Vocational High School Infrastructure Conditions and The Challenges in Facing The Era of Literation and Industrial Revolution 4.0

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Abstract. Infrastructure is an important component to support the learning operational in Vocational High Schools (SMK). This is a challenge for Vocational High Schools to manage their infrastructure so that they can keep up with the developments of technology and information. This study aims to: 1) determine the condition of the infrastructure and facilities of lightweight vehicle engineering of Vocational High Schools (SMK TKR) in Yogyakarta; and 2) describe the challenges of SMK, especially SMK TKR in the field of infrastructure to face the era of literaction and industrial revolution 4.0. This research is a quantitative research with survey method and literature review. The subject of this research is the Head of TKR Department or the Head of TKR workshop from 10 State and Private Vocational Schools in Yogyakarta. Data were collected by questionnaire and analyzed using descriptive analysis techniques. The results showed: 1) There are still infrastructure facilities at SMK TKR in Yogyakarta that have not met the demands of Indonesia Minister of Education Regulation No. 40, 2008 and the demands of the Curriculum 2013 syllabus; and 2) Infrastructure and facilities at SMK TKR is very difficult to follow the technological advances responsively, because technology is developing very quickly. Collaboration with the industry and the use of technology information in learning process are important to resolve the infrastructure limitation in SMK TKR.

1. Introduction
Vocational high school is responsible for preparing students to enter the workforce and developing a professional attitude (Government Regulation of the Republic of Indonesia Number 29 of 1990, Article 3). To achieve this, vocational high school organizes certain competency education and training, so that graduates can have qualified competencies and have a professional attitude. Thus, vocational high school graduates will find it easier to find jobs and this will reduce the number of unemployed, which is due to the presence of unskilled human resources.

The fact is inversely proportional to the goal of vocational high school (SMK) where the number of unemployed from vocational high school graduates is still high. In Indonesia, the number of unemployed is still very high. Based on data from the Central Statistics Agency (BPS) in 2015, the percentage of unemployed SMK graduates was 12.65 percent; in 2016 it fell to 11.11 percent; 2017 rose 11.41 percent; and 2018 to be 11.24 percent. The percentage is higher than the open unemployment of high school graduates, 7.95 percent, elementary school graduates 2.43 percent, while unemployment for junior high school graduates is 4.8 percent.
The unemployment condition of SMK graduates in the Special Region of Yogyakarta, the condition is not much different from the overall condition at the national level. Unemployment of SMK graduates is still in the first rank when compared to graduates from other education levels. It is necessary to examine the causes of these problems. Minister of National Development Planning / Head of Bappenas Bambang Brojonegoro said unemployment for SMK graduates was caused by several factors including; 1) curriculum factors that cannot adapt to the needs of the times; 2) the number of SMKs in Indonesia is privately owned, but their capacity is small. SMK management foundations do not have the capacity for teacher development, let alone curriculum development that involves companies; 3) the problem of teachers is that there are not many productive teachers or teachers who are experts in the vocational field in SMK (Yoga Sukmana, 2019).

The conditions conveyed by the Minister for National Development Planning / Head of Bappenas in general also describe the conditions that exist in the Special Region of Yogyakarta. Where the number of private SMKs is very dominant based on SMK Principal Data from 220 SMK in Yogyakarta 170 are private schools and the remaining 50 are state schools (Data Pokok SMK, 2020). Where the conditions of the foundations that overshadow private vocational schools also vary, it will affect the quality of the SMK being held.

Based on the description above, problems related to vocational high school in Indonesia are numerous and complex. This can be understood because vocational high school has special characteristics as a vocational education institution, where the characteristics of vocational education must be able to keep up with the times and technology both in terms of curriculum, learning, infrastructure and teacher competence. To be able to unravel problems and find solutions and future development directions, it is necessary to map and identify problems from the school.

Vocational high school must be able to anticipate changes and developments in the world of work in the era of literacy and industrial revolution 4.0 as it is today. The industrial revolution that occurred has changed the work process in the industrialized world which emphasizes effectiveness and efficiency. In the future there will be work done by robots, this of course will change the needs of workers. The demand for the labor market has changed, many economists have pointed out that this revolution can pose a risk of damaging the labor market. In the future, automation will replace workers, especially low and middle-skill workers, the education that is carried out will be redundant if it is not quickly adapted to changes in production (Vu, T. L. A., & Le, T. Q., 2019). To eliminate the gap between graduate competencies and real competencies that needs in the workforce, industry must be actively involved in curriculum development and learning evaluation (Suroto, S., & Hung, N. T., 2018). With these changes and developments, vocational high school needs to prepare a strategy to prepare the learning process and suitable infrastructure.

2. Methodology

This research is a quantitative research with survey method and literature review. A literature review was conducted to see the challenges of vocational schools in the future in facing the literacy era and the industrial revolution 4.0. Assessment of Vocational High Schools Facilities and Infrastructure Based on Indonesia Minister of Education Regulation No. 40, 2008 about Standards for Facilities and Infrastructure for Vocational High Schools and the demands of the Curriculum 2013 syllabus. Aspects which assess related to three things, namely quantity, quality and relevance. The subject of this research is the Head of TKR Department or the head of TKR workshop from 10 State and Private Vocational High Schools (SMK) in Yogyakarta. Data were collected by questionnaire and analyzed using descriptive analysis techniques.
3. Result and Discussion

3.1. The condition of the infrastructure and facilities of SMK TKR in Yogyakarta

3.1.1. The condition of the infrastructure and facilities of SMK TKR in Yogyakarta based on Indonesia Minister of Education Regulation No. 40, 2008

Indonesia Minister of Education Regulation No. 40, 2008 regulates the standard of infrastructure for vocational high schools. The infrastructure especially for SMK TKR practice learning activities that are regulated, the work area covers the workspace of engine, electricity, chassis and power train, storage and instructor room. Based on the research results, the average work area that meets the standards is 68.75% and 31.25% unstandads.

Table 1. Workspace Condition based on Indonesia Minister of Education Regulation No. 40, 2008.

| Condition       | Engine Workspace | Electricity Workspace | Chasis & Power Train Workspace | Storage & Instructor Room | Average |
|-----------------|------------------|-----------------------|-------------------------------|---------------------------|---------|
| Standard (%)    | 75               | 75                    | 75                            | 50                        | 68.75   |
| Unstandard (%)  | 25               | 25                    | 25                            | 50                        | 31.25   |

In the Indonesian Minister of Education Regulation No. 40, 2008 the practice facilities that are regulated, namely, furniture, equipment, educational media, and other equipment for the workshop of engine, electricity, chassis and power train. The condition of the facility is viewed from three aspects, namely quantity, quality and relevance. The condition of automotive engine, electricity, chassis and power train workshop in SMK TKR are as follows:

Table 2. Engine Workshop Condition based on Indonesia Minister of Education Regulation No. 40, 2008.

| Infrastructure | Quantity | Quality | Relevance |
|----------------|----------|---------|-----------|
|                | Don't Have (%) | Less (%) | Enough (%) | More (%) | Don't Have (%) | Broken (%) | Good, but not complete (%) | Good, complete (%) | Not Relevance (%) | Less Relevance (%) | Relevance (%) | Very Relevance (%) |
| Furniture      | 0        | 41.67   | 50        | 8.33     | 0            | 25          | 66.7                  | 8.3               | 0              | 16.7               | 58.3          | 25                |
| Equipment      | 0        | 50      | 25        | 25       | 0            | 25          | 75                   | 0                 | 0              | 25                | 25            | 50                |
| Educational media | 25      | 0       | 50        | 25       | 25           | 0           | 50                   | 25                | 0              | 25                | 25            | 50                |
| Other equipment | 0       | 25      | 75        | 0        | 0            | 12.5        | 62.5                  | 25                | 0              | 12.5               | 75            | 12.5              |
| Average        | 6.25     | 29.2    | 50        | 14.6     | 6.3          | 15.6        | 63.5                  | 14.6              | 6.3            | 13.5               | 45.8          | 34.4              |

Table 3. Electricity Workshop Condition based on Indonesia Minister of Education Regulation No. 40, 2008.

| Infrastructure | Quantity | Quality | Relevance |
|----------------|----------|---------|-----------|
|                | Don't Have (%) | Less (%) | Enough (%) | More (%) | Don't Have (%) | Broken (%) | Good, but not complete (%) | Good, complete (%) | Not Relevance (%) | Less Relevance (%) | Relevance (%) | Very Relevance (%) |
| Furniture      | 41.7     | 33.3    | 8.3       | 16.7     | 42           | 8          | 50                   | 0                 | 41.67          | 25.0              | 8.3           | 25                |
| Equipment      | 25       | 25      | 25        | 25       | 25           | 25         | 25                   | 25                | 25             | 0                 | 50            | 0                 |
| Educational media | 25     | 0       | 50        | 25       | 25           | 0          | 50                   | 25                | 25             | 0                 | 25           | 50                |
| Other equipment | 0       | 50      | 50        | 0        | 0            | 12.5       | 58.3                 | 0                 | 0              | 12.5               | 75            | 12.5              |
| Average        | 22.9     | 27.1    | 33.3      | 16.7     | 22.9         | 11.5       | 45.8                 | 12.5              | 22.9           | 15.6              | 27.1          | 34.4              |
### Table 4. Chasis & Power Train Workshop Condition based on Indonesia Minister of Education Regulation No. 40, 2008.

| Infrastructure   | Quantity | Quality               | Relevance          |
|------------------|----------|-----------------------|--------------------|
|                  | Don't Have (%) | Less (%) | Enough (%) | More (%) | Don't Have (%) | Broken (%) | Good, but not complete (%) | Good, complete (%) | Not Relevant (%) | Less Relevance (%) | Relevance (%) | Very Relevance (%) |
| Furniture        | 50       | 16,7                 | 8,3   | 16,7   | 50       | 8,3   | 33,3                     | 8,3   | 50               | 8,3         | 8,3       | 33,33          |
| Equipment        | 25       | 50                  | 0     | 25     | 25       | 25    | 25                       | 25    | 25               | 25          | 0         | 50             |
| Educational media| 50       | 0                   | 25    | 25     | 25       | 0     | 50                       | 25    | 0                | 25          | 50        | 50             |
| Other equipment  | 25       | 25                  | 38    | 0      | 12.5     | 0     | 87.5                     | 0     | 12.5             | 0           | 75        | 12.5           |
| Average          | 37,5     | 22,9                 | 17,7  | 16,7   | 28,1     | 8,3   | 49,0                     | 14,6  | 28,1             | 8,3         | 27,1      | 36,5           |

The conditions of the SMK TKR infrastructure are still not optimal to meet the standards of the National Education Minister Regulation No. 40 of 2008. In terms of quantity, there are still many schools whose conditions do not meet with the number of students in the school. In terms of quality, only a small proportion of SMKs have complete equipment and in good condition. Where most of the conditions are equipment owned by SMK, the condition is damaged and incomplete. Therefore, maintenance management is very important to maintain the quantity and condition of the infrastructure. So far, the weak points in SMK are the limited number of technicians and funding for maintenance which tends to be low. In terms of relevance, most of the equipment in SMK TKR is still relevant to technological developments, however, there are still SMK TKR whose infrastructure conditions are no longer relevant to technological developments.

Various systematic efforts need to be implemented to overcome existing deficiencies. The condition of infrastructure is very vital, to meet the characteristics of vocational high schools including oriented to individual performance in the workforce, special justification on the demand of the workforce, curriculum focus to improve students psychomotor, affective, and cognitive aspects, the benchmark of success is not only limited to school but it is important to improve the sensitivity of the workforce development, requires adequate facilities and infrastructure, and support from the community (Yahya, M., 2018).

#### 3.1.2. The condition of the infrastructure and facilities of SMK TKR in Yogyakarta based on the demands of the Curriculum 2013 syllabus

Currently the curriculum applied in SMK is the 2013 curriculum, of course, to achieve the target, learning quality is needed in accordance with the demands of the curriculum both in methods, models, and assessment techniques. The infrastructure aspect is very important in order to achieve existing learning objectives. Moreover, the 2013 curriculum for SMK TKR emphasizes contextual learning and contains some of the latest technology in the automotive field. In addition, SMK TKR is closely related to practical competencies, and appropriate assessment techniques in practice, namely assessment of practice so that it requires sufficient facilities (Pambayun, N. A. Y., & Haryana, K., 2020).

In this study, based on the existing learning outcomes, practical facilities and infrastructure needed for the automotive engine, electricity, chassis and power transfer systems were identified. Then it is used to identify the condition of the infrastructure at SMK TKR. Based on the study, obtained data as follows:
Table 5. The Condition of the Infrastructure and Facilities of SMK TKR in Yogyakarta Based on the Demands of the Curriculum 2013 Syllabus.

| Workshop          | Quantity | Quality | Relevance |
|-------------------|----------|---------|-----------|
|                   | Don't Have (%) | Less (%) | Enough (%) | More (%) | Don't Have (%) | Broken (%) | Good, but not complete (%) | Good, complete (%) | Not Relevant (%) | Less Relevant (%) | Relevance (%) | Very Relevant (%) |
| Engine            | 6         | 14,8    | 63        | 16,6     | 5           | 15,6        | 44,4        | 35,1        | 6,5          | 9,2           | 45,4         | 38,7          |
| Electricity       | 8,6       | 7,6     | 61,4      | 22,4     | 11          | 11          | 22          | 56          | 4,3          | 6,4           | 12,8         | 76,4          |
| Chasis & Power    | 14,2      | 8,5     | 67,6      | 9,7      | 15,3        | 18,2        | 29          | 37,5        | 21           | 10,8          | 45,5         | 22,7          |
| Train             |           |         |           |          |             |             |             |             |              |              |              |              |
| Average           | 9,4       | 10,3    | 64        | 16,2     | 10,2        | 14,8        | 32          | 42,9        | 10,6         | 8,8           | 34,6         | 45,9          |

Based on the results of the study, there are still SMKs whose infrastructure facilities are still not satisfactory in terms of quantity, quality and relevance. Where the respondents of this study are public and private SMKs that have a good reputation in Yogyakarta. If this is done thoroughly to all Vocational High Schools in Yogyakarta, surely the gap in infrastructure conditions with ideal conditions will be even higher.

3.2. The Challenges of Vocational High School to Face the Era of Literation and Industrial Revolution 4.0

3.2.1. Vocational high school get difficulties to meet their infrastructure with the technological development

Vocational high schools must be able to anticipate and respond to developments in the world of work with relevant and systematic programs such as curriculum adjustments, development of facilities and infrastructure, breakthroughs in teaching-learning activities and assessments, the students should be adapted to Industry 4.0 (Alias, S. Z., Selamat, M. N., Alavi, K., & Arifin, K., 2018). The development of technology, especially in the automotive sector, is very fast, and the variety of technology applied to vehicles is very high. Based on the research data about infrastructure of vocational high school in Yogyakarta, fulfillment of infrastructure in accordance with technological developments and needs in the world of work is very difficult for both public and private SMKs to do with all the existing limitations. Moreover, the trend of changes in the world of work which is very dynamic and dynamic from the need for manpower and the competencies of workers needed make the fulfillment of supporting facilities for competence very difficult to be pursued.

Vocational high schools must be able to equip graduates with abilities that are suitable for career development in the 21st century. Where institutions must be able to prepare competencies to face increasingly complex challenges, through 4C namely critical thinking and problem solving, creativity and innovation, communication and collaboration (Yahya, M., 2018).

3.2.2. The need for labor will change

In the future, many jobs will be replaced by machines, the tendency of the automotive industry to develop technology in manufactured vehicles that is easy to maintain and technology that is plug and play so that maintenance and repair work is minimized. Vocational high school needs to anticipate this so that there is no over-supply of the workforce because existing jobs require fewer people. Current conditions in the world of work, higher quality jobs can be created, but digitization can also lead to job shifting (Hoffmann, R. DGB Vorstand, 2015). With the digitalization and modernization of the industry, work has become more effective and efficient. However, the impact is that the labor required is less. Therefore, Industry 4.0 and future manufacturing require theoretical and vocational skills to be able to master the future complex technologies. Future industry employees must have in-depth theoretical knowledge and, in addition, have the skills to demonstrate proficiency in complex technologies under different conditions. (Madsen, E. S., Bilberg, A., & Hansen, D. G., 2016).
Innovations in technology by companies will affect the economy and the employability of workers (Tempel, S. (Ed.), 2015). The development of this technology is a must to always be strived for, and the impact that will occur need to be considered and anticipated. The impact that occurs will be systemic. The industrial revolution 4.0 which has the characteristics, the emergence of high technology, smart machines and robots with artificial intelligence will bring major changes to the labor market and job structures at various levels. More specifically, labor supply-demand, the structure of the workforce and the nature of work will be greatly affected (Junaid, S., Gorman, P.C., & Leslie, L.J., 2018). The dynamics of the requirements for the professional jobs of the future not only requires a fixed qualification profile, but rather an applied on competency development professional life - from vocational education up to retirement. Therefore, lifelong learning can be considered as a requirement for a long lasting curriculum vitae of workers (Gebhardt, J., Grimm, A., & Neugebauer, L. M., 2015). Everyone must be able to develop themselves and be able to take advantage of technological developments and digital communication to anticipate the impact of the development of the industrial revolution 4.0.

3.2.3. **Strengthening cooperation with industry and industrial apprenticeships is important**

There is a need for strong cooperation with the world of work or industry in the fulfillment of infrastructure and transfer of technology. Education 4.0 makes the students to adopt real-world skills that are representative of their jobs (Hariharasudan, A., & Kot, S., 2018). This is important because Vocational high school has difficulty developing its infrastructure independently. A strong relationship between vocational education institution and the industries should be maintained thus the school can balance and adapt fast technological developments in the industry. Other vocational schools should also establish partnerships with the industries to organize industry standard classes since it is beneficial for all parties, particularly for the students (Suroto, S., & Hung, N. T., 2018).

There is a need for training or apprenticeship in industry for SMK TKR teachers to develop competencies and find out about technological developments in the industry. Expertise certification for SMk teachers is mandatory to ensure teacher competence. In addition, expertise certification has a positive impact on teachers in terms of career advancement, competence and motivation to develop themselves (Pambayun, N. A. Y., Haryana, K., & Yuswono, L. C. (2020). Improvement the elements of educators and education personnel in vocational high schools include, provision, distribution, qualifications, certification, training, career and welfare, appreciation and protection (Setiyawami, S., & Sugiyono, T. J. R., 2019).

Strengthening the apprenticeship program / industrial work practice for students needs to be done. The need for the development of special instruments to regulate the important components / curriculum of apprentices, so that apprenticeship activities can be directed according to targets and achieve the expected goals. In fact, developing vocational high schools in Indonesia requires revitalization in many aspects, where these aspects are interrelated. Revitalization that needs to be done is in the aspects of learning systems, education units, students, educators and education personnel (Setiyawami, S., & Sugiyono, T. J. R., 2019).

3.2.4. **Infrastructure management needs to be strengthened**

The management of infrastructure for maintenance and development plays an important role to be enforced so that existing limitations can be minimized and in procurement the priority scale of the most essential practical equipment can be determined. Currently the management of infrastructure facilities in SMK according to the rules and regulations that have been made is sufficient but the action of implementing the rules in management needs to be improved. There needs to be a strong synergy from every element in the vocational high school. Management of facilities and infrastructure in vocational high schools can be improved optimally through the following stages, 1) planning based on needs analysis, determining priority scales, calculating budget, and preparing proposals; 2) school facilities and infrastructure procurement activities are carried out by first disbursing funds in accordance with the school activity plan and budget, to purchase school equipment; 3) Maintenance of
school facilities and infrastructure is carried out by all school components, all of them are responsible for school facilities and infrastructure; 4) inventory is carried out by recording, coding, and reporting; 5) elimination activities are carried out by sorting out items that are not feasible and then replaced with new items. (Agustin, H. Y., & Permana, J., 2020). With current technological developments, the management of infrastructure facilities should be changed to a digital system so that all data can be better integrated and organized. This can also be used as a control function of the central government to see the condition of vocational high schools more easily, practically, effectively and efficiently.

3.2.5. Utilization of information technology and technological developments to minimize gaps

Information technology is developed fastly, which needs to be used to reduce the gap in the lack of practical facilities with ideal conditions. Moreover, at this time there has been a change in the learning style of students who tend to learning from the internet so this needs to be accommodated by the use of technology that allows students to be able to learn independently. The need for workforce qualifications in the 4.0 industrial revolution has become a question of various parties, especially for vocational high schools to form successful workers and leaders in that era. To answer this question, not only educational content must be revised, but also skills development methods that are in line with the development of the industrial revolution 4.0 are needed (Richert, A., Shehadeh, M., Plumanns, L., Grob, K., Schuster, K., & Jeschke, S., 2016).

Industry 4.0 primarily aims to unify information technology and industry. In other words, industry 4.0 can be interpreted as a smart factory (Baygin, M., Yetis, H., Karakose, M., & Akin, E., 2016). Employment and unemployment are common problems as the impact of industry 4.0, especially in the early stages when the workforce failed to adapt to new industrial working conditions and there was a strong shift in the employment structure between sectors. This condition has become a reality, there has been a change of jobs in the labor market, robots have taken over humans to do manual work (M. R. Cabrita, V. Cruz-Machado, & S. Duarte, 2018). The use of virtual reality technology can be a solution to reduce the cost of certain high-cost objects. The fact that students are currently very adaptable to learn and practice in an online environment such as cloud data can improve personal, interaction and communication skills. The augmented reality (AR) and virtual reality (VR) environments may not be as realistic as factories and workshops, but it is safe and facilitate to upgrade of new skills today, such as dealing with in-process issues to minimize the risk of harm (Vu, T. L. A., 2018).

4. Conclusion

Conclusions that can be drawn in this study are, 1) There are some infrastructure facilities at SMK TKR in DIY that have not met the demands of Indonesia Minister of Education Regulation No. 40, 2008 and the demands of the Curriculum 2013 syllabus; 2) Infrastructure and facilities at SMK TKR is very difficult to follow the technological advances responsively, because technology is developing very quickly. Collaboration with the industry and the use of technology information and the development of technology in learning process are important to resolve the infrastructure limitation in SMK TKR.

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