Design Learning of Teaching Factory in Mechanical Engineering

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Abstract. The industrial world that is the target of the process and learning outcomes of vocational high school (SMK) has its own character and nuance. Therefore, vocational education institutions in the learning process should be able to make the appropriate learning approach and in accordance with the industrial world. One approach to learning that is based on production and learning in the world of work is industry-based learning or known as Teaching Factory, where in this model apply learning that involves direct students in goods or service activities are expected to have the quality so it is worth selling and accepted by consumers. The method used is descriptive approach. The purpose of this research is to get the design of the teaching factory based on the competency requirements of the graduates of the spouse industry, especially in the engineering department. The results of this study is expected to be one of the choice of model factory teaching in the field of machinery engineering in accordance with the products and competencies of the graduates that the industry needs.

1. Introduction

The world of industry makes use of high technology to improve its production in this emerging market era. To take advantage of these high technologies, the industry requires quality human resources [1]. Recent research indicates the need for a teaching curriculum that can meet the growing and growing industry needs [2]. Lessons learned need to use facilities and infrastructure along with real situations in accordance with the industry [3].

Teaching Factory is a learning based on modern practices and facilities for the realization of industrial products aimed at providing a better educational experience that emphasizes the business world and the industrial world especially the manufacturing industry [4]. Teaching Factory is expected to be an alignment between learning with the modern industry world and for two-way communication between academia and industry [5]. A harmonized learning becomes one of the efforts to develop skills so as to produce professional graduates in the field of engineering, especially manufacturing [4].

Teaching Factory is an effort to complement the knowledge of emerging modern industry, to produce graduates who can compete in the industry today, update the existing curriculum, to be a solution to the dynamics of challenging technology as a whole, transferring technology and information from the couple's industry [6]. Therefore, it is necessary to design teaching factory alignment of the school with the industry so that the competence of graduates in accordance with industry needs, especially majoring in machining engineering.
1.1. Teaching factory
Teaching Factory or Pabrik Pengajaran is a concept of learning in the real atmosphere, so as to bridge the gap of competence between industry needs and knowledge of the school. Innovative learning technology and productive practice is the concept of educational methods oriented to the management of student management in learning to be in tune with the needs of the industrial world [7].

In a simple concept teaching factory is the development of the double unit production and education system that has been implemented in SMK - SMK. The concept of teaching factory is one form of development from vocational school to model of production school. SMK is still difficult to implement production-based education (production based education and training) as implemented in ATMI (Akademi Teknik Mesin Indonesia) [8]. Therefore, the term teaching factory requires SMK to implement a business unit or unit of production as a place for student learning. In the business or production unit, students directly practice by producing goods or services that can be sold to consumers. The implementation of teaching factory for learning by establishing a business unit or production in school is in contrast to the learning process taking place in Germany. The practical activities of vocational school students in Germany are conducted within a factory or company, while the government teaches theoretical materials at school for one to two days per week [9].

In another sense, production-based learning is a process of skill or skill learning that is designed and implemented based on real-time work procedures and standards to produce goods or services appropriate to market or consumer demands. In other words, the manufactured goods can be a production that can be sold or that can be used by the community, the school or the consumer. Thus, teaching factory is a learning activity where students directly perform production activities either in the form of goods or services within the school education environment. Goods or services produced have the quality so it is worth selling and accepted by the public or consumers. Teaching factory as one learning strategy has several goals. In a paper published by the American Society for Engineering Education Annual Conference and Exposition, the objectives of the teaching factory are: to produce professional graduates in their fields, to develop curricula that focus on modern concepts, demonstrate appropriate solutions for the challenges facing the industrial world, as well as the transfer of technology from industries that are partners with students and educational institutions [10]. While the development of the teaching factory at Penn State University, The University of Puerto Rico-Mayaguez, The University of Washington and Sandia National Labs aims to provide real experience in the design, manufacture and realization of designed products and develop a curriculum that has a balance between knowledge theory and analysis with professional manufacturing, design, business, and skill [11].

2. Methods
This research uses descriptive research method with the flow of research activities as follows (see figure 1):

![Flowchart of research activities](image-url)
3. Results and Discussion

3.1. Concept teaching factory

![Concept teaching factory diagram]

Based on figure 2, there are 4 main factors that become the basis of competence that must be achieved in teaching factory teaching: (1) Society that represents aspects of soft skill and attitude that must be owned by graduates who will join the community itself, (2) Business World representing entrepreneurial competence expected graduates become self-sufficient and entrepreneurial, (3) Industry partner is the main target that represents the hard skill and soft skill competencies to work, and (4) Vocational school itself has a major role in teaching facilities and facilities itself.

3.2. Frame work

![Frame work diagram]

Figure 3. Frame work of teaching factory.
Based on figure 3, there are six factors according to researcher that has to be attention to get the teaching factory concept right, they are: learning process, alumnus’s competency, process of production in pair industry, curriculum, job in Industry, and Tools & Infrastructures.

3.3. Design teaching factory
Based on figure 4 in appendix, there are explains about design teaching factory machining technique.

4. Conclusions
The design of this factory enables the pair industry's products especially the machining engineering department which can be produced and done by the students in the school through the learning process. In the planning of the educational institutions and the industry to negotiate to determine the products that can be done students with existing school facilities, but the product has a sale value to be accepted by consumers and the industry itself. In the process of learning that is implemented also allows third parties can order special order products that can also be done or produced students with existing facilities at school through analysis first. This design is expected to be one of the bridge gap trimmer between the competence of graduates with the competence of industry needs, especially industry couple.

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Appendix

Figure 4. Design teaching factory machining technique.