Study on assessment and factors supporting successful vocational high schools student of industrial class

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Abstract: The purpose of this study is to investigate the learning effectiveness of the industrial class of vocational high schools (VHS) and to identify the required factors to improve VHS students' skill. This research is an ex-post facto type of causal research to reveal occurred events and to see various factors related to the events. Data collection of learning effectiveness assessment and factors supporting successful VHS students' identification were done through focus group discussion (FGD), interviews, questionnaires, and pre-test-post-test. The samples were 30 students of the industrial class and 30 students of the regular class of class XI TP1. The result shows that the average grade of an industrial student is 81, while the average grade of a regular student is 70.

Keywords: vocational high school; VHS; effectiveness; learning; student skill; industrial class.

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1 Introduction

One of the challenges faced by education is to ensure that students are allowed to make informed choices regarding their future careers and to obtain competencies that match the needs of the working world and industry. Vocational high school (VHS), together with the partner industries, need to manage the curriculum according to the needs of partner industries. Traditionally, VHS was previously designed to produce graduates who ready to work, ready to continue their studies, and ready to become entrepreneurs. In fact, to be able to produce graduates who can continue their studies, as well as being able to become

entrepreneurs, the treatments shall be different. VHS students must be equipped with specific competencies so that they are ready to work in partner industries and able to develop partner industries in order to compete globally.

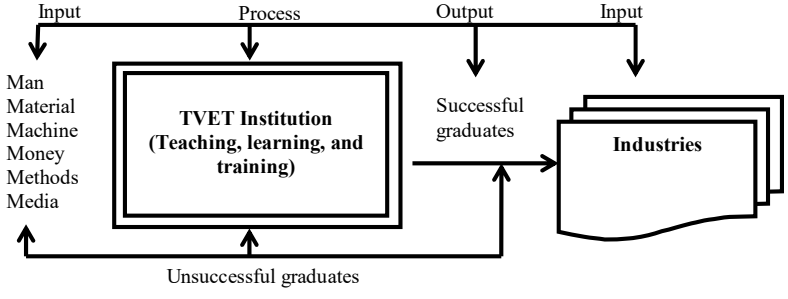
The vocational education system in several Asia countries has been successfully developed; for example; Japan, Korea, and Singapore have successful vocational education systems. However, in several other Asia countries such as Indonesia, Malaysia, the Philippines, Thailand, and Sri Lanka, the system has not been successful (Agrawal, 2013). The vocational education system in Indonesia has not been entirely successful. It is indicated by the fact that the highest unemployment in 2018 was VHS graduates. An open unemployment rate of Central Java in August 2018 showed the number of 5.34%. Judging from the level of education, the open unemployment rate for VHS was the highest among other education levels, which was about 11.24% (Badan Pusat Statistik, 2018).

In order for VHS graduates to be employed, they must have those competencies needed by the industry. VHS graduates are potentials human resources who will work in the industrial world. VHS graduates are human resource inputs for partner industries that must have mutually beneficial relationships with partner industries through increasing practical training activities such as the utilisation of every resource owned by VHS and industries to increase students' competency to match the industry needs. Various activities are needed, including the use of shared equipment, expert exchanges, and placement of students and teachers in the industry to make them experience the work culture in the partner industry. Figure 1 shows VHS graduates as input for HR for industry (Raihan, 2014).

Based on Figure 1, the input of labour in the industry is human. It can be said that students from VHS graduates are input for the industry. However, many VHS graduates are not absorbed into the industry. In the process of successful student learning also needs to be considered in order to become successful graduates.

Efforts to improve student learning success are implementing vocational schools partnership programs with industry. Partnership is defined as a relationship where two or more parties have compatible goals and form an agreement to do something together. Partnership is a strategic relationship for independent companies to share compatible goals, attempt to be mutually beneficial, and recognise a high level of interdependence. Therefore, it can be concluded that partnerships are beneficial for both parties, which are VHS and the industries (Frank and Smith, 2000).

Figure 1 Outputs of VHS/technical and vocational education and training (TVET) are the inputs of industries



Source: Raihan (2014)

There are three aspects of partnership success factors. The first aspect is the attributes of the partnership which consists of commitment, coordination, interdependence, and trust. The next aspect is the communication behaviour which includes quality, information sharing and participation. The third aspect is the conflict resolution techniques, which are the joint problem solving, persuasion, smoothing, domination, harsh words and arbitration (Mohr and Spekman, 1994).

The advantages of establishing partnerships are as follows:

1 creative solutions that emerge from different perspectives that offer partnerships

2 benefit or profit margin is increasing, job opportunities or training are created, and wealth is generated

3 partnerships often develop relationship between various groups, and they extend 'purchasing' or have more ownership

4 communities grow stronger with more participation and income, and it is an excellent way to increase the current strength and activities

5 partnerships can sometimes become a good response to funding and requirements when they are trying to make the program more effective even with limited resources

6 partnerships tend to bring a holistic approach to communities or organisational problems through discussion and joint resolution

7 partnerships can promote, repair or improve communication

8 partnerships often involve people and organisation that might not participate

9 partnerships can be a strong body to support change and transition (Mohr and Spekman, 1994).

In creating a good partnership, there are several value principles and fundamental concepts that must be considered. The important principle that cannot be bargained in establishing partnerships is the mutual trust between institutions/partnered foundations. The value needed is the characteristic or quality of human resources to achieve the organisation's vision and mission. The implementation is often different in each organisation because when the shared value can be formulated together; in fact, each organisation often violates the very fundamental principles. The concept or idea implemented by each partner should be based on a sharing strategy, shared or joint vision, common goals and performance indicators so that each partnered institution own a joint responsibility (Lendrum, 2003).

Now, SMK N 1 Semarang is collaborating with PT BUMA. SMK N 1 Semarang is implementing a partnership program with industry through industrial classes. Through this program, it is expected that VHS graduates can be absorbed 100% into the industry and have competencies that are in line with the industry.

Collaboration is essential for VHS to advance their education. Cooperation is a basic requirement for VHS to follow up on the productive aspects of learning as the VHS characteristic. The development of cooperation tied between VHS and the industrial world allows the schools to provide enormous opportunity for students to obtain productive skill trainings that matches the needs of the community. The educational

activities implementation process involves resources through collaboration to achieve goals effectively and efficiently (Arifin, 2012).

One of the subjects in the industrial class is basic engineering work (BEW). In industrial competency classes, this is also taught in the learning process. In its implementation, an appropriate learning model is needed so that vocational students can understand and have these competencies.

All students must prioritise competencies such as:

1 Cognitive skills: Critical thinking, problem solving, knowledge and creative applications.

2 Interpersonal skills: Communication and collaboration, leadership, global awareness and cross cultures.

3 Intrapersonal skills: Self-development, motivation, learning how to learn (Budiyono, 2015).

Skills are related to student's competence. Competence is described as the capacity to carry out specific activities that will always require several combinations of knowledge skill/disposition/values which when it is analysed, it almost always seems like a combination of generic or key competence (Gonczi, 2004). Theories about the development of competencies emphasise that students must not only acquire but also integrate knowledge, skills and attitudes to achieve vocational competence (Kaslow et al., 2007). Table 1 is the competency needed in the industrial class partnership program of SMKN 1 with PT BUMA.

Table 1 Competencies needed in BEW lessons

Subject	*Competence*
Basic engineering works	Implement safety, health and environment
	Take measurements with comparative measuring instruments and or basic measuring instruments
	Use precision measuring instruments
	Modify the use of hand tools
	Repairing the use of powered tools/handheld operations
	Operate general machines

It is because the current VHS graduates shall not only be equipped with the competency in making components, but they also need the ability to design, produce and do the information technology-based marketing. This online marketing ability is a competency that needs to be provided to VHS students so that what they design is made by the dynamic needs of the consumers. The increasing demand of consumers for a fast and easy service demands the world of industry and vocational education to keep innovating to be more efficient (Sumbodo, 2018). For this reason, efforts are needed to make the implementation of learning efficiently. One learning model is project-based learning (ProBL).

The ProBL is a learning approach in which students work on authentic problems to develop their knowledge, develop inquiry, higher level thinking skills, developing independence, and self-confidence (Arends, 2008). The ProBL organises learning around projects and involves the students in authentic situations where they can explore and

apply the subject matter to problems that are complex and relevant to the professional practice for which they are preparing (Hârtescu, 2014). The ProBL approach has been used in science, technology, engineering, and mathematics (STEM) education, which is integrated and practical, to enhance understanding of the course material (Capraro and Slough, 2009; Biggs, 2000; Redkar, 2012). The ProBL has a positive contribution to critical thinking skills, which are part of the cognitive sub-dimension but have not seen how they can influence the mastery of concepts simultaneously (Tosun and Taskesenligil, 2011). The purpose of this study was to investigate the learning effectiveness of the industrial class of VHS and to identify factors that needed to improve VHS students' skill.

2 Method

This research was an ex-post facto type of causal research, which is to reveal events that have occurred and see various factors related to the event. Industrial class learning effectiveness and factors supporting successful VHS students' data collection were done by using tests, forum group discussion (FGD), interviews, and questionnaires.

The objects of this study were 30 students of industrial class and 30 students of regular class of class XI TP1. In developing the theory of vocational partnerships with industry, FGD, interviews, and questionnaire were carried out. In BEW, the questionnaire was used to find out problem solving skills. Student learning outcomes data was used to compare learning outcomes of industrial class students and regular classes.

The validity of the instrument was tested using expert judgment using product moment correlation. The instrument was tested using the alpha Cronbach formula. The data obtained were analysed using descriptive statistics; requirements test analysis, and correlation analysis with the help of IBM SPSS Statistics 20 computer program. The value of $r\text{-}_{tabel}$ was determined using a correlation table with a significance level of 5%. Data validity and reliability are shown in Table 2.

Table 2 Data validity and reliability criteria

Validity	*Result*	*Reliability*	*Result*
$r_{table} > r_{count}$	Valid	$r_{table} > r_{count}$	Valid
$r_{table} < r_{count}$	Not valid	$r_{table} < r_{count}$	Not valid

The criteria for student learning are shown in Table 3.

Table 3 Criteria for student learning outcomes

Score	*Criteria*
91–100	Very good
81–90	Good
76–80	Average
70–75	Less good
<69	Not good

The learning qualifications achieved by students can be determined through the average of this equation (1) (Sudjana, 2012):

$$\bar{x} = \frac{\sum fixi}{\sum fi} \tag{1}$$

$\bar{x}$ mean

$\sum fixi$ the number of multiplication of each data from its frequency

$\sum fi$ the number of data.

The deviation standard was calculated using the following equation (2):

$$s = \sqrt{\frac{\sum fi(xi - \bar{x})^2}{n-1}} \tag{2}$$

s deviation standard

$\bar{x}$ mean

$\sum fi$ the number of data frequency to i

n the number of data

xi i data.

Table 4 Criteria for N-gain effectiveness

Percentage	*Criteria*
<40	Not effective
40–55	Less effective
56–75	Effective enough
>75	Effective

3 Result and discussion

Based on the results of the focus group discussion (FGD), we can take 11 tips for the success of VHS students related to partnership programs with industry. The 11 keys to this success called as 11 theories of vocational partnership with industry. The 11 theories of VHS partnership with industry are described as follows:

1 VHS must have industrial partners.

2 The partnership is oriented to industrial needs.

3 VHS will be effective if they produce graduates who are ready to work.

4 The learning and training process held by VHS is identical to the work types in the partner industry.

5 The partnership between VHS and industry will be meaningful if it supports industrial growth.

6 The partnership will continue if it is beneficial for both parties.

7 The benefits of partnership include: human resources, relevance, efficiency and product quality.

8 VHS prepare graduates who are able to work in certain fields according to the industry's needs.

9 The partnership requires mutual agreement.

10 The partnership of industrial VHS requires the involvement of all resources.

11 The partnership between VHS and industry will be effective when using a partnership information system (PIS).

Results of the 11 theories were then validated by 30 experts; they were principals, teachers, and industry people. The validity of the development of 11 theories of vocational partnership with industry is shown in Table 5.

Table 5 Validity of the development of 11 theories of vocational partnership with industry

No.	*Theory/point*	r_{table}	r_{count}	*Result*
1	VHS must have industrial partners	0.361	0.750	Valid
2	The partnership is oriented to industrial needs	0.361	0.603	Valid
3	VHS will be effective if they produce graduates who are ready to work	0.361	0.402	Valid
4	The learning and training process held by VHS is identical to the work types in the partner industry	0.361	0.780	Valid
5	The partnership between VHS and industry will be meaningful if it supports industrial growth	0.361	0.835	Valid
6	The partnership will continue if it is beneficial for both parties	0.361	0.818	Valid
7	The benefits of partnership include: human resources, relevance, efficiency and product quality	0.361	0.738	Valid
8	VHS prepare graduates who are able to work in certain fields in accordance with industrial needs	0.361	0.663	Valid
9	Partnerships require collective agreements	0.361	0.427	Valid
10	The partnership of VHS with industry requires all resources involvement	0.361	0.745	Valid
11	The partnership of VHS with industry will be effective when using partnership information systems (PIS)	0.361	0.735	Valid

Table 6 Reliability of data on the development of 11 theories of vocational partnership with industry

Reliability statistics	
Cronbach's alpha	*N of Items*
0.920	11

The research data was obtained from class XI students of SMK N 1 Semarang majored in engineering technique skill competencies, which are students taking industrial classes (experimental class) and regular classes (control class). 60 achievement test instruments

were given to students who were the object of the research. The results of BEW of the experimental class students and control class students are presented in Table 7.

Table 7 Statistics descriptive learning outcome industrial class and regular class

Descriptive					
Class				*Statistic*	*Std. error*
Ngain_persen	Experiment	Mean		60.3957	3.46993
		95% confidence interval for mean	Lower bound	53.2989	
			Upper bound	67.4925	
		5% trimmed mean		60.4767	
		Median		60.0000	
		Variance		361.213	
		Std. deviation		19.00561	
		Minimum		20.00	
		Maximum		100.00	
		Range		80.00	
		Interquartile range		24.23	
		Skewness		–0.262	0.427
		Kurtosis		–0.112	0.833
	Control	Mean		29.1931	3.21328
		95% confidence interval for mean	Lower bound	22.6212	
			Upper bound	35.7650	
		5% trimmed mean		29.9272	
		Median		33.3333	
		Variance		309.755	
		Std. deviation		17.59986	
		Minimum		–15.38	
		Maximum		57.14	
		Range		72.53	
		Interquartile range		29.21	
		Skewness		–0.639	0.427
		Kurtosis		–0.042	0.833

Table 8 The result of learning BEW

	Control class		*Experimental class*	
	Pre	*Post*	*Pre*	*Post*
Highest score	84	87	87	95
Lowest score	65	70	68	81
Average	74.53	77.7	75.96	89.83

Description of the result of BEW learning is presented in Table 8. The difference in learning outcomes of the control class and experimental class is shown in Figure 1. Based

on the study results, there is a difference in learning outcomes between VHS students who did not take industrial class (control class) and those who took industrial class (experimental class). The difference happened in BEW subject. It is shown in Table 9.

Based on Table 4, student learning outcome of industrial class was enough effective and conventional teaching method was not effective. More detail results are shown in Table 9.

Table 9 The difference in student learning outcomes (HR)

Learning outcome			
Experimental class	*Category*	*Control class*	*Category*
60.39	Effective	29.19	Not effective

4 Discussion

Implementation of VHS partnerships with industries provided several advantages from the management element. Advantages of 11 partnership theories include:

1 VHS must have industrial partners. As one example, SMK N 1 Semarang has an industrial partner with PT BUMA. One of the programs implemented is an industrial class. From the elements of planning management, VHS will have many advantages in terms of man, material, machine, money, methods, and media. From the aspect of man, vocational students will be provided with the skills needed in the industry. From the material aspects students can practice from industry partner practice materials. In terms of machine and media students can carry out practices in accordance with machines in the industry. In terms of school money, it will be helped by the presence of materials and machinery in the industry, thus minimising expenditure and can be used to improve facilities and infrastructure. From the method aspect, when students practice will follow methods that are in accordance with the industry.

2 The partnership is oriented to industrial needs.

   In the SMK N 1 partnership program with PT BUMA, students are trained to have the competencies needed in the industry. From the learning process and the curriculum prepared according to industry competencies. Fulfilment of graduates' competency requirements that are in line with industry expectations become a reference for vocational and industry partnership programs. The growth of the industry as a result of partnerships built by VHS and industries will be able to develop vocational schools that are in accordance with partner industry standards.

3 VHS will be effective if they produce graduates who are ready to work.

   Industry prefers to accept prospective employees who have been provided with abilities according to their needs. From the partnership program of Semarang VHS 1 with PT BUMA students who take industrial classes are trained to be ready to work. After the learning process in the industrial class, students are expected to be ready for work and recruited to become employees in the partner industry.

4 The learning and training process held by VHS is identical to the work types in the partner industry.

In the implementation of industrial class partnership programs and PT BUMA, the learning model used was ProBL. The advantage gained from students is that students are trained and studied in the actual conditions in the industry.

5 The partnership between VHS and industry will be meaningful if it supports industrial growth.

With students who have been trained and studied according to the conditions in the actual industry, the industry does not need to train new prospective employees who will work. Thus, the costs incurred by the industry can be reduced to find prospective workers. If the industry is successful and has a skilled workforce, it will support industrial growth.

6 The partnership will continue if it is beneficial for both parties.

Based on the interview, it was found that the partnership between SMK N 1 and PT BUMA has benefits for both parties. On the other hand, vocational schools can use industry-owned facilities that are expensive. On the other hand, industries benefit from cheap labour when students practice in their place and can recruit students who are ready to work.

7 The benefits of partnership include human resources, relevance, efficiency, and product quality.

If partnerships are implemented between VHS and industry, the human resource development (HRD) section is more comfortable in recruiting prospective workers. Because workers have previously been trained and educated according to real conditions in the industry. HRD no longer needs to train workers so that the time spent is more efficient. With the presence of skilled and trained workers in a certain period of time, of course workers will have good skills, thus will be able to improve the products produced by the industry.

8 VHS prepare graduates who are able to work in certain fields in accordance with industrial needs.

Vocational graduates generally are equipped with skills that will be used when working. These skills are in accordance with the field of expertise. For example, SMK N 1 Semarang also has an industrial partner, CV Suryacip. CV Suryacip is engaged in manufacturing printing machines. Vocational graduates can work in the industry because they have been equipped with the competence to operate lathes, milling, and CNC.

9 Partnerships require collective agreements.

The agreement between VHS and industry usually uses an MoU between the two parties. For example, SMK N 1 Semarang partnered with PT BUMA with a three-year collaboration period and the program implemented was an industrial class program. Another example, in the Semarang N 1 VHS Engineering competency, the expertise is working with CV Suryacip in the manufacture of printing machine components.

10 The partnership of VHS with industry requires all resources involvement.

In its implementation, VHS partnerships with industry involve existing resources from both vocational and industrial sectors. For example, CV Suryacip Semarang has collaboration with SMK N 1 Semarang for manufacturing printing machine components. This industry benefits from the lack of facilities they have. Another example, for example in the industrial class, is that teachers are trained at PT BUMA with the facilities they have. This will improve teacher competencies in order to be able to educate students in accordance with the partnership program undertaken.

11 The partnership of VHS with industry will be effective when using PISs.

Information systems are very much needed to support the implementation of partnership programs between vocational schools and industries.

Based on 11 theories, the implementation of the industrial class between SMK N 1 Semarang and PT BUMA used the ProBL learning model. The learning process of the ProBL of vocational partnership programs with industry in industrial classes. Learning steps using the ProBL learning model were:

a *Question*, start with the essential question. Take a real-world topic and begin an in-depth investigation. Make sure it is relevant to your students.

b *Plan*, plan which content outcomes will be addressed while answering the question. Involve students in the questioning, planning, and project-building process. Teacher and students brainstorm activities that support the inquiry.

c *Schedule*, teacher and students design a timeline for project components. Set benchmarks. Keep it simple and age-appropriate.

d *Monitor make the assessment authentic*, know authentic assessment will require more time and effort from the teacher. Vary the type of assessment used.

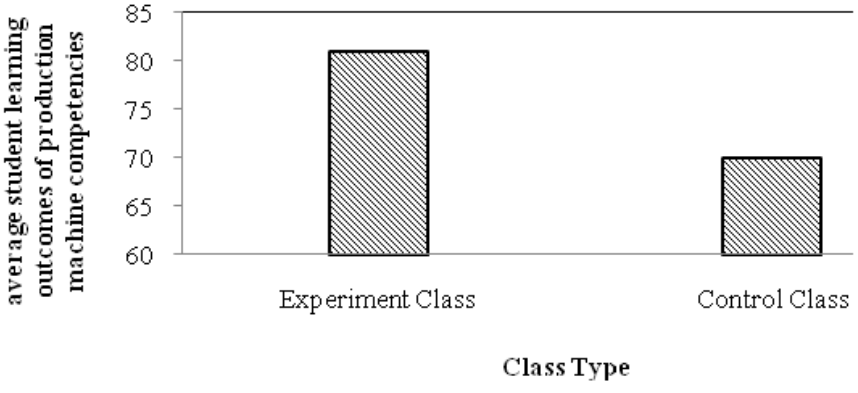
e *Facilitate the process*, mentor the process. Utilise rubrics.

f *Evaluate*, take time to reflect individually and as a group. Share feelings and experiences. Discuss what worked well. Discuss what needs change. Share ideas that will lead to new inquiries, thus new projects (The George Lucas Educational Foundation, 2003).

The difference in learning outcomes of the control class and experimental class after post-test is shown in Figure 2.

Based on Figure 2, it is showed that the average score in the experimental class is higher than the average score of the control class. The deviation in the average score between the control and experimental class was 11. This is because students who took industrial class had previously taken part in the selection. In general, students who have taken industrial class have better learning abilities and learning outcomes. In addition, industrial class students also have higher motivation compared to students in the regular class.

Figure 2 The difference in student learning outcomes in the experimental class and control class



5 Conclusions

Based on the results presented above, it can be concluded that learning effectiveness of industrial class used PRoBL learning model was more effective compared to regular class used conventional learning model. The average learning outcome of industrial class after the post test was 81, while the learning outcome of regular class was 70 only. The results also identified 11 keys called '11 theories of vocational partnership with industry' that needed to improve VHS students' skill, namely:

1 VHS must have industrial partners.

2 The partnership is oriented to industrial needs.

3 VHS will be effective if they produce graduates who are ready to work.

4 The learning and training process held by VHS is identical to the work types in the partner industry.

5 The partnership between VHS and industry will be meaningful if it supports industrial growth.

6 The partnership will continue if it is beneficial for both parties.

7 The benefits of partnership include: human resources, relevance, efficiency and product quality.

8 VHS prepare graduates who are able to work in certain fields according to the industry's needs.

9 The partnership requires mutual agreement.

10 The partnership of industrial VHS requires the involvement of all resources.

11 The partnership between VHS and industry will be effective when using a PIS.

6 Recommendations

1 Implementation of partnership programs of VHS with industry is highly recommended for supporting successful VHS student.

2 Further research to explore the effectiveness of ProBL in teaching the Industrial Era 4.0 skills is suggested.

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