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Student's Regional Potential-based Project: TEFA for Schools in Low Industrial Areas

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Abstract—**One of the ways to get a link and match between Vocational High School graduates and the working world is by implementing a teaching factory (TEFA). Teaching Factory aims at aligning teaching and training in schools with the needs of modern industrial practices. However, not all schools can implement it optimally, especially those in low-industrial areas. This is one of the reasons why many Vocational High School graduates are not able to compete in the labor market. One of the solutions is to get students' project assignments based on the potential of their region. Therefore, this study aims to develop a teaching factory model integrated with student's regional potential-based project (SRPP). This research and development (R&D) employs the Borg and Gall model, which consists of four main stages: need analysis, model development, model validation by experts through a focus group discussion and a pilot study, and model evaluation. The results show that the teaching factory model for vocational schools in low-industrial areas is valid and can be widely tested.**

Keywords— **Teaching factory; student's regional potential-based project; vocational school; artificial industry.**

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I. Introduction

One of the ways to get a link and match between Vocational High Schools and the industrial world is by implementing the teaching factory model [1], [2], [3]. The teaching factory concept is to align students' competencies and industrial needs [4]. However, not all vocational high schools can implement the model optimally, especially for those located in low-industrial areas. This is caused by the limited number of industries that schools can cooperate with. This truly affects the students' competencies to be not by the needs of industry and the working world. It has been proved by the conditions for the last three years that vocational high school graduates have the highest open unemployment rate based on data from BPS in February 2020. Therefore, assigning the students to do the student's regional potential-based project is one alternative to optimally implementing the teaching factory model at vocational high schools in low industrial areas. The project allows them to develop the potential of their regions, and the potential can be their learning resources.

The potential existence in a region can help the schools implement the teaching factory model optimally through the projects given to the students [5]. The student's regional potential-based project is based on the Project-based Learning (PjBL) model. The empirical proofs show that implementing PjBL can improve students' skills in learning [6], improve relationships between students and dialogue between students and teachers, and build constructive learning that can get students independent [7], [8], [9].

The core of the teaching factory model is production-oriented learning, hands-on, and practice as done in a real industry. It is in line with the purpose of the student's regional potential-based project in which students are required to do a project based on their real life, so it gets them involved in an active inquiry, builds their ability to learn actively and creatively, and leads them to be a good problem solver [6]. In addition, the project has an excellence in which students get teaching, which gives them knowledge in the form of descriptions related to the potential of a region based on its characteristics. Moreover, it develops students' competencies by integrating the project into the learning [5] and improves their skills through the potential of their region [8], [10]. The previous studies found that the student's regional potential-based project, currently shortened as SRPP, generates students' positive perceptions of motivation, interest, the real world, usefulness, and more fun learning [11] and effectively improves the 4Cs skills of vocational students [12]. This study aims to develop a learning model by integrating the SRPP into teaching factories.

The teaching factory model that has been widely applied before has yet to include projects or products made by students based on the potential of their region. Generally, the projects or products produced in teaching factory-based learning are made by orders from industries with partnership programs. As in China where schools make products ordered by industry by establishing a "virtual industry" [13], [14]. Another case is teaching factory activities at Nanyang Polytechnic Singapore, which are carried out in collaboration with industries in developing new products, formulating solutions to solve problems, and supporting each other in training and consulting [15]. In Indonesia, the teaching factory implemented in the Mechanical Engineering Academy is in cooperation with industries in preparing infrastructure that meets industrial standards [16]. The teaching factory network concept developed by the University of Patras research team in Greece keeps collaborating with industries, where a platform is provided for industries to offer technical content or problems which will be learning topics for students at the University to solve [17], [18].

It isn't easy to find industrial partners for schools or colleges that are far from or not in industrial areas. This is based on the research team's findings on schools in Indonesia, which are located in areas without any industries. Therefore, a teaching factory that is integrated with the potential development of each student's region needs to be developed. In other words, SRPP will be their focus to develop at schools, which are regarded as the factory itself. Thus, the schools can learn by implementing a teaching factory, which has the advantage that students get a learning experience from the same environment as the industry. This integrated teaching factory model with the developed potential of the students' region can be a reference for schools or universities that find it difficult to find industrial partners as they are located in non-industry areas.

II. Material and Methods

A. Research Type and Procedure

This study belongs to Research and Development (R&D), and its procedures were adapted from the Borg and Gall model. They were: (1) analyzing the needs toward the learning characteristics to develop a teaching factory model integrated with projects based on the potential of students' regions by using a need analysis instrument; (2) designing a teaching factory model integrated with SRPP by using explanatory sequential design with structured questionnaire and interview; (3) conducting a focus group discussion with experts to discuss about teaching factory model integrated with SRPP; (4) administering validation of teaching factory model integrated with student's regional potential-based project by using validation questionnaire and small scale model trial on students by looking at their cognitive and psychomotor abilities; and (5) evaluating teaching factory model integrated with SRPP by regarding inputs from the experts.

B. Respondents

Thirty students from two vocational high schools were the respondents for this study. They contributed to the need for analysis and model validation. Furthermore, five experts participated in focus group discussions and model validation. Their expertise is in learning models, vocational curriculum, assessment, and language.

C. Research instrument

1) Need Analysis Instrument: The questionnaire was used as an instrument here. It was to analyze the competencies needed by the vocational high school students. In addition, the learning process of the current condition was then compared with the expected condition. The comparison aspects include the competencies that students must master, the current learning process and the current implementation of the teaching factory.

2) Model Validation Instrument: The instruments used here were a questionnaire and an interview. The questionnaire consists of syntaxes relevant to teaching factories integrated with SRPP, and the grid of interview questions is also related to the relevant syntaxes.

3) Model Validation instrument: The validation sheet was used here to evaluate the completeness of the developed model before implementing a broad trial of the model. Some aspects assessed in this model validation were rationality, model support theory, model syntax, social system, reaction principle, support system, and instructional and accompaniment impact.

D. Data Analysis Technique

The data analysis technique in this study can be seen in the following Table 1.

TABLE I
DATA ANALYSIS TECHNIQUE

Rated Aspect	Rating Technique
Needs Analysis	Mean
Model Validation	Path Analysis

III. Results and discussion

A. Need Analysis

The needs analysis was carried out at two vocational high schools. The first was at a vocational high school with no industry. The second one was at a vocational high school where there are some industries in the area, but they need to be more relevant to the majors of the vocational high school. Therefore, the two regions are considered industrial areas for vocational high schools. The results of the needs analysis state that teachers at a vocational high school which is located in a low industrial area have implemented a teaching factory model in learning, but it is not optimal. This is due to the lack or absence of supporting industry in the area, so there is a gap between the current teaching factory learning process and the expected one. It can be seen in Table 2.

TABLE II
TEACHING FACTORY LEARNING PROCESS ACHIEVEMENTS

Mean of Current Teaching Factory Implementation	Mean of Expected Teaching Factory Implementation	Delta Mean
62.81	91.23	28.42

Table 2 shows a gap between the meaning of the current teaching factory learning process and the expected one. This means that the teachers hope for a teaching factory model that can be implemented in vocational high schools located in low industrial areas so that teachers can implement it optimally even if there is no industry at all in there or some industries with no relevance to the majors of the vocational high schools. Thus, a teaching factory model integrated with SRPP was developed.

B. The Principle and Syntax of Teaching Factory Model Integrated with SRPP

The teaching factory model integrated with SRPP was developed from a combination of three learning models, namely the Teaching Factory model (TF-6M) produced by [19], [20], the seven steps of the Project-based Learning model developed by [21], and the SRPP model developed by [22]. The principles of those models were developed into a new model called the teaching factory integrated with SRPP. The development of this model is an opportunity to answer the challenge for vocational high schools to implement a teaching factory model where the schools are located in low industrial areas, both in regions without industry and in areas with some sectors. Still, they are not relevant to the majors of the vocational high schools there. The conceptual framework of the teaching factory integrated with SRPP based on the three models can be seen in Figure 1.

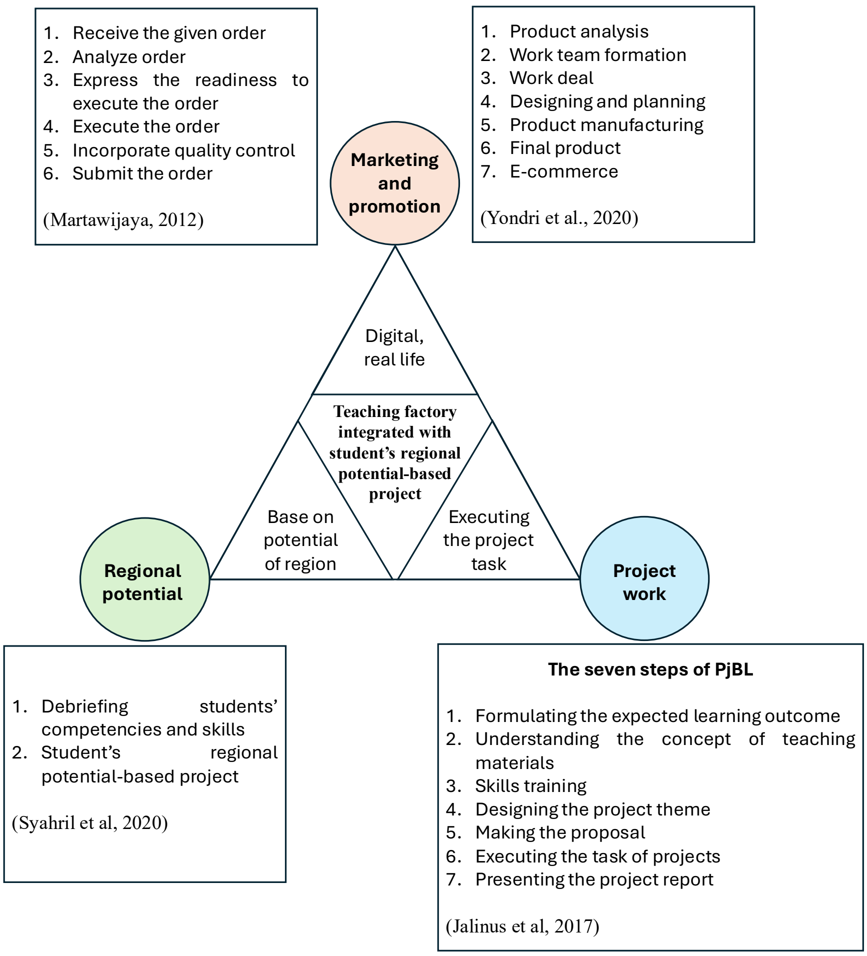

Fig. 1 The framework of the teaching factory integrated with SRPP

Teaching Factory integrated with a project based on the potential of students' region is a learning model developed based on the Teaching Factory model (TF-6M) produced by [19], [20], Project-based Learning model developed by [21], and students' region-based project model developed by [22], where the syntaxes of the model are not separated from the components contained in those three models above. Figure 2 shows the syntaxes of the teaching factory integrated with the project based on the potential of students' region.

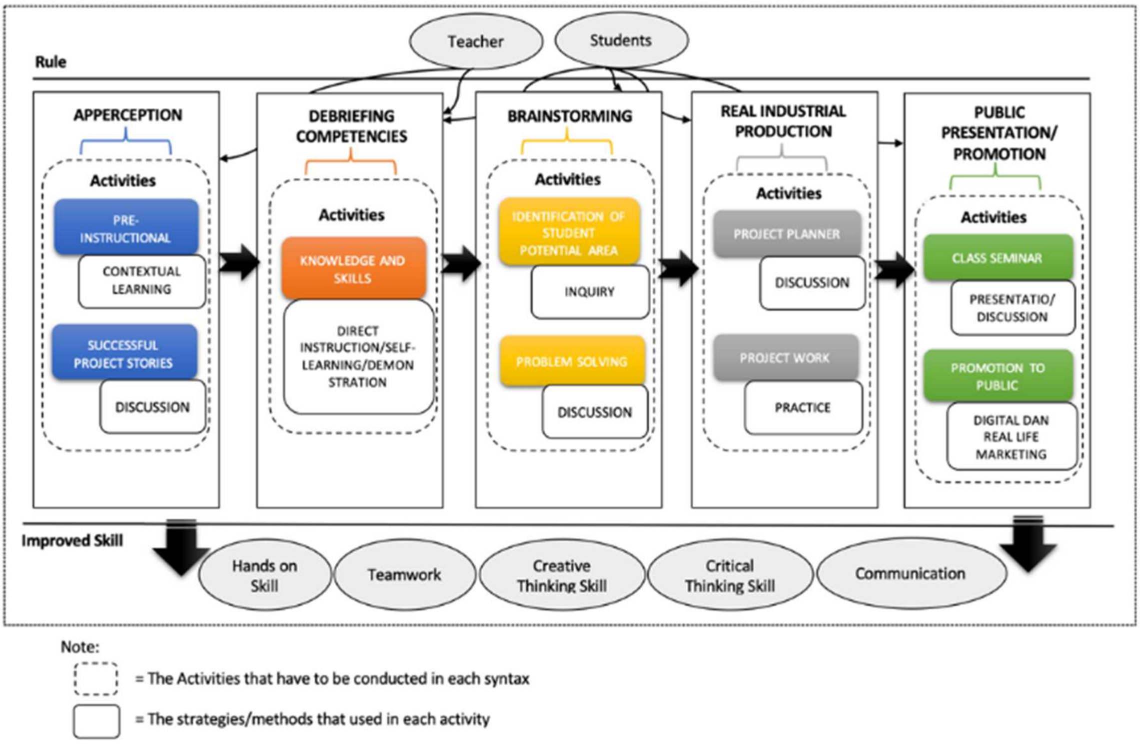

Fig. 2 Syntaxes of teaching factory integrated with SRPP

The description of the syntaxes in Figure 2 is as follows:

1) Apperception: Apperception is the first syntax of the teaching factory integrated with SRPP. The teacher carried out this stage at the beginning of the learning process. It has two activities as the following:

a. Pre-instructional

At this stage, the teacher selects content, sets learning objectives, considers incentive structures, and designs an overall classroom atmosphere for participation. Those were done to ensure that the classroom environment was conducive to starting learning. When beginning, teachers need to consider what they will do in class. Time and energy devoted to lesson planning and classroom management considerations will make the learning positive and more productive. In this pre-instructional activity, the teacher used contextual learning.

b. Successful project stories

In this activity, the teacher displayed stories and experiences of previous students doing projects based on the potential of their regions. This aimed to motivate the students to work on the assigned project and to help them understand and know how to do it. In this successful project stories activity, the teacher used discussion as the method.

2) Debriefing

The second syntax of the teaching factory integrated with SRPP is debriefing competencies. The teacher carried out this stage after the apperception syntax. This syntax has one activity, namely knowledge and skill. In this activity, the teacher introduced the material and training regarding the operation of the machine that would be used. This activity was intended to get the students to master the material, and the essential technical content or machine operations of the subjects taught. Furthermore, the teacher also provided practical skills training before the students did the project assignments. The methods used in this activity were self-learning, direct instruction, and demonstration.

3) Brainstorming: The third syntax of the teaching factory integrated with SRPP is called brainstorming. It has two activities, which are as follows:

c. Identification of student's potential area

In this activity, teachers and students discussed and identified the real-world problems or challenges that arose in the area where the schools are located. The identification was conducted through surveys and interviews with specific communities and students about the issues or challenges of each region. Students identified the problems and investigated them through information obtained from interviews, internet sites, articles, and magazines. In this activity, the method used was inquiry.

d. Problem-solving

In this activity, students solved the problems related to the projects they did to make the project designs become tangible objects. The method used here was group discussion, where students discussed how to solve problems in groups, and the teacher acted as their mentor, tutor, supervisor, and evaluator to enable them to carry out the learning process well.

4) Real industrial production

Real industrial production is the fourth syntax of the teaching factory integrated with SRPP. It has two activities, which are as follows:

e. Project planner

In this activity, students planned a project, including its scope, schedule, costs, and resources, and ensured it stayed on track and within the budget.

f. Project work

In this activity, students worked on projects that had been previously planned. They carried out the activity according to the estimated production activities, safety priorities, and solid teamwork. They were allowed to consult the teacher when they found problems. The method used in this activity was practice.

5) Public presentation/promotion

The fifth syntax of the teaching factory integrated with SRPP is public presentation/promotion. This syntax is the last syntax of this model. It has two activities as the following:

g. Class seminar

In this activity, students presented the process and result of their work in a seminar class at the end of the term. They also opened a discussion with teachers and classmates about deficiencies in the process and results of the projects they had done. The methods used here were presentation and discussion.

h. Promotion to public

In this activity, students promoted their products. The promotions were carried out directly to the public and indirectly through digital platforms. The methods used here are digital and real-life marketing.

C. Validity

Table 3 shows the results of the data analysis of the validity of a teaching factory integrated with SRPP.

TABLE III
LOADING FACTOR VALUE FOR EACH ACTIVITY OF EACH SYNTAX

Syntax	Activity	Code	Loading Factor
Apperception	Pre-instructional	A1	0.87
	Successful Project Stories	A2	0.59
Debriefing Competences	Knowledge and skill	B1	0.82
Brainstorming	Identification of student potential area	C1	0.64
	Problem-solving	C2	0.62
Real Industrial Production	Project planner	D1	0.64
	Project work	D2	0.59
Public Presentation/ Promotion	Class seminar	E1	0.60
	Promotion to public	E2	0.62

Based on Table 3, there is no loading factor value below 0.50. Thus, all activities in each step of the syntax of the teaching factory integrated with the project based on the potential of students' region can be declared as valid. Based on the SEM analysis, which is to analyze the degree of conformity between the teaching factory integrated with the project based on the potential of students' region on cognitive and psychomotor abilities, it was found that the P-value is 0.000, which means it is smaller than 0.05. The result of the analysis shows that the P-value is 0.000. It can be concluded that the teaching factory integrated with a project based on the potential of students' region positively influences students' cognitive and psychomotor abilities. Thus, this model is valid and acceptable.

The choice of the teaching factory integrated with SRPP is caused by the pattern in project-based learning, which is adopted from the real workings of the industrial or business world. [21]. Project-based learning refers to student's design, planning, and execution of extended projects that result in widely exhibited products to be promoted in product publications or presentations (project-based learning directs students to design, plan, and present, promote, or publish the project outcomes [23], [24], [25], [26]. Similarly, according to the Buck Institute for Education (BIE) quoted from the official website bie.org, project-based learning is a teaching method in which students acquire knowledge and skills by working for long periods to investigate and respond to complex questions, problems, or challenges [22].

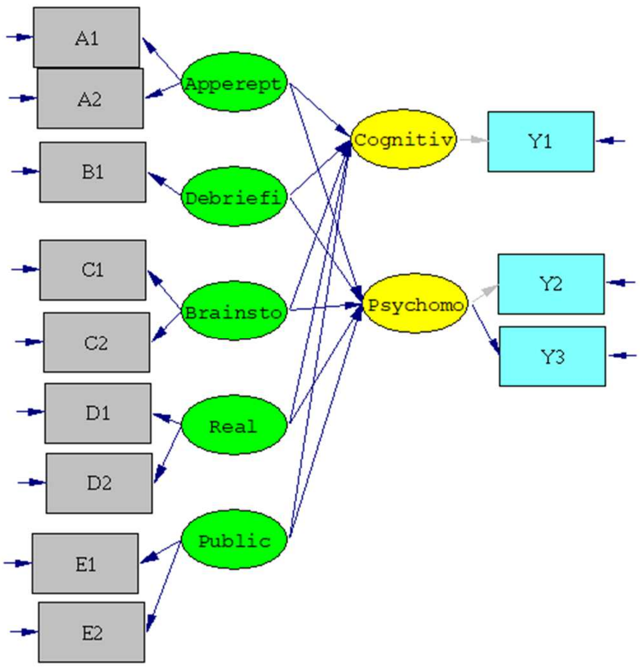

Fig. 3 Path Syntax of Teaching Factory integrated with SRPP

PjBL is also a systematic learning model that involves students in learning knowledge and skills through a long and structured inquiry process with authentic and complex questions and carefully designed tasks and products [27], [28]. Project-based learning is rooted in constructivist learning and discovery-based methods, both of which depend on the inquiry process and students' ability to design solutions based on their perspectives and thoughts [29]. PjBL is a careful and systematic process that uses different methodologies to elicit students' best thinking but also sets parameters and goals for the skills and knowledge that students are expected to acquire [30]Therefore, it can be concluded that the PjBL model is a systematic learning model whose implementation follows a predetermined pattern.

In addition to PjBL, project assignments based on the potential of the students' region are also learning models that allow students to design and manufacture tools or machines that can develop their regional potential. Regional potential is an asset and competitive advantage possessed by certain regions [31], [32] since, in essence, the school as an official educational institution must be able to invite students always to be close and interact with local wisdom [33]. The role of vocational high schools in developing the potential of the students' regions is an added value for the institution, in addition to its main task of creating competent students. Developing the regional potential through the learning conducted by vocational high schools is expected to create the community's economy in each area where the schools are located.

According to previous research, the PjBL model and regional potential-based project assignments have been effective in improving various student competencies, both cognitive and psychomotor [6], [33]. The novelty of the developed teaching factory model is that every teacher can implement it by involving the regional potential in each area where the vocational high schools are located. Teachers no longer need to worry about the industry. Even though no industry exists in their school area, they can implement this teaching factory optimally by integrating it with the project assignments based on regional potential.

IV. Conclusion

Researchers have designed a teaching factory model that can be applied to vocational high schools in low-industrial areas. This model is called the teaching factory integrated with SRPP. This model has five steps: Apperception, Debriefing Competencies, Brainstorming, Real Industrial Production, and Public Presentation/Promotion. This model has been proven valid and can be tested widely based on the research results. The results of this study have significant contributions, especially in theory, method, and practice of learning. Regarding contribution to theory, the teaching factory model can be applied to vocational high schools in low-industrial areas.

In addition, regarding the contribution of learning methods and practices, there are variations in learning models that vocational high school teachers can apply to improve the quality of learning. The weakness of this study is that the developed teaching factory integrated with SRPP focuses on low-industrial areas in two categories, including areas with no industry and regions with some sectors that are not relevant to the schools' majors. Therefore, further research is hoped to develop a teaching factory model in other categories of low-industrial areas.

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