Vocational students readiness in the face of the Industrial Revolution 4.0 and the demands of life in the 21st Century Skills

Edy Kurniawan¹, Supari Muslim², Erina Rahmadyanti³, Widi Aribowo⁴, Nita Kusumawati⁵, Euis Ismayati⁶, Ismet Basuki⁷, Ruzairi Abdul rahim⁸

¹Electrical Engineering Education, Universitas Negeri Surabaya, Indonesia Email: edykurr@gmail.com
²Electrical Engineering Education, Universitas Negeri Surabaya, Indonesia Email: supari.muslim@gmail.com
³Civil Engineering, Universitas Negeri Surabaya, Indonesia Email: erinarahmadyanti@unesa.ac.id
⁴Electrical Engineering Education, Universitas Negeri Surabaya, Indonesia Email: widiaribowo@unesa.ac.id
⁵Chemestry, Universitas Negeri Surabaya, Indonesia Email: septian.1800@mhs.unesa.ac.id
⁶Electrical Engineering Education, Universitas Negeri Surabaya, Indonesia Email: Euisheru@gmail.com
⁷Electrical Engineering Education, Universiti Tun Hussein Onn Malaysia Email: Ismetbasuki@unesa.ac.id
⁸Electrical Engineering Education, Universiti Tun Hussein Onn Malaysia Email: ruzairi@uthm.edu.my

Abstract. Vocational High School (VHS) is the initial level of vocational education whose task is to prepare students to become skilled labor in the industrial field. At this time there have been many changes, related to the era of industrial revolution 4.0, and the demands of life in the 21st century. Therefore it is necessary to increase the competence of vocational students in order to respond to these changes, both related to the era of industrial revolution 4.0, and demands for skills 4C to be able to live in existence in the 21st century. How far has the implementation of Vocational Schools been able to respond to these changes and demands? To answer this question, a research is needed entitled "Readiness of Vocational students in order to face the industrial revolution 4.0 and the demands of 21st century skills". Through literature studies, it was found that it was needed: (1) the use of learning models such as Problem Based Learning (PBL), Project Based Learning (PjBL), Cooperative Learning and the like, in order to foster 4C skills capabilities for vocational students; (2) the use of learning media such as e-learning, Flipped classroom and podcasts; (3) IoT utilization, digital literacy, and utilization of e-books that are cheap, practical, environmentally friendly, and up to date, (2) improving teacher quality related to the demands of 21st century skills.
INTRODUCTION

Vocational Vocational High School is one of the levels of secondary education whose task is to prepare students to become skilled labor in the industry (Aulbur & Bigghe, 2016). Therefore, SMK is an educational unit that is quite important in increasing competitiveness to face competition between countries, especially in free trade, including in the ASEAN region. One of the efforts made in fulfilling quality middle-level Human Resources (HR) is the development of vocational education (Darmajati, 2016). The demand for the quality of vocational school graduates is even more important given the industrial revolution 4.0 and the demands of life in the 21st century known as 4Cs which include creativity, critical thinking, collaboration, communication (NEA, 2014). In connection with that, according to Stock, learning in the classroom must contain 4Cs skill elements (NEA, 2014). Educators need to prepare students to enter new global societies. The quality of the learning process in core subjects, social studies, and art must be improved by using creative thought patterns, critical thinking, collaboration, and communication, especially related to employment.

On the other hand, there are three labor issues in Indonesia, namely: (1) unemployment at a young age; (2) lack of skilled labor; and (3) incompatibility between work and skills of workers. It is estimated that around 51.5% of workers in Indonesia do not meet underqualified standards in their jobs, as many as 40% are well-matched and the remaining 8.5% are too skilled (Yusuf, 2018). McKinsey predicts that Indonesia needs 3.8 million skilled workers every year. If it cannot be fulfilled, there will be a shortage of experts in Indonesia which will have an impact on domestic economic growth (Handayani, 2015). Some other data that needs to be noted is that in the industrial revolution 4.0, there were around 12.5% of jobs that would be lost, and 55.9% of them came from the agricultural sector (Yusuf, 2018). Even according to Oxford University, that work will be lost in the next 25 years by 47% (Keegan, 2017). In terms of Indonesia is the fourth most populous country in the world. The facts in the field show that in the years 2030-2040, Indonesia will experience a demographic bonus, when the productive age population aged 15-64 years will dominate the total population of 64% of Indonesia's population.

Data in recent years shows that the 15-24 year age group is the most vulnerable age group to become unemployed (Yusuf, 2018). Of these young age groups, among them are vocational students who have an average age of 15-18 years. Question, how far do Vocational students have 4Cs skills to face the era of industrial revolution and the demands of life in the 21st century? What is the role of vocational schools to equip their students in the face of the era of industrial revolution and the demands of life in the 21st century?

To answer this question, a research is needed entitled 'Readiness of Vocational students in facing the industrial revolution 4.0 and the demands of 21st century skills'. The research was conducted through literature studies, to examine the theories and results of relevant research. The theories examined include vocational education, related government policies, industrial revolution 4.0 and the demand for life in the 21st century. Vocational education is part of an education system that prepares someone to be better able to work in one work group or one occupational field. from other fields of work (Albright, Evans, & Fabac, 1978). Internationally, education is divided into three levels, namely primary, middle, and tertiary levels (NEA, 2014), and in Indonesia there are three levels of education, namely basic education, secondary
Vocational students readiness (Kurniawan, Muslim, Rahmadyanti, Aribowo, Kusumawati, Ismayati, Basuki, Rahim) | 42

Education, and higher education. Vocational education is at the level of secondary education and higher education. Vocational education at the middle level is better known as Vocational High School (SMK).

Vocational High School (SMK) is one form of formal education unit that provides vocational education at the secondary education level as a continuation of junior high school, MTs, or other forms of equal or continued learning outcomes that are recognized as equal or equivalent to junior high school or MTs (PP No. 19, 2017). Vocational education emphasizes skills competency for students. Therefore, vocational school teachers will guide students in mastering a skill well, so that when graduating it is expected that a vocational student is ready to face the world of work, including facing the industrial revolution 4.0 and demands for life in the 21st century. In line with the opinion that SMK as part of vocational education aims to prepare students to have knowledge, skills, and work attitudes in accordance with the needs of employment, both in the industrial environment, and in the business world (Muslim, et al., 2018).

The 21st Century Skills Demands

The Industrial Revolution 4.0 is a change in the industrial system better known as industrial automation. Industrial automation has the effect of losing many jobs, in addition to the emergence of many new types of jobs that emphasize 21st century skills. 21st century skills include critical thinking skills, creativity, collaboration, and communication (Sutanto, 2018; and NEA, 2014). These four competencies will play an important role in facing the 4.0 industrial revolution. There are 10 skills changes needed in the face of the 4.0 industrial revolution (Yusuf, 2018). These changes will occur between 2015-2020 as shown in Figure 1 below.

| in 2020                     | in 2015                      |
|-----------------------------|------------------------------|
| 1. Complex Problem Solving  | 1. Complex Problem Solving   |
| 2. Critical Thinking        | 2. Coordinating with Others  |
| 3. Creativity               | 3. People Management         |
| 4. People Management        | 4. Critical Thinking         |
| 5. Coordinating with Others | 5. Negotiation               |
| 6. Emotional Intelligence   | 6. Quality Control           |
| 7. Judgment and Decision Making | 7. Service Orientation    |
| 8. Service Orientation      | 8. Judgment and Decision Making |
| 9. Negotiation              | 9. Active Listening          |
| 10. Cognitive Flexibility   | 10. Creativity               |

Figure 1 Skill needed in job (2020-2025)
(Source: Yusuf, 2018)

The development of the industrial revolution began when the steam engine was discovered. Furthermore, the industrial revolution continues today to revolution 4.0. The first revolution was marked by the discovery of steam engines and weaving machines in 1784, the 2.0 industrial revolution was marked by the discovery of electricity in 1870. While the Industrial Revolution 3.0 began when it was discovered by PLC in 1969, and the industrial revolution 4.0 was marked by the use of smart automation systems in 2015 (Sutanto, 2018).

The industrial revolution 1.0 lasted 86 years, while the 2.0 industrial revolution lasted 99 years, and the 3.0 industrial revolution only lasted 46 years. The industrial revolution 4.0 is only 4 years old, and how long will it last? We all cannot answer, and those who will answer are developments in science and technology. The faster the development of science and technology, the shorter the age of an industrial revolution. More fully, the development of the revolution from industrial revolution 1.0 to revolution 4.0 as shown in Figure 2 (Hartmann & Bovenschulte, 2013) below.
The industrial revolution 4.0 was marked by changes in the digital direction. One form of the industrial revolution 4.0 is about Internet of Thing (IoT). IoT is a change where all activities are connected to the internet. Each industry sector needs to be differentiated between IoT vertical strategies between companies, commercial, consumer, and industry as shown in Figure 3. Many industry leaders predict that Industrial Internet will produce a level of growth and productivity that has not happened during the previous decade. Business leaders, governments, academics, and technology vendors work closely, to try to exploit and realize this great potential (Gilcrist, 2016).

METHOD

This research was conducted through a literature study of references and relevant research results. The results of the study are then discussed in the focus Group discussion (FGD). The relevant references include: (1) books on vocational education and vocational education; (2)
Vocational students readiness (Kurniawan, Muslim, Rahmadyanti, Aribowo, Kusumawati, Ismayati, Basuki, Rahim) | 44

some references to 21st century skills demands; (3) policies of the Government of the Republic of Indonesia; and (4) relevant research results are the results of research on vocational education related to 21st century skills.

RESULT AND DISCUSSION

At present, the number of Vocational Schools has reached more than 13 thousand Vocational Schools spread throughout Indonesia. A complete picture of Vocational Schools in Indonesia as shown in Table 1 below. Organizing Vocational Schools requires a lot of facilities and infrastructure.

Tabel 1. Vocational School Statistic in Indonesia

| No | Variabel | state total | %  | private total | %  | Grand Total |
|----|----------|-------------|----|---------------|----|-------------|
| 1  | School   | 3.519       | 25,67 | 10.191        | 74,22 | 13.710      |
| 2  | Student  | 2.110.751   | 43,04 | 2.793.280     | 56,96 | 4.904.031   |
| 3  | Gender   |             |       |               |      |             |
|    | Man      | 1.182.083   | 42,19 | 1.619.679     | 47,81 | 2.801.762   |
|    | Women    | 928.668     | 44,17 | 1.173.601     | 55,83 | 2.102.269   |
| 4  | Usia     |             |       |               |      |             |
|    | <16 year | 434.392     | 44,61 | 539.471       | 55,39 | 973.863     |
|    | 16-18 year | 1.597.236  | 42,81 | 2.133.508    | 57,19 | 3.730.744   |
|    | >18 year | 79.123      | 39,68 | 120.301       | 60,32 | 199.424     |
| 5  | Teacher  | 141.813     | 48,53 | 150.399       | 51,47 | 292.212     |

(Source: Vocational Statistics 2017/2018 Ministry of Education and Culture Education and Culture Statistics Data Center 2017).

The number of facilities and infrastructure in Vocational Schools will have a direct impact on the quality of the Vocational School concerned. The state of vocational facilities and infrastructure in Indonesia as shown in Table 2. If viewed from the state of the classroom, the area in Java has more classrooms than the area outside Java. But the amount of damage experienced is also not small. The biggest damage occurred in West Java and East Java.

Tabel 2. Vocational Classroom Condition between State and Private School
Furthermore, in Table 3, it describes the development of classrooms in Vocational Schools throughout Indonesia. The regions of West Java and Central Java have a higher number of classrooms compared to other provinces.

**Tabel 3. Development of Classroom Quantity between State and Private School**

(Source: Vocational Statistics 2017/2018 Ministry of Education and Culture Education and Culture Statistics Data Center 2017).

Every Vocational Schools has a special room that is used to carry out practical work activities. The room is known as a workshop or laboratory. Each Vocational School has a number of different laboratories. The number of SMK laboratories in each Province as shown in Table 4 below.

(Source: Vocational Statistics 2017/2018 Ministry of Education and Culture Education and Culture Statistics Data Center 2017).
Based on Table 4 above, it can be seen that the comparison between the number of laboratories compared with the number of Vocational Schools is still very small. In order to improve the quality of vocational school graduates, the number of existing laboratories still needs to be improved, especially in the face of the 4.0 industrial revolution and the demands of 21st century skills.

Several studies related to improving the quality of vocational schools have been carried out. In the last four years, several studies that have been conducted in Vocational Schools are: (1) Wulandari & Surjono (2013); Sihotang, Zahara, & Silintong (2015); and Akbar (2018) who researched learning models; (2) research on learning modules is carried out by Roshyda & Jailani (2014); Hakim, Wibowo, & Hidayati (2015); and Rosyidi & Wibawa (2017); (3) research on learning devices carried out by Indrayanti & Wijaya (2016); and (4) research on instructional media carried out by Aziz & Suparman (2015) and Susilo, Anitah, & Yamtinah (2017).

The use of learning models has a significant influence on students' abilities, including the ability to think critically and creatively. Some learning models for improving creative and critical thinking skills are problem-based learning (PBL) and project-based learning (PjBl) (Nurlaela & Ismayati, 2015). The use of PBL models is known to improve student learning outcomes (Wulandari & Surjono, 2013). If combined with several learning strategies, the utilization of the learning model will further improve student learning outcomes (Akbar, 2018). The use of the learning model must be able to increase learning motivation, so that student learning outcomes
In addition to the use of learning models, the use of modules is an important part of the learning process. Modules are a set of teaching materials that can be used by students to study independently. The module serves as a supplement in learning. Therefore, Rosyidi & Wibawa (2017) see that module development is very necessary. Especially in the 2013 curriculum, there were several changes to the learning model in the classroom, and it turned out that the use of modules proved to be able to support the implementation of the 2013 curriculum (Hakim et al., 2015). In addition to the use of modules, the intensity of learning can be increased by using learning media. Appropriate learning media proved to be able to increase students' understanding of teaching material, both theoretically and practically (Susilo et al., 2017; Aziz & Suparman, 2015). The use of flipped classroom (Bishop & Verleger, 2013) and podcasts (Chester et al., 2011) in developed countries, can be replicated by the education system in Indonesia.

Flipped classrooms and podcasts are learning tools that students can use to learn independently. Flipped classroom emphasizes students to learn material that will be taught at the next meeting independently, so that class meetings are used for discussions between teachers and students about the problems found. Bishop & Verlegher (2013) found that the use of flipped classroom was effective in improving student learning outcomes compared to conventional methods. Flipped classroom combines learning material that has not been understood by students with PBL learning models that are carried out independently by students. This independent learning was previously examined by Chester, et al (2011) using podcast media. The results of the study show that media podcasts are very helpful for groups of students who have little time to study in class. The use of podcast media is able to help students continue to follow the learning process without having to come in the classroom, so that it can be used by students who are in industrial practice, but students still get material from the teacher through podcast media. The results of research on the benefits of learning media including e-learning have been widely carried out. Muslim, et al. (2018.a) found that the Electrical Motor Control (EMC) Trainer was proven to be very effective, because as many as 26 (74.28%) students had obtained learning outcomes in the range 71-100, with good and very good categories. Working with training tools allows students to acquire practical knowledge and skills and then use those skills for problem solving encountered (Muslim, 2018.b). In line with the results of the study, Soeparno & Muslim (2018) found that e-learning was very effective in improving student learning outcomes which included learning outcomes in the cognitive, affective and psychomotor domains.

Regarding the industrial revolution 4.0 there are many changes that have occurred, such as the strategy of using IoT which can be seen from various types of online services that have been utilized by the public at large. IoT provides unlimited creativity potential in the digital era (Sutanto, 2018), with several examples: (1) large lodging accommodation companies without owning a hotel like traveloka; (2) large transportation companies without owning vehicles such as Gojek; (3) Online shops without having a mall like Bukalapak; and (4) The Industrial Internet provides a way to gain visibility and better insight into the company's operations and assets through sensor engine integration, middleware, software and backend cloud computing and storage systems. Likewise, business profits can be achieved through increased operational efficiency and accelerated productivity, which results in a reduction in unplanned time and optimized efficiency, and thus generate profits (Gilcrist, 2016). All of these things are related to IoT, as a feature of the era of industrial revolution 4.0. This change must be responded to by improving the quality of education in Vocational Schools.

Related to IoT utilization, in 2015 the Ministry of Education has collaborated with Indosat Oreedoo to implement IoT in the world of education. IoT implementation is done by implementing a cloud-based CREATE CyberSchool With IoT platform in 65 pilot schools spread across five regions of Indonesia, namely Sumatra, Java, Kalimantan, Sulawesi, and Maluku - Papua (Sukma, 2015). This program is a five-year program that is currently underway. The Ministry of Education hopes that changes in patterns of interaction and communication will occur in the education environment and the wider community. Such interaction patterns will enhance cooperation in the community. Collaboration can eliminate mental barriers due to the
limited experience and perspective (Johnson, 2014, p. 164).

Another change that occurred in the era of the 4.0 industrial revolution, was about digital literacy. Digital literacy is the ability to interpret and design communication in all forms of digital flow (Heick, 2015). There are seven important aspects of digital literacy, namely innovation, communication & collaboration, research & information, critical thinking, problem solving, digital citizenship, concepts and use of technology (Sutanto, 2018). Digital literacy is important and one of them is for education, for example, the use of e-books in learning, including abroad, has utilized e-books. The advantages of ebooks from physical books are lower costs, more availability, up-to-date content, interactive, dynamic, and can be used in several special applications. The use of ebook is able to support the education system 4.0 which is currently being developed.

The advantages of e-books are cheap, practical, environmentally friendly, and up to date (Carvalho et al., 2018), where students will be able to obtain information that is faster and more accurate than printed books. The e-book is able to create a pleasant atmosphere for students who read it, with content that is more interesting, interactive, so it is enjoyed by students (Sargeant, 2015). Moreover, currently various learning media including e-books can be accessed on a portable basis using a smartphone (Yu & Coway, 2012). Furthermore Ogata et al (2015) analyzed the number of ebook users at one of the universities in Japan. The results of the study found that there were at least 2700 first-year students using the ebook. Facilities and the level of the number of sources of books provided is one of the factors that drives the large number of ebook users. This situation must be responded to by education in Indonesia, especially Vocational Schools, to meet the 4.0 industrial revolution.

Education in the industrial revolution era 4.0 is said to still be developed, because until now there are still no provisions governing the education of the industrial revolution era 4.0. Education in the industrial revolution era 4.0 is considered a more complex education than previous education. An educational model is needed in order to meet the demands of 21st century skills that require lifelong learning competencies, including: (1) knowledge construction; (2) adaptability; (3) the ability to find, organize, and retrieve information; (4) management capabilities; (5) critical thinking skills; and (6) the ability to cooperate in the Team (Dermatini & Benussi, 2017). According to Benussi (2017), previously there was education in the industrial revolution era 1.0, 2.0, and 3.0.

Table 5 illustrates the educational profile starting from the industrial revolution era education up to the era of 4.0 industrial revolution by adopting attribute-based educational profiles to obtain a more balanced pattern and educational profile. Looking at the attribute column in Table 5 by considering the need for the labor market, any educational profile can be formed in accordance with the demands of the labor market (Benussi, 2017).
CONCLUSION

In order to deal with the industrial revolution 4.0, and demands for 21st century life, 4C skills (communication, creativity, critical thinking, collaborative) are needed, which are in accordance with government policy, that these competencies need to be developed through the 2013 curriculum (revised edition). In order to develop these 4C skills are needed:

1. Utilization of learning models such as Problem Based Learning (PBL), Project Based Learning (PjBL), Cooperative Learning and the like, in order to foster critical thinking skills, creativity, cooperation and communication skills of vocational students;

2. Use of learning media such as e-learning, flipped classroom and podcasts. The use of podcast media is able to help students continue to follow the learning process without having to come in class, when students are doing industrial practice, but students still get material from the teacher through podcast media.

3. Utilization of IoT, digital literacy, and utilization of e-books that are cheap, practical, environmentally friendly, and up to date, where students will be able to obtain faster and more accurate information, and be able to study happily anywhere, and when just according to the conditions of the students concerned;

4. By utilizing the learning model as referred to in point 1, the use of learning media as referred to in point 2, and the use of IoT as referred to in point 3, it is expected that SMK graduates have critical, creative thinking skills in order to create innovations in accordance with the fields of study, through the ability of cooperation and communication along with the demands of life in the 21st century;

5. It is necessary to improve the quality of vocational teachers in order to carry out conclusions in points 1, 2, 3 and 4 above.

ACKNOWLEDGEMENT
This research will not succeed without the support of some people around me who continue to provide positive motivation. Thank you to my supervisor, Mr. Prof. Dr. H. Supari Muslim, M.Pd who continued to provide guidance and motivation in completing this research. Do not forget also to all parties who have been willing to provide assistance in finding reference sources in this study.

REFERENCES

Akbar, S. F. (2018). Perbandingan Penerapan Model Pembelajaran PjBL dengan Metode Drill Dibandingkan dengan Penerapan Model Pembelajaran PjBL dengan Metode Feedback Pengaruhnya Terhadap Hasil Belajar Pemrograman Web Dinamis Siswa Kelas XI RPL di SMKN 6 Malang. SKRIPSI Jurusan Teknik Elektro-Fakultas Teknik UM.

Albright, L., Evans, R. N., & Fabac. (1978). A system for the identification, assessment and evaluation of the special needs learner in vocational education. Bureau of Educational Research, University of Illinois at Urbana-Champaign.

Aulbur, W., & Bigghe, R. (2016). Skill development for Industry 4.0: BRICS skill development working group. Roland Berger GMBH.

Aziz, A. F., & Suparman, M. P. (2015). Pengembangan Media Pembelajaran Berbasis Adobe Flash Untuk Meningkatkan Minat Belajar Siswa Pada Mata Pelajaran Mekanika Teknik Jurusan Teknik Figure Bangunan di SMK N 1 Seyegan. E-Journal Pend. Teknik Sipil Dan Perencanaan, 3(5), 1p

Bishop, J. L., & Verleger, M. A. (2013, June). The flipped classroom: A survey of the research. In ASEE national conference proceedings, Atlanta, GA (Vol. 30, No. 9, pp. 1-18).

Carvalho, J. L., González, R. L., García, L. M. C., & Juarez, J. C. (2018, October). What is better to study: the printed book or the digital book?: An exploratory study of qualitative nature. In World Conference on Qualitative Research (pp. 34-45). Springer, Cham.

Chester, A., Buntine, A., Hammond, K., & Atkinson, L. (2011). Podcasting in education: Student attitudes, behaviour and self-efficacy. Journal of Educational Technology & Society, 14(2).

Gilchrist, A. (2016). Industry 4.0: the industrial internet of things. Apress.

Hakim, L., Susilowibowo, J., & Widayati, I. (2015). Analisis Hasil Penelitian Pengembangan Bahan Ajar dan Modul Pembelajaran Akuntansi di Smk Pendukung Implementasi Kurikulum 2013. In Prosiding Seminar Nasional Pendidikan Akuntansi dan Keuangan.

Handayani, T. (2015). Relevansi lulusan perguruan tinggi di Indonesia dengan kebutuhan tenaga kerja di era global. Jurnal Kependudukan Indonesia, 10(1), 53-64.

Hartmann, E. A., & Bovenschulte, M. (2013). Skills needs analysis for "Industry 4.0" based on roadmaps for smart systems. In Using Technology Foresights for Identifying Future Skills Needs. Global Workshop Proceedings (pp. 24-36).

Indrayanti, R. D., & Wijaya, A. (2016). Pengembangan Lembar Kerja Siswa Berbasis Pendidikan Matematika Realistik Untuk Topik Matriks Di SMK Kelas X. Jurnal Pendidikan Matematika-S1, 5(6).

Johnson, E. B. (2014). CTL-Contextual teaching & learning. Bandung: Kaifa.
Keegan, H. (2017, Mei 1). *47% of jobs will disappear in the next 25 years according to Oxford University* [Blog Post]. Retrieved from https://technokitten.blogspot.com/2017/01/47-of-jobs-will-disappear-in-next-25.html.

Muslim, S., et al. (2018.a). Development Module (Lab Report) As a Media of Learning in Vocational Education Viewed by Gender. ICVEE IOP Publishing IOP Conf. Series: Materials Science and Engineering 336 (2018) 012035 doi:10.1088/1757-899X/336/1/012035

Muslim, S., et al. (2018.b). Development Of Electrical Motor Control Learning Media As Learning Support For Electrical Power Installation Courses In The Department Of Electrical Engineering. Journal of Educational Science and Technology Volume 4 Number 3 December 2018 page 170-178p-ISSN:2460-1497 and e-ISSN: 2477-3840.DOI: http://dx.doi.org/10.26858/est.v1i16047.

National Education Association. (2014). Preparing 21st century students for a global society: An educator’s guide to the “Four Cs”. Alexandria, VA: National Education Association.

Nurlaela, L., & Ismayati, E. (2015). Strategi Belajar Berpikir Kreatif. Ombak, Bandung.

Ogata, H., Yin, C., Oi, M., Okubo, F., Shimada, A., Kojima, K., & Yamada, M. (2015, January). E-Book-based learning analytics in university education. In *International Conference on Computer in Education (ICCE 2015)* (pp. 401-406).

Republik Indonesia. (2017). Peraturan pemerintah nomor 19 tahun 2017 tentang guru. Lembaran Negara RI Tahun 2017, No. 6058. Sekretariat Negara. Jakarta.

Rosyidi, A. I., & Wibawa, S. C. (2017). Pengembangan Modul Pembelajaran Perakitan Komputer Untuk Meningkatkan Prestasi Belajar Siswa Di SMK Mahardhika Surabaya. *IT-EDU*, 2(02).

Sargeant, B. (2015). What is an ebook? What is a book app? And why should we care? An analysis of contemporary digital picture books. *Children's Literature in Education, 46*(4), 454-466.

Sihotang, T., Zahara, R., & Silitonga, A. B. (2015). Pengaruh Model Pembelajaran Kooperatif Tipe Course Review Horay (CRH) Terhadap Motivasi Belajar Siswa. *Jurnal Pendidikan dan Pembelajaran Ekonomi Akuntansi*, 1(1).

Soeparno, Muslim, S. (2018). Effectiveness of E-Learning for Students Vocational High School Building Engineering Program. IOP Conf. Series: Materials Science and Engineering 336 (2018) 012039. https://doi:10.1088/1757-899X/336/1/012039.

Sutanto, T. (2018, November). *Peran literasi dan budaya digital dalam pendidikan modern dan industri 4.0*. Seminar nasional implementasi riset dan literasi untuk menghadapi revolusi industri 4.0, Yogyakarta.

Susilo, J., Anitah, S., & Yamtinah, S. (2017, March). Pengembangan Media Pembelajaran Virtual dan Interaktif untuk Mensimulasikan Instalasi Jaringan Listrik di SMK 2 Surakarta. In *Prosidings Seminar Nasional Teknologi Pendidikan*.

Wulandari, B., & Surjono, H. D. (2013). Pengaruh problem-based learning terhadap hasil belajar ditinjau dari motivasi belajar PLC di SMK. *Jurnal Pendidikan Vokasi*, 3(2).

Yu, F., & Conway, A. R. (2012). Mobile/smartphone use in higher education. *Proceedings of the 2012 Southwest Decision Sciences Institute*, 831-839.
Vocational students readiness (Kurniawan, Muslim, Rahmadyanti, Aribowo, Kusumawati, Ismayati, Basuki, Rahim) | 52

Yusuf, B. I. (2018, November). Kesiapan SDM menghadapi revolusi industri 4.0. Seminar nasional implementasi riset dan literasi untuk menghadapi revolusi industri 4.0, Yogyakarta.