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

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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-larning, 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.*

Keywords:
Industrial Revolution 4.0; 21st century skills; Vocational students; vocational education.

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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

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.

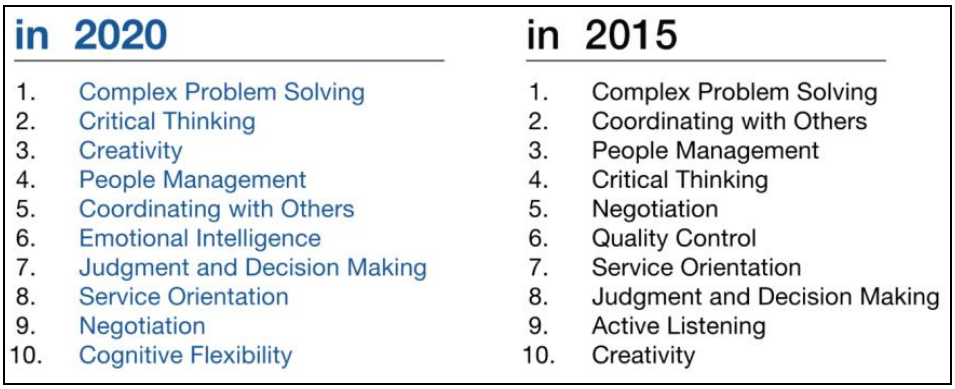
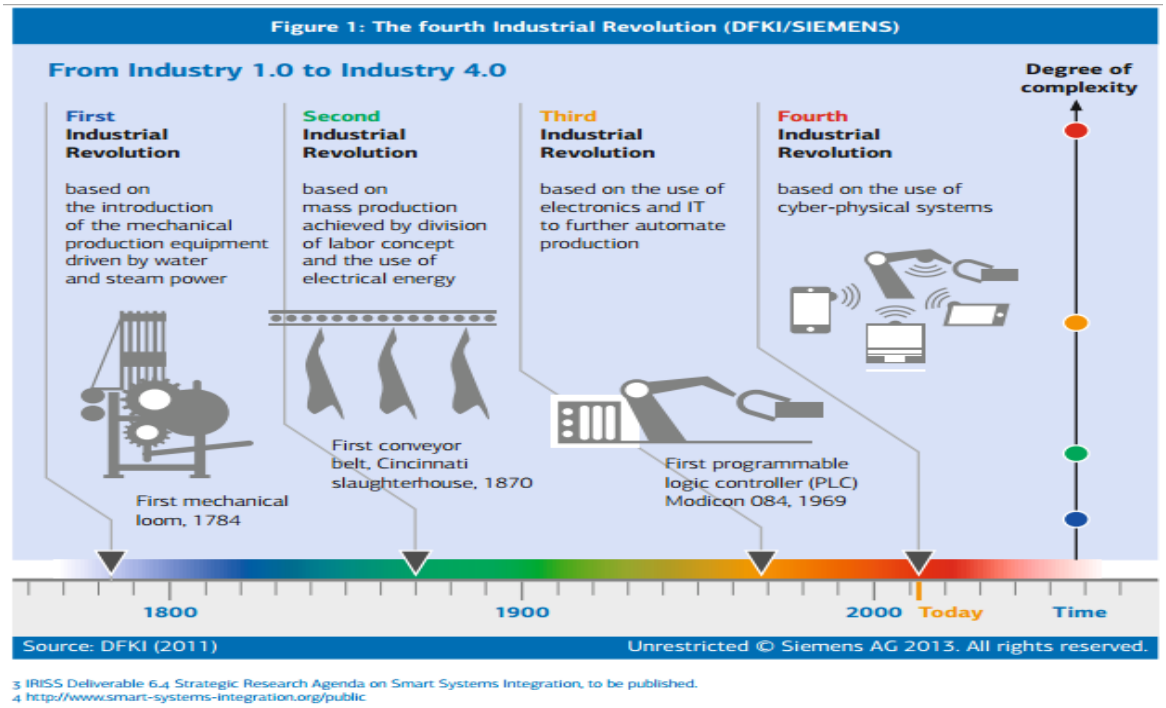


Figure 1 Skill needed in job (2020-2025)
(Source: Yusuf, 2018)

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.



3 IRISS Deliverable 6.4 Strategic Research Agenda on Smart Systems Integration, to be published.
4 http://www.smart-systems-integration.org/public

Figure 2. Fourth Industrial Revolution
(Source: Skills needs analysis for "Industry 4.0" based on roadmaps for smart systems, Hartmann & Bovenschulte, 2013)

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).

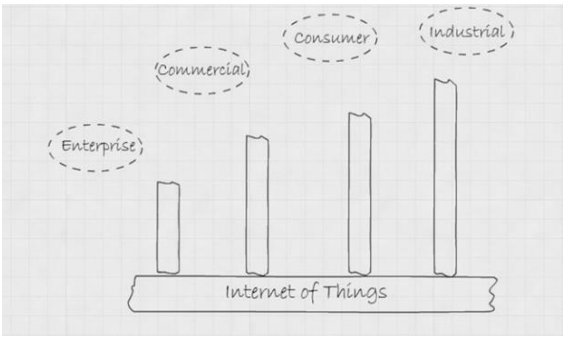


Figure 3. Vertical Strategy of IoT
(Sumber: Gilcrist, 2016)

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)

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		private		Grand
		total	%	total	%	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

No.	Provinsi *Province*	Baik *Good*	Rusak Ringan *Minor Damage*	Rusak Sedang *Middle Damage*	Rusak Berat *Major Damage*	Rusak Total *Total Disrepair*	Jumlah *Total*
1	DKI Jakarta	3.758	3.364	58	35	82	7.297
2	Jawa Barat	14.463	15.444	865	641	453	31.866
3	Banten	2.979	3.722	246	157	195	7.299
4	Jawa Tengah	10.896	12.247	409	285	276	24.113
5	DI Yogyakarta	1.710	1.349	45	38	30	3.172
6	Jawa Timur	10.051	11.005	476	324	296	22.152
7	Aceh	986	1.197	58	35	49	2.325
8	Sumatera Utara	5.469	4.921	328	267	120	11.105
9	Sumatera Barat	1.686	1.258	44	7	6	3.001
10	Riau	1.587	1.696	94	64	75	3.516
11	Kepulauan Riau	553	541	10	2	-	1.106
12	Jambi	737	1.095	50	39	46	1.967
13	Sumatera Selatan	1.727	1.668	68	27	39	3.529
14	Bangka Belitung	452	388	7	9	3	859
15	Bengkulu	474	657	38	9	5	1.183
16	Lampung	2.022	2.478	149	103	42	4.794

17	Kalimantan Barat	1.049	971	41	14	14	2.089
18	Kalimantan Tengah	640	716	11	8	13	1.388
19	Kalimantan Selatan	817	892	12	27	31	1.779
20	Kalimantan Timur	1.304	1.246	29	22	11	2.612
21	Kalimantan Utara	188	116	3	2	1	310
22	Sulawesi Utara	1.126	1.149	29	15	29	2.348
23	Gorontalo	515	292	44	12	7	870
24	Sulawesi Tengah	911	936	37	44	25	1.953
25	Sulawesi Selatan	2.845	2.328	136	63	53	5.425
26	Sulawesi Barat	502	501	31	42	15	1.091
27	Sulawesi Tenggara	658	776	48	30	8	1.520
28	Maluku	454	442	32	36	11	975
29	Maluku Utara	351	428	9	11	14	813
30	Bali	1.522	1.036	-	-	-	2.558
31	Nusa Tenggara Barat	1.208	1.079	73	61	30	2.451
32	Nusa Tenggara Timur	1.284	1.374	151	72	107	2.988
33	Papua	642	621	81	41	26	1.411
34	Papua Barat	238	271	16	30	6	561
	Indonesia	**75.804**	**78.204**	**3.728**	**2.572**	**2.118**	**162.426**

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

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 province.

Tabel 3. Development of Clasroom Quantity between State and Private School

No.	Provinsi *Province*	2015/2016			2016/2017			2017/2018		
		Negeri *Public*	Swasta *Private*	Jumlah *Total*	Negeri *Public*	Swasta *Private*	Jumlah *Total*	Negeri *Public*	Swasta *Private*	Jumlah *Total*
1	DKI Jakarta	1.380	4.443	5.823	1.387	4.893	6.280	1.433	5.864	7.297
2	Jawa Barat	5.893	18.110	24.003	6.542	20.353	26.895	7.475	24.391	31.866
3	Banten	1.454	4.625	6.079	1.577	4.899	6.476	1.812	5.487	7.299
4	Jawa Tengah	5.454	14.413	19.867	5.956	15.361	21.317	6.536	17.577	24.113
5	DI Yogyakarta	1.239	1.602	2.841	1.199	1.674	2.873	1.350	1.822	3.172
6	Jawa Timur	6.659	11.173	17.832	7.353	11.981	19.334	8.148	14.004	22.152
7	Aceh	1.754	237	1.991	1.892	241	2.133	2.065	260	2.325
8	Sumatera Utara	3.351	5.861	9.212	3.718	6.221	9.939	4.136	6.969	11.105
9	Sumatera Barat	1.885	648	2.533	2.000	667	2.667	2.261	740	3.001
10	Riau	1.727	1.311	3.038	1.784	1.409	3.193	1.937	1.579	3.516
11	Kepulauan Riau	444	519	963	463	574	1.037	504	602	1.106
12	Jambi	1.173	430	1.603	1.322	484	1.806	1.448	519	1.967
13	Sumatera Selatan	1.460	1.285	2.745	1.639	1.388	3.027	1.861	1.668	3.529
14	Bangka Belitung	562	214	776	617	205	822	642	217	859
15	Bengkulu	887	171	1.058	906	192	1.098	975	208	1.183
16	Lampung	1.467	2.276	3.743	1.683	2.487	4.170	1.913	2.881	4.794
17	Kalimantan Barat	1.148	623	1.771	1.271	634	1.905	1.369	720	2.089
18	Kalimantan Tengah	968	228	1.196	1.059	246	1.305	1.108	280	1.388
19	Kalimantan Selatan	1.062	480	1.542	1.149	512	1.661	1.227	552	1.779
20	Kalimantan Timur	1.175	1.080	2.255	1.269	1.130	2.399	1.386	1.226	2.612
21	Kalimantan Utara	231	34	265	249	34	283	265	45	310
22	Sulawesi Utara	1.281	740	2.021	1.362	789	2.151	1.443	905	2.348
23	Gorontalo	699	94	793	713	99	812	762	108	870
24	Sulawesi Tengah	1.063	489	1.552	1.198	559	1.757	1.368	585	1.953
25	Sulawesi Selatan	2.676	1.778	4.454	3.068	1.861	4.929	3.356	2.069	5.425
26	Sulawesi Barat	616	282	898	667	323	990	738	353	1.091
27	Sulawesi Tenggara	1.073	206	1.279	1.169	228	1.397	1.272	248	1.520
28	Maluku	623	180	803	708	192	900	760	215	975
29	Maluku Utara	431	238	669	478	260	738	537	276	813
30	Bali	1.027	1.130	2.157	1.064	1.193	2.257	1.197	1.361	2.558
31	Nusa Tenggara Barat	1.410	620	2.030	1.525	733	2.258	1.639	812	2.451
32	Nusa Tenggara Timur	1.512	823	2.335	1.629	958	2.587	1.873	1.115	2.988
33	Papua	758	355	1.113	836	393	1.229	928	483	1.411
34	Papua Barat	378	104	482	418	132	550	423	138	561
	Indonesia	**54.920**	**76.802**	**131.722**	**59.870**	**83.305**	**143.175**	**66.147**	**96.279**	**162.426**

(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.

Tabel 4. Quantity Laboratory According Condition in State and Priavate Vocational School

No.	Provinsi *Province*	Baik *Good*	Rusak Ringan *Minor Damage*	Rusak Sedang *Moderate Damage*	Rusak Berat *Major Damage*	Rusak Total *Totally Damage*	Jumlah *Total*
1	DKI Jakarta	101	71	1	1	2	176
2	Jawa Barat	388	244	24	13	18	687
3	Banten	90	84	4	3	7	188
4	Jawa Tengah	565	402	4	1	8	980
5	DI Yogyakarta	93	58	2	-	-	153
6	Jawa Timur	541	358	12	6	19	936
7	Aceh	110	134	2	3	2	251
8	Sumatera Utara	203	176	14	7	6	406
9	Sumatera Barat	138	102	2	3	2	247
10	Riau	85	83	3	3	11	185
11	Kepulauan Riau	26	29	3	-	1	59
12	Jambi	61	74	1	3	10	149
13	Sumatera Selatan	76	76	-	-	-	152
14	Bangka Belitung	53	32	-	1	1	87
15	Bengkulu	37	49	4	-	1	91
16	Lampung	102	101	7	8	1	219
17	Kalimantan Barat	93	67	5	3	-	168
18	Kalimantan Tengah	50	71	1	-	5	127
19	Kalimantan Selatan	53	63	3	2	4	125
20	Kalimantan Timur	54	87	2	1	1	145
21	Kalimantan Utara	16	6	-	-	-	22
22	Sulawesi Utara	60	63	6	2	1	132
23	Gorontalo	56	30	5	2	-	93
24	Sulawesi Tengah	48	81	1	-	-	130
25	Sulawesi Selatan	207	133	2	3	4	349
26	Sulawesi Barat	41	26	2	-	4	73
27	Sulawesi Tenggara	81	68	9	3	4	165
28	Maluku	43	51	1	1	4	100
29	Maluku Utara	21	44	2	1	2	70
30	Bali	45	51	-	-	-	96
31	Nusa Tenggara Barat	83	67	2	-	1	153
32	Nusa Tenggara Timur	95	79	7	6	6	193
33	Papua	51	76	7	-	-	134
34	Papua Barat	20	34	1	5	2	62
	Indonesia	**3.786**	**3.170**	**139**	**81**	**127**	**7.303**

(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, & Silitonga (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

increase (Sihotang et al., 2015).

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 clasroom 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 Oredoo 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).

Tabel 5. *Education Profiles*

Attribute	Education 1.0	Education 2.0	Education 3.0	Education 4.0 (*still emerging*)
Teacher	Knowledge source	+ Counselor, guide	+ Leader of collaborative knowledge creation	*+ Supported by an AI-based learning portal*
Content delivery	Traditional copyright support	+ Free/OER* (inside disciplines)	+ OER created and used by the learner; delivered across disciplines, institutions, certified sources (MERLOT, Coursera)	*+ Available in AI-based learning portals integrating certified OER with individual adaptive learning*
Learning process	Lectures, essays, assignments, written and oral tests, bounded group work	+ More open technologies (such as Arduino); learning by project; confined to institution and classroom boundaries	+ Open learning activities addressing student creativity; social networking outside boundaries of discipline, institution, and nation	*+ Adaptive learning driven by the AI portal tuning the learning process according to real-time learner profiles*
Learning organization	Buildings with fixed boundaries among co-located institutions; teaching, assessment, and accreditation by a single institution	+ Collaboration among institutions (ERASMUS, EU student exchange); still 1-to-1 affiliation between learner and institution	+ Teachers exchange, one-to-many affiliation between learners and institutions (for example, double degree)	*+ Institutional affiliations irrelevant; new institutions providing AI-driven high/ higher education on Internet; breakdown of national, regional, and institutional boundaries*
Student	Mainly passive	+ Evidence of transition to an active profile; enhanced ownership of own education process	+ Ownership of own education plan, co-develops new ideas and artifacts	*+ Autonomous; counselors and AI help co-develop education plans, continuously updated by adaptive mechanisms*
Means	E-learning management system, but limited to a single institution	+ E-learning collaborations involving other institutions, mainly within the borders of a single learning management system	+ Web-driven technologies to address full individual distributed learning environments consisting of a portfolio of applications (for example, MOODLE)	*Web-driven e-learning organizations integrated with several AI applications*

(Source: Benussi, 2017, Do Web 4.0 & Industry 4.0 Imply Education X.0)

CONCLUSION

In order to deal with the industrial revolution 4.0, and demands for 21st century life, 4C skills (communication, creativity, critical thinkink, colaborative) 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-larning, 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.

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