrial activities are carried out in an automated system, namely the cyber system, which plays an important role in industrial processes. In this era, the UMKM (SMEs) industry require training, and the training involves the Teaching Factory (Faller & Feldmüller, 2015). In addition, to keep in line with the rapid development of technology, a system called the Changeable Manufacturing System (CMS) has currently been developed for the Teaching Factory in schools (Wagner, AlGeddawy, ElMaraghy, & Müller, 2015).

In this regard, the Indonesian government through the ministry of education and culture had previously implemented Teaching-Factory-based learning in vocational high schools (SMKs) as targets to anticipate changes in the business and industrial sectors. The Teaching Factory basically aims to provide learning and training to a prospective workforce so that they are ready to meet the demands for skills expected by the industrial world (Chryssolouris, Mavrikios, & Rentzos, 2016). According to the Directorate of vocational high school education of Indonesia (Directorate of PSMK), the Teaching Factory is the development in the production unit. It is the application of industrial-partner systems in the units of production that already exist in SMKs. Furthermore, the Directorate of PSMK also explains that the Teaching Factory aims to develop characters and work ethics such as discipline, responsibility, honesty, cooperation and leadership, which are needed by business and industrial sectors, and to improve the quality of learning outcomes rather than competency-based training. This then leads to production-based training in which students possess the ability to produce goods or services.

Teaching-Factory-based learning fosters practical-teaching concepts that can be used to develop students' competencies in the independent learning process based on competency models (Müller-Frommeyer, Aymans, Bargmann, Kauffeld, & Herrmann, 2017). Active learning in this context means the practice of independent learning using internal abilities and independent concepts that can make someone able to explore the skills that they have. Independent learning is usually conducted by utilising the existing facilities such as access to social networking, textbooks, or even by direct observation of the environment related to the subjects being learned. To provide learning media for students, schools also need to build learning facilities, such as laboratories that can be used by students to directly gain the knowledge needed.

Teaching-Factory-based learning implements the concept of e-learning modules and other applications which support independent learning and the process of teaching and learning is prepared in accordance with the complete action model (Lanza, Minges, Stoll, Moser, & Haefner, 2016). Through e-learning modules, students are not only focused on the books but are also able to access other materials. The main purpose of the teaching-factory method is to

convey complex views, to utilise different methods and to deliver concepts more efficiently (Li, Yang, Wang, Li, & Zheng, 2019).

Previous research shows that the implementation of the Teaching Factory in Surakarta is still not effective (Fajaryati, 2012). Moreover, the high number of unemployed vocational school graduates indicates students' poor ability to absorb materials delivered through the Teaching Factory. This also means that the concept of the Teaching Factory has not been comprehensively implemented (Yunanto, 2016). The results of other previous studies also reveal that vocational high schools that have their own workshops are able to produce competent students that are ready to work in industrial companies (Widiatna, Madhakomala, & Rugaiyah, 2019).

SMKN 5 Surakarta High School is a vocational high school in Indonesia that has implemented the Teaching Factory method. There are two Teaching Factory models in SMKN 5 Surakarta High School. One involves working on the orders from companies that collaborate with the school, and the other involves creating the school's own unit programs with standardised products. The Teaching Factory certainly is in line with the development of industrial technology that is currently used in the industrial world. Owing to this, the purpose of this study is to provide an evaluation on the implementation of the Teaching Factory in SMKN 5 Surakarta High School.

**Methodology**

A survey design of the quantitative approach was used. This study involved 20 students and 5 teachers who taught the Teaching Factory at SMKN 5 Surakarta High School, Central Java, Indonesia. SMKN 5 Surakarta High School is a vocational high school that has excellence in it's engineering department. The learning process that refers to practical learning in related industries or factories plays an important role in the development of students' knowledge and experience in their respective fields. Thus, graduates from SMKN 5 Surakarta High School are able to meet the demands of the industrial world. Respondents were chosen randomly using the proportional random-sampling technique.

The questionnaire was developed based on the Teaching Factory handbook published by the Directorate of Vocational School Development, the Ministry of Education and Culture of the Republic of Indonesia. The validity and reliability testing of the instruments was carried out by conducting bivariate and analytical reliability tests using SPSS software. The data collected was analysed by descriptive analysis using graphical methods to show the elements of Teaching Factory implementation that still needed to be developed.

The aspects evaluated in this study included management, workshop (laboratory) equipment,

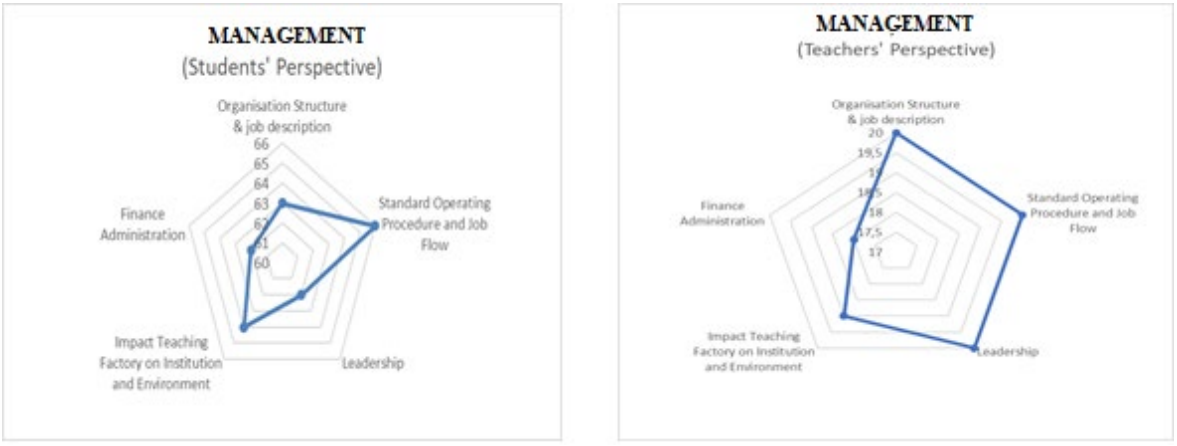
learning (training) patterns, marketing (promotion), product (service) produced, human resources, and relations with industry. Each aspect had certain criteria that had to be fulfilled. After that, the components of each aspect were compared and analysed to see which component still produced the lowest percentage from the perspective of both the students and the teachers.

## Results and Discussion

### *The Management Aspects*

The concept of the Teaching Factory that brings the atmosphere and activities of a factory to a school for learning purposes, requires good arrangement. This approach emphasises the learning process in accordance with the perspectives of the prospective employers both in terms of the work cycle and the obstacles that may be faced (Mavrikios et al., 2019). Arrangements must be made in such a way that the objectives of the learning process can be obtained by students and all involved stakeholders.

**Figure 1.** Assessments in Management Aspect by Students and Teachers




The management aspect is one of the important aspects in managing the Teaching Factory. Teaching Factory management is the first step in planning all available resources, and arranging and managing all the tasks of everyone who is involved in implementing this learning process. This management aspect consists of five components, namely organisational structure and job description, SOP of performance and workflow, leadership, the impact of the Teaching Factory on institutions and environment, and financial administration. The results of the evaluation analysis of the five aspects can be seen in figure 1 b:

Figure 1 shows the perceptions of the students and teachers on teaching management in this Teaching Factory. The students state that the standard operating procedure and the impact of

the Teaching Factory on the institution and the surrounding environment are well implemented in comparison to the other three aspects. This indicates that the school provides clear explanations and directions to students and teachers about what needs to be done. Moreover, the products that the school produces can be utilised by the community.
However, the results of the analysis also show that there are three areas that still need to be developed at the management level, namely the use of organisational structures and clear job descriptions in the implementation of teaching factories, better leadership, and more transparent financial administration. The information on the organisational structure and tasks of each student and teacher must be more detailed so that the students are the ones who are directly involved in the Teaching Factory, while the teachers are only facilitators. The school principal also needs to show stronger leadership. The students claim that they do not directly recognise the role that the principal plays in managing this learning method.

Regarding teachers' perceptions, four aspects of Teaching Factory management have positive assessments. The four aspects include organisational structure and job description, the SOP of performance and workflow, leadership, and the impact of the Teaching Factory on the surrounding environment. Nevertheless, the teachers state that the financial administration aspect still needs improvement. It can be seen in Figure 1 that the financial administration aspect is given the lowest rate. This might be related to the lack of transparency in financial administration in managing the Teaching Factory.

It is clear that students and teachers both agree that there are two elements that must be improved in the management aspect of the Teaching Factory, namely organisational structure and job descriptions in the workshop. The financial aspect still needs further study since additional data is still needed to show the actual results. Previous research shows that one of the weaknesses of the Teaching Factory is the difficulty in the implementation of factory cycles in schools (Chryssolouris, Mavrikios, & Rentzos, 2016). The results of this research have not yet revealed why this problem exists. The results of this study suggest that one of the causes of the difficulty in implementing factory cycles in the Teaching Factory is the lack of strong management, especially in the aspects of organisational structure and the job description of each party involved in the Teaching Factory. Broad networking provided by school managers can strengthen the management aspect (Mavrikios et al., 2018). This should be done because of the existence of the mini-factory, which can train the students for competence in an optimum way (Matt, Rauch, & Dallasega, 2014). In addition, what needs to be improved is the leadership aspect of both the teachers and the principal. This is because strong leadership has a positive impact on students' learning outcomes (Chin, 2007).

***The Workshop (Laboratory) Aspects***

A workshop or lab is the core of the learning process using the Teaching Factory method. A workshop is a place for students to study in an atmosphere that is very similar to that in the industrial world. There are five criteria in this aspect that must be met. These five criteria are good governance and tool utilisation, adequate learning space, the management of maintenance and repair in accordance with industry standards, appropriate workshop layouts and the application of OHS.

**Figure 2.** Assessments in Workshop Aspect by Students and Teachers


Figure 2 depicts the perceptions of the students and teachers on the capacity and quality of workshops or laboratories of this Teaching Factory. Based on data analysis, the layout of the workshop is comfortable and satisfying for the students as users. This can be seen from the high rating in this criterion. Nonetheless, the same evaluation is not seen in the other three criteria, in which the governance of the equipment utilised, space capacity, and maintenance management are given the same low ratings. One very important element, the application of OHS, requires even more attention. The results show that the symbols or directives of the OHS aspect were not well implemented or socialised. Each student ideally has their own tools, but the test results suggest the opposite, considering the level of student satisfaction is fairly low. Meanwhile, the MRC (Maintenance, Repair and Calibration) aspect indicates incomplete tools and poor maintenance of tools.

On the other hand, the teachers give slightly different evaluations. Of the five aspects there are two aspects that still need to be improved, namely space capacity and maintenance management. This is evident from the very low ratings of these two elements. The school needs to provide three standard rooms to implement the Teaching Factory. The three rooms include: (1) Grade X: the learning process is divided into curriculum-based (maximum 70%) and production-based (minimum 30%) learning, (2) Grade XI: 50% curriculum-based and 50% production-based learning, and (3) Grade XII: minimum 30% curriculum-based and

maximum 70% production-based learning. These results indicate that the school has put maximum effort into equipment utilisation, the application of OHS and the layout of the workshops, even though the students think otherwise.

The results of data analysis of this aspect are quite interesting because there are significant differences between the perceptions of the students and teachers. This mainly occurs in the management of the use of tools and the application of OHS. The students feel that OHS implementation in the school is inadequate even though the teachers have tried to apply it. This application is important considering the tools used by the students are the same tools used in the factory. The results of previous studies indicate that the Teaching Factory is a very complex learning environment (Enke, Glass, & Metternich, 2017), so extra caution is needed by instructors and students. In the Teaching Factory schools collaborate with related industries to use factory machines in schools (Stavropoulos et al., 2018). Regarding this aspect, the results of the study show that the management of the use of tools is an important element to consider. This aspect trains students to use tools efficiently (Abele et al., 2017) so that the appropriate application of the factory SOP must be carried out. The space capacity aspect for the implementation of the Teaching Factory should also be considered. The teachers are of the opinion that the space does not meet the standards. In fact, the size of classrooms can influence the classroom atmosphere and learning process (Mastika & Adnyana, 2014; Yamti, 2016).

***The Learning-pattern Aspects***

There are some unique aspects in the learning patterns of the Teaching Factory when compared to other learning methods. Teachers must prepare a plan that includes producing a product that can be used by the community. In this learning pattern, there are various components that must be followed during the learning process. The components are a learning implementation plan, students' worksheets that contain student activities in each meeting, and the availability of material for making products. The main principle of the Teaching Factory is the production of finished or semi-finished products that can be sold. The learning process of this method is the practice in implementing work that is actually done in the factory, entrepreneurship, teaching, and corporate culture.

**Figure 3.** Assessments in Learning Patterns by Students and Teachers'

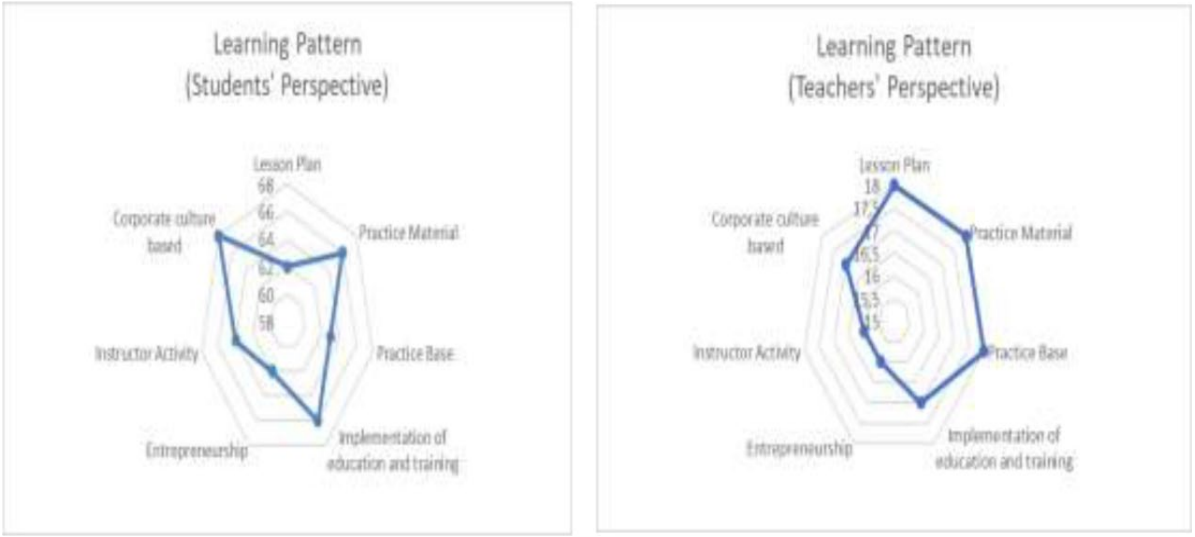



Figure 3 shows students' and teachers' perceptions on Teaching Factory learning patterns. The students argue that there are at least three aspects that still need to be improved. These include the quality of instructors/teachers, entrepreneurship, and activities that are less practice-based. There is another aspect that received a low rating, namely the lesson plan, but this is understandable, considering that students are not necessarily familiar with this aspect. However, it would be better if teachers informed students about their lesson plans before they started to teach. Apart from these problems, students feel quite satisfied with the implementation of corporate culture, training materials, and adequate practice materials. The implementation of corporate culture means that students are able to experience what they will face in the industrial world. The application of product-based training combined with adequate materials provided by the school make it easier for the students to understand the learning process.

Teachers' assessments of the learning patterns of the Teaching Factory are different from assessments made by the students. There are four aspects that need to be improved, namely the learning process, which does not quite represent the corporate culture; the ability of teachers/instructors that is still poor; entrepreneurial values that have not been included in the learning process; and training. The teachers claim that there has not been optimal implementation of corporate culture in the Teaching Factory. In addition, the instructor's/teacher's ability to complete job orders in accordance with industrial standards is still relatively poor. Nevertheless, there are three aspects that are considered quite good, namely the practice-based Teaching Factory, adequate practice materials, and the learning implementation plan that is available before the learning process begins.

It can be seen from figure 3 that strengthening entrepreneurship in the Teaching Factory is often overlooked. Both students and teachers feel that the entrepreneurship aspect of what is learned in the workshop should be emphasised more. There is still a tendency to prepare students as prospective workers with their own expertise. It is acknowledged that entrepreneurship is one of the cores of the economy sector. The introduction to the entrepreneurial aspect in academic circles is very important (Fischer, Moraes, & Schaeffer, 2019) and vocational school students generally have an interest in entrepreneurship (Fischer et al., 2019).

## Conclusion

The Teaching Factory basically prepares students to be ready to join the industrial world. Therefore, the management of the Teaching Factory needs to be optimised so that students are able to achieve the expected competencies. Schools need to strengthen the management aspects that include the structure and job descriptions of each part of the Teaching Factory. Schools need to simulate the systems and activities of the industrial world. Similar management gives students a complete picture of the world of work. Regarding the aspect of school workshops/labs, the application of OHS and management of tool utilisation needs to be improved. OHS is an important part of an industry so it is necessary to strengthen the application of this aspect in addition to hard skills. Good tool management must also be considered. How tools are used and how to maintain them is one form of effectiveness and work efficiency that needs to be applied in the world of work and at school. In addition, student entrepreneurship needs to be increased so that students are able to prepare themselves to be job providers, not just job seekers.

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