EDUCATION AND INDUSTRIAL REVOLUTION 4.0

Delipiter Lase
STT Banua Niha Keriso Protestan Sundermann Nias
piterlase@sttsundermann.ac.id

Abstract: Industrial Revolution 4.0 has brought changes in various aspects of human life. One of them is the education system. The problem is, what components of education are affected, and how to respond to these implications? This paper aims to explain changes and alignment that are required to be done in education so that the human resources produced by various educational institutions can compete and contribute globally. The type of research used is library research. The discussion shows that the development of current and future curricula must elaborate on the abilities of students in the academic dimension, life skills, and the ability to live together and think critically and creatively. Other invisible skills like interpersonal skills, global-minded citizens, and literacy of the media and information available. Also, the curriculum must be able to direct and shape students ready to face the industrial revolution era with an emphasis on the fields of STEM. Curriculum reorientation refers to ICT-based learning, the internet of things, big data and computerization, as well as entrepreneurship and internship; this needs to be a compulsory curriculum to produce skilled graduates in literacy, technology literacy, and human literacy aspects. The competencies that must be possessed by the teacher are educational competence, skill for technological commercialization, capability in globalization, expertise in future strategies, and counselor competence. In addition to these competencies, teachers also need to have skills and friendliness with technology, collaboration, creative and taking risks, having a good sense of humor, and teaching as a whole (holistic). The open learning platform is one way to be considered by the school and teacher in deciding how education and learning are held.

Keyword: Industrial Revolution 4.0, Education 4.0

Abstrak: **Revolusi Industri 4.0 telah membawa perubahan dalam berbagai aspek kehidupan manusia.** Di antaranya, dalam bidang pendidikan. Masalahnya adalah, apa saja komponen pendidikan yang terkena terdampak, dan bagaimana merespons implikasi ini? Makalah ini bertujuan untuk menjelaskan perubahan yang harus dilakukan pada sistem pendidikan sehingga sumber daya manusia yang dihasilkan oleh berbagai lembaga pendidikan dapat bersaing dan berkontribusi secara global. Jenis penelitian yang digunakan adalah penelitian kepustakaan. Pembahasan menunjukkan bahwa pengembangan kurikulum saat ini dan masa depan harus melengkapi kemampuan siswa dalam dimensi akademik, keterampilan hidup, kemampuan untuk hidup bersama dan berpikir secara kritis dan kreatif. Keterampilan tak kasat mata seperti keterampilan interpersonal, berpikir global, dan literasi media dan informasi. Selain itu, kurikulum harus mampu mengarahkan dan membentuk siswa dengan penekanan pada bidang STEM. Kurikulum mengacu pada pembelajaran berbasis TIK, internet of things, big data dan komputer, serta kewirausahaan dan magang. Ini perlu menjadi kurikulum wajib untuk menghasilkan lulusan yang terampil di bidang literasi, literasi teknologi, dan literasi manusia. Kompetensi yang harus dimiliki oleh guru adalah *educational competence*, *competence for technological commercialization*, *competence in globalization*, *competence in future strategies*, and *counselor competence*. Selain kompetensi ini, guru juga perlu memiliki keterampilan dan sikap yang bersahabat dengan teknologi, kolaborasi, kreatif dan mengambil risiko, memiliki selera humor yang baik, dan mengajar secara holistik. *Open Learning Platform* dapat dipertimbangkan oleh sekolah dan guru dalam memutuskan bagaimana pendidikan dan pembelajaran diselenggarakan.

Kata kunci: Revolusi Industri 4.0, Pendidikan 4.0

INTRODUCTION

At present, the world has entered the era of the fourth generation industrial, which was characterized by increasing connectivity, interaction, and development of digital systems, artificial intelligence, and virtual. With the increasingly convergent boundaries between humans, machines, and other resources, information, and communication technology certainly have an impact on various sectors. One of them is impacting the education system.

No one can avoid these changes, so it is necessary to prepare adequate human resources to be ready to adapt and be able to compete on a global scale. Improving the quality of human resources through education is a way to balance the development of IR 4.0.

The success of a country in facing the Industrial Revolution 4.0, is also determined by the quality of educators such as teachers. Teachers are required to have the expertise, ability to adapt to new technologies and global challenges. In this situation, every educational institution must prepare new information and literacy in the field of education. Old literacy that relies on reading, writing, and mathematics, must be strengthened by preparing new literacy: data literacy, technology, and human resources. Data literacy is the ability to read, analyze, and use information from data in the digital world. Then, technology literacy is the ability to understand the systems of mechanics and technology in the world of work, whereas human resource literacy is the ability to interact well, not rigidly, and with character (Aoun, 2018), (Sudlow, 2018).

Education is required that can form a creative, innovative, and competitive generation. One of them can be achieved by optimizing the use of technology as an educational aid that is expected to produce output that can adapt and change the era for the better. Without exception, Indonesia also needs to improve the quality of graduates according to the world of work and the charges of digital technology.

Education 4.0 is a response to the need for the Industrial Revolution 4.0, where humans and technology are converging to create new opportunities creatively and innovatively. Fisk (2017) explains "*that the new vision of learning promotes learners to learn not only skills and knowledge that are needed but also to identify the source to learn these skills and knowledge.*"

Still, according to Fisk (2017), as cited by Aziz Hussin (2018), there are nine trends related to Education 4.0. *First*, learning can be taken place anytime, anywhere. E-Learning tools offer great opportunities for remote, self-paced learning. *Second*, learning will be personalized to individual students. *Third*, students have a choice in determining how they want to learn. *Fourth*, students will be exposed to more project-based learning. *Fifth*, students will be exposed to more hands-on learning through field experiences such as internships, mentoring projects, and collaborative projects. *Sixth*, students will be exposed to data interpretation in which they are required to apply their theoretical knowledge to numbers and use their reasoning skills to make inferences based on logic and trends from given sets of data. *Seventh*, students will be assessed differently, and the conventional platforms to assess students may become irrelevant or insufficient. *Eighth*, the student's opinion will be considered in designing and updating the curriculum. *Lastly*, students will become more independent in their learning, thus forcing teachers to assume a new role as facilitators who will guide the students through their learning process.

Nine shifts in the trend of Education 4.0 above are the primary responsibility of teachers to students. Educators must play a role to support the transition and not regard it as a threat to traditional teaching. Adaptation to this educational trend guarantees individuals and communities to develop a range of

competencies, skills, and knowledge that are complete and expel all their creative potential.

Based on the description above, the 4.0 industrial revolution characterized by technological disruption has significant implications for the education system. The problem is, what components of education are affected, and how to respond to these implications? This paper is intended to describe necessary changes and adjustments made in the education system in order to respond to the spectrum of the digital revolution so that educational output can compete and contribute globally.

METHOD

The research method used in completing this paper is library research. A literature study is data collection techniques by conducting study studies of books, literature, records, and reports that have to do with problems solved (Nazir, 1988). Along with this opinion, Arikunto explained that literature studies in research are a method of collecting data by seeking information through books, magazines, newspapers, and other literature that aims to form a theoretical foundation (Arikunto, 2006). Data and information be obtained from scientific books, research reports, scientific essays, theses and dissertations, regulations, provisions, encyclopedias, and other written and electronic sources

Result (Discussion)

Industrial Revolution 4.0

The industrial revolution 4.0 is a concept that was first introduced by Professor Klaus Schwab. He is a famous German economist and initiator of the World Economic Forum (WEF), who through his book, *The Fourth Industrial Revolution*, states that the industrial revolution 4.0 can fundamentally change the way we live, work, and relate to one another (Schwab, 2016).

Richard Mengko, who cites from A.T. Kearney in Stevani H., (Medium, 2018), describes four stages of industrial evolution.

First, the first industrial revolution took place at the end of the 18th century. It is marked by the discovery of the first mechanical loom in 1784.

Second, the Industrial Revolution 2.0 occurred in the early 20th century. At that time, there was an introduction to mass production based on the division of labor.

Third, the beginning of 1970 was suspected as the premiere of the emergence of the 3.0 industrial revolution, which began with the use of electronics and information technology to automate production.

Finally, 2018 until now is the era of the 4.0 industrial revolution. Industry 4.0 is an industry that combines automation technology with cyber technology. It is a trend of data automation and exchange in manufacturing technology. In this era, the industry began to touch the virtual world, in the form of human, machine, and data connectivity, everything was everywhere or known as the Internet of Things (IoT).
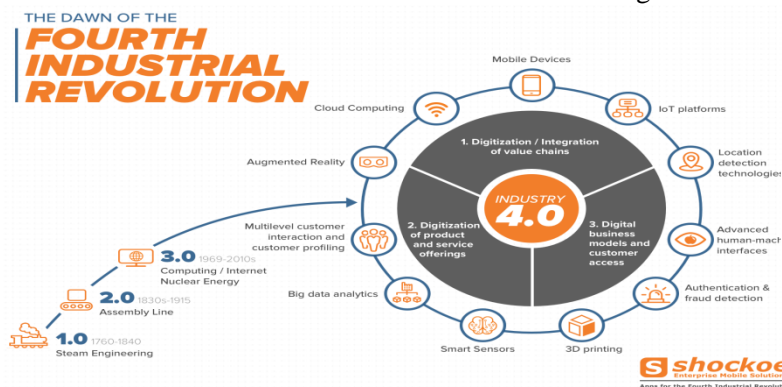
Figure 1. The Dawn of 4IR (Schwab, 2016)

Industry 4.0 then replaces industry 3.0, which is characterized by cyber-physical and manufacturing collaboration (Hermann at al., 2016; Irianto, 2017). Lee, Lapira, Bagheri, & Kao (2013) explain, industry 4.0 is characterized by an increase in digitalization of manufacturing driven by four factors: 1) increased data volume, computing power, and connectivity; 2) the emergence of analysis, capability, and business intelligence; 3) the occurrence of new forms of interaction between humans and machines; and 4) improvement of digital transfer instructions to the physical world, such as robotics and 3D printing. The basic principle of industry 4.0 is the incorporation of machines, workflows, and systems, by applying intelligent networks along the chain and production processes to control each other independently (Liffler & Tschiesner, 2013). One of the unique characteristics of industry 4.0 is the application of artificial intelligence (Tjandrawinata, 2017).

Education 4.0

Education 4.0 is a general term used by educational theorists to describe various ways to integrate cyber technology both physically and not into learning. It is a leap from education 3.0. Education 3.0 includes meeting neuroscience, cognitive psychology, and educational technology, using digital and mobile web-based, including applications, hardware, and software (Hussain, 2013). Education 4.0 is a phenomenon that arises as a response to the needs of the industrial revolution 4.0, where humans and machines are harmonized to obtain solutions, solve various problems faced, and find various possibilities for innovations that can be utilized to improve the lives of modern humans.

Dunwill (2016) said that there would be many changes in the future and estimating how classrooms would be seen in the next 5-7 years. (a) significant changes in classroom layout, (b) virtual and augmented reality would change the educational landscape, (c) Flexible assignments that accommodate many learning styles, and (d) MOOC and other online learning options will have an impact on secondary education.

The 21st century is a century of globalization. Therefore, learning content is expected to be able to reach 21st-century skills. *First*, learning and innovation skills include mastering diverse knowledge and skills, learning and innovation, critical thinking and problem-solving, communication and collaboration, and creativity and innovation. *Second*, skills digital literacy includes information literacy, media literacy, and ICT literacy. *Third*, career and life skills include flexibility and adaptability, initiative, social and cultural interaction, productivity and accountability, and leadership and responsibility (Trilling & Fadel, 2009).

Today, individuals aged 18 and 23, known as Generation Z (Gen Z) have changed due to technological advancements. This generation has learning preferences which are fully involved in the learning process. They welcome challenges and enjoy group discussions and a very interactive learning environment. For them, learning is unlimited; they can study anywhere and anytime and have unlimited access to new information. They pay attention to learning that involves active collaboration with the team and learning in places other than class. Also, the use of digital tools and online forums is becoming more preferred; they prefer to be integrated into their learning process. Because Gen Z students like digital tools, they hope they are available whenever they need them with low access barriers. These Gen Z students need to be prepared to develop in the 4.0 Industrial Revolution (Kozinski, 2017).

In his speech, Mendikbud RI Muhadjir Effendy at the National Education Day (Hardiknas) May 2, 2018, at University of Yogyakarta, said

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that the presence of the industrial revolution 4.0 made the world undergoing changes that were increasingly fast and competitive. He assessed that it was necessary to revise the curriculum by adding five competencies. *First*, students can think critically. *Second*, students are expected to have the creativity and have innovative abilities. *Third*, communication skills and competence. *Fourth*, the skill to cooperate and collaborate, and *finally*, students have confidence (Hafil, 2018). In addition to vocational education programs, the curriculum must adapt to the increasingly competitive business and industrial climate. Students are prepared with a curriculum that has artificial intelligent content (Pan, 2016), internet of things (IoT), wearable (augmented reality and virtual reality), advanced robotics, and 3D printing. In short, a compulsory link and match curriculum between schools and business and industry.

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The World Economic Forum (2016) has estimated the ten best skills for the future. Creativity will be one of the three skills needed by workers. With the massive movement of new products, new technologies, and new ways of working, workers must be more creative to benefit from these changes. Although robots can help to reach the desired place and destination faster, robots cannot be as creative as humans. The skill to negotiation and cognitive flexibility falls in sequence and is replaced by big data-based decision making.

Figure 2. Top 10 Skills in 2015 & 2020 (Schwab, 2016 & Alex Gray, 2016)

A survey done by the World Economic Forum's Global Agenda Council on the Future of Software and Society shows people expect artificial intelligence machines to be part of a company's board of directors by 2026. Active listening, which is considered a core day skill this, will disappear entirely from the top 10. Emotional intelligence, which is not included in the top 10 today, will be one of the top skills needed by all (Alex Gray, 2016).

Qusthalani was on the Rumah Belajar, as cited by Dinar Wahyuni, mentioning the five competencies teachers must prepare to enter the Industrial Revolution era 4.0. *First*, educational competence, s*econd*, competence for technological commercialization, *third*, competence in globalization. *Fourth*, competence in future strategies, and fifth, counselor competence (Wahyuni, 2018).

Meanwhile, Latip (2018) argues that there are at least four competencies that must be possessed by teachers in industrial revolution 4.0. First, teachers must be able to conduct a comprehensive assessment; second, teachers must have 21st-century competencies: character, morals, and literacy; third, teachers must be able to present modules according to students' passion; and fourth, teachers must be able to do innovative, authentic learning.

Learning and best practices must also be adapted, one of which is through integrated learning or blended learning (Graham & Dziuban, 2008). Blended learning is a way of integrating the use of technology in learning that enables learning that is appropriate for each student in the class, and allows reflection on learning" (Wibawa, 2018). Blended learning is one of the learning solutions in the revolutionary era of 4.0. According to experts, blended learning is a combination of online-based learning with face-to-face learning in class (Fitzpatrick, 2012; Wilson, 2019). It is a blend of real learning (physical) in the classroom with a virtual environment (Maarop & Embi, 2016). Definitions show that blended learning based learning is a combination of old literacy and new literacy (human literacy, technology, and data literacy).

Curriculum for Education 4.0

IR 4.0, which is full of fast technology, has brought significant changes, one of which is the education system. Changes in the education system will undoubtedly have an impact on curriculum construction, the role of teachers as educators, and the development of educational technologies based on ICT. There is a new challenge to revitalize our education in order to obtain competent, creative, and innovative human being who can compete globally.

There are many studies revealed that curriculum implementation in the field experiences degradation that comes out of context and is no longer oriented towards achieving students ability to understand science in the context of daily and life skills competencies, but only revolves around the target achievement academic values.

Alignment of learning at the level of practice adapted to curriculum constructs becomes the first focus of completing homework in the field of education. The curriculum policy must elaborate on students abilities in the pedagogical dimension, life skills, ability to live together (collaboration), and critical and creative thinking. It is promoting soft skills and transversal skills, life skills, and skills that are invisible, not related to specific technical and academic fields. However, it is widely useful in many work situations like critical and innovative thinking skills, interpersonal skills, global-minded citizens, and literacy of the media and information available.

It has been time for our curriculum to be reviewed and gradually develop an educational curriculum that can direct and shape students ready to face the industrial revolution era with an emphasis on the fields of Science, Technology, Engineering, and Mathematics (STEM) (Education, 2009). Also, there needs to be a reorientation of the curriculum; the curriculum must refer to learning in information technology, internet of things (IoT), big data and computerization, as well as entrepreneurship and internship in aspects of data literacy, technology literacy, and human literacy.

Teacher Competence & Skills for IR 4.0

The industrial revolution 4.0 had a significant influence on various fields, but not for teachers, doctors, nurses, and arts. The role of the teacher as a whole as an educator, teacher, mentor, and 'parent' in the school will not be wholly replaced by technological sophistication because the treatment of a teacher to students has a specificity that cannot be done by just anyone or replaced by technology.

Although the teaching profession does not have a significant influence with the 4.0 industrial revolution, teachers must not be complacent with the existing conditions; teachers must continue to improve themselves so they can become teachers who can produce better quality human resources. Therefore, other than those described by Wahyuni (2018) and Latih (2018), other

skills that teachers need to face of the Industry 4.0 era, are among others:

1. Friendly with Technology
   The world is changing and developing to a higher level, everyone will not be able to fight technology, so in order not to be crushed by it, teachers must have the willingness to learn continuously. Changes in the world by technological advances do not need to be a threat, but face positively, learn and adapt, and want to share with colleagues, both success and failure.

2. Collaboration
   The optimal results will be difficult to achieve if done individually without collaborating with others. Therefore, the teacher must have a strong willingness to collaborate and learn with and or from others. This skill is essential now and in the future. Doing so is not too tricky, because the world is already interconnected, so there is no reason not to collaborate with others.

3. Creative and Taking Risks
   Creativity is one of the skills needed in the Top 10 Skill 2020; creativity will produce a structure, approach, or method to solve authentic problems. Teachers need to model this creativity and undertaker how this creativity is integrated into their teaching. Educators also do not need to be too afraid of being wrong but always ready to face the risks that arise. Mistakes are things that are often faced when starting learning activities, and do not need to be obstacles to progress; errors must be corrected.

4. Have a good sense of Humor
   A laughter and humor teacher is usually the teacher who is most often remembered by students. Laughter and humor can be essential skills to help in building relationships and relaxation in life. It will reduce stress and frustration while providing opportunities for others to see life from the other side.

5. Teaching Holistically
   In various learning theories, we recognize individual and buzz-group learning. Moreover, lately, individual learning and learning preference is increasing. Therefore, the present teachers need to recognize students individually, including their families and the way they learn (know them in their entirety, including the obstacles they experience both personally and within their families).
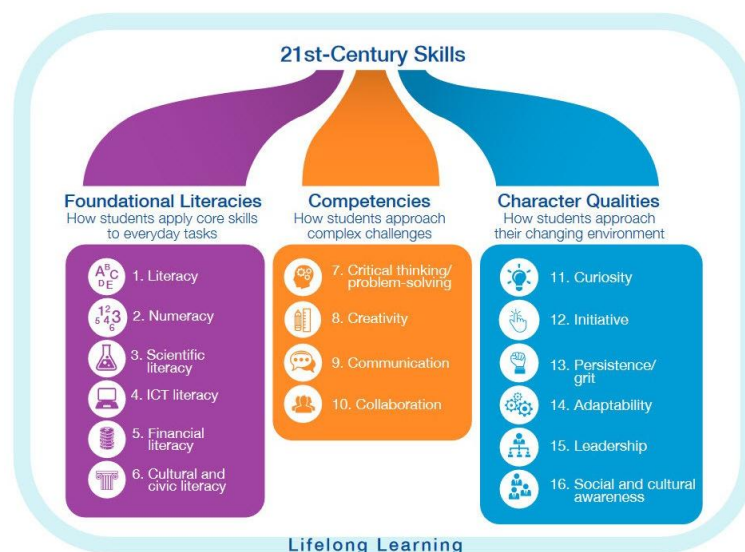

Figure 3. 21st Century Skills (World Economic Forum, 2016)

Open Learning Platform

Based on the 2015 World Economic Forum Report, there are 16 skills students need for the 21st century (Figure 3).

The figure above shows that to get to the 21st-century, students need learning that is no longer just traditional academic learning. It is an education that offers learning services that enable them to collaborate, communicate, and solve problems, think critically, creatively, and innovatively. The competence and skills can only be realized through mixed learning, e-learning, and face-to-face, or known as blended learning (Kristanto et al., 2017). This learning model requires the optimization of technology involved in learning that is expected to be able to obtain creative, innovative, and competitive graduates to face the era of industrial revolution 4.0.

Indicates that the involvement of technology in learning is no longer just a discourse or limited to a vision, but must be a real action at all levels of education ranging from basic to higher education. The problem is the low quantity of educational institutions that organize learning based on information, computers, and technology. Our schools, mainly in remote areas, are difficult to get out of conventional learning models. It is indeed not without reason, including concerning lack of human expertise and educational infrastructure. This situation, cannot be maintained, the system and learning model must be transformed through the use of educational technology, the expansion of the learning process that transcends the boundaries of classrooms by increasing the interaction of students with the surrounding environment. Moreover, this can only be realized if there is a shift in mindset and action in various contexts in the implementation of education and learning.

To face learning in the 21st century, everyone must have critical thinking skills, knowledge, and digital literacy skills, information literacy, media literacy, and master information and communication technology (Frydenberg & Andone, 2011), including educators (teachers/lecturers). The use of various learning activities that support Industry 4.0 and the disruption of technological innovation is a must with resource sharing models with anyone and anywhere, class and labs augmented with virtual materials, interactive, challenging, and content-rich learning is not just complete.

One of the emerging technologies in the field of education today is augmented technology and virtual reality (AR/VR), has begun to be adopted as a medium of learning in the classroom and also research aids in the laboratory (Zhu, 2016). AR/VR technology can be used to support education and improve student learning effectiveness. For example in the process of learning mathematics related to the topic of discussion of geometry, learning biology material with the topic of human digestive systems, the process of cell division, it is learning activities and experiments imitating various objects that are around, and for other learning complex and challenging to do real. Learning media that use this technology can quickly improve students' understanding because of 3D objects, text, images, videos, audio can be displayed to real students.

As students need increase for individual learning experiences, here, students have choices in determining how they learn. Students will potentially modify their learning process with the tools they feel are necessary. Students will learn with different tools, programs, and techniques based on their preferences. At this level, schools and teachers must be open mind to the concept of the flipped classroom, and students bring their learning tools (bring your own device / BYOD). The involvement of the community (parents) in the context of BYOD will fill the shortage of schools (educational institutions) in terms of providing ICT infrastructure in education.

Paradigm shifts and action in various contexts in the implementation of education and learning is a necessity. The logical consequence of this ever-evolving technological innovation demands a modification of the concept of class management and learning methods so that it fits the expectations, learning styles, and interests of students. At present, blended learning has become the preferred learning strategy for all grade levels. Moreover, it is increasingly popular because it effectively combines the benefits of conventional learning with e-learning.

Recently a study conducted by Jennifer Rogers (Associate Professor) from the University of Iowa (USA) found that the learning process that applies blended learning is more effective than lectures (face-to-face) in class or e-learning only. Roger explained that more than 95% of students were enrolled in the blended course section received a grade of C- or more compared to 82% in the lecture classroom sections and 81% were enrolled online only (Jarman, 2019). Also, blended learning creates learning independence and student academic responsibility; preparing students to face a technology-centered world, saves on the costs of online learning, enhances collaborative, exciting and fun skills and triggers full (physical and socio-emotional) involvement of students in the learning process.

Various studies have shown that memorization is not an effective learning strategy. Also, teacher-centered learning is not the most efficient approach to student involvement. However, apart from learning about the skills that students need to be successful in the 21st century, schools and teachers need to find out what roles are needed to be in 21st-century education.

The role of education is to prepare students to become active, successful, and contributing members of society. However, there are necessary changes that must be considered; the community has changed. The responsibility of schools and educators is to prepare students to be able to compete and play their role amid the global community. Schools and teachers can consider the following aspects to organize education and learning.

1. Student-centered Learning
   Student-centered learning means that teachers are no longer the only primary source of knowledge in the classroom. In order to be able to compete and contribute to the global community in the future, students must be able to obtain new information when problems arise (learning how to learn). Then, they need to connect new information with the knowledge they already have and apply it to solving existing problems. In this class model, the teacher will act as a facilitator for students, students will collect information and knowledge themselves, under the guidance of the teacher. Teachers must accommodate student learning styles because this can increase learning motivation and student academic responsibility. They are involved in various types of direct activities and show learning in various ways. Learning is about discovery, not memorizing facts.

2. Collaborative Learning
   Students need to be encouraged to work together to find information, collecting, and build meaning. Each student has different strengths, and talents, and how to recognize the different strengths and talents that everyone has brings to the project, and changing roles depends mainly on the extent to which the school, teacher, and students develop collaborative learning.
   It is time to collaborate to become a tradition in various learning activities. Encouraging students to collaborative learning with people around the world can provide them with the future to work with people from other cultures, with values that are different from their own. Schools

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must also collaborate with other educational institutions around the world to share information and learn about various practices or methods that have been developed. They must be willing to change their teaching methods in light of new advances.

3. Meaningful Learning

Student-centered learning does not mean that the teacher gives up all control of the class. While students are encouraged to learn according to their learning styles, the teacher still guides skills that need to be acquired. Teachers can make essential points to help students understand how the skills they build can be applied in their daily lives. Students will be more motivated to learn something useful and valuable to them. Teachers need to teach and train students skills that are useful in any situation. Lessons have no meaning if they do not affect the lives of students outside of school.

4. Integrated with the Community

With the internet, students today can do many things. The school community no longer only covers the area located in the school environment, but reaches all over and covers the world. Education needs to help students to be able to contribute to the global community and find ways to have an immense impact on their environment. That is, besides learning about values helping others around them and protecting their closest environment, but they also have to learn about how they can help and protect the world far from them. To prepare students to be responsible citizens, schools need to educate students to become responsible citizens. Through the activities of the school community, students are encouraged to take part in these activities or projects, and occasionally help communities around them with diverse social activities.

One of which is the presence of learning activities at different times and places Fisk (2017), supported by online learning, some of the following simple ways can be integrated into blending learning, among others:

1. *Flipped Classroom*

Flipped Classroom is a learning model that reverses traditional methods. The concept of Flipped Classroom includes active learning, student involvement, and podcasting. In the flipped classroom, the subject matter is given through learning videos that students must watch in their homes. Instead, classroom learning sessions are used for group discussions and working on assignments. Here, the teacher acts as a coach or advisor (Lowell Bishop & Verleger, 2013).

2. Integrating Social Media

By integrating social media, students can demonstrate mastery of content through various digital tools such as blogging, Facebook, Skype, YouTube, or video conferencing. Classmates have the option to continue to share knowledge and interact with each other far beyond the hours spent in class, and online discussions can be exciting (Yeo, 2014).

3. Khan Academy

Khan Academy is a free website where students can access thousands of tutorial videos, along with interactive practice exercises, in almost all subjects. It is an excellent site to use in class for students who need improvement or acceleration. The teacher has the option to create a class account, and the teacher can monitor the progress of each student by accessing data on the completed exercises. From these data, it will be known that the field of strength and the problem areas of the students (David, 2014), (Murphy et al., 2014).

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4. Project-Based Learning (PBL)
Project-based learning is a learning model that implements learning with projects. The intended project is a task that must be completed within a specified period. The task is in the form of an investigation from data collection, organizing, evaluation, to presenting data. This project-based inquiry activity can be carried out by students at school after students. So they can spend most of their class time working collaboratively with their team at school (Bell, 2010).

5. Moodle
Moodle is a course management system that gives teachers the option to send assignments, lectures, videos, and more. Students can interact with each other through discussion forums, private messages, and chat rooms. Students can upload tasks completed by attaching files. Inputting test scores to the class book at the same site, and students can also see the feedback given by the teacher. Moodle performs well when used in addition to face-to-face learning (Cole & Foster, 2007), (Setiyorini et al., 2017).

6. Schoology
Blended Learning based on Schoology can be a solution to overcome the learning process that requires many theories. Blended Learning based on Schoology is learning that combines face-to-face learning in the classroom and online learning using Schoology application outside of school hours. Students who used Blended Learning based on Schoology get more new theories outside school hours individual so that the face-to-face meetings to provide the theoretical material can be reduced and replaced with a practicum to the student. (Irawan et al., 2017).

7. PLATO Academy
PLATO academy is one of the online learning options outside the traditional school domain. Middle school students can stay in school and get the credit needed for graduation. PLATO classrooms offer independent courses that students can use to complete both at school and home. This course uses tests to place students in the appropriate class, and they have the opportunity to master the content and meet the stringent academic standards set by the school district. A trusted teacher facilitates this course, and after completion, students can obtain course credit (https://platoacademy. net).

The advanced of technology also does not hurt changes in attitudes, behavior, and character of students. Among them are internet addiction and lazy learning due to online games and watching, losing playing time with children of the same age because they are more focused on digital devices, making the lack of balance in children's social life, even potentially reducing academic achievement. This medium, the teacher plays an essential role in shaping the character of students. Teachers are expected to not only transfer knowledge but more than that attitude and spiritual development so that there will be a balance between intellectual competence and mental attitudes and competencies.

CONCLUSION
Industrial revolution 4.0 has changed the way of thinking about education. Changes made are not just a way of teaching, but far more necessary is a change in the perspective of the concept of education itself. There will affect adaptation and renewal to almost all educational components such as curriculum construction, improvement of teacher competencies and skill, and the involvement of technology into the learning process. Therefore, the development of current and future curricula must elaborate on the abilities of students in the pedagogic dimension, life skills, and the ability to live together

and think critically and creatively. Promoting soft skills and transversal skills, life skills, and invisible skills, not related to specific technical and academic fields. However, it is widely useful in many work situations like critical and innovative thinking skills, interpersonal skills, global-minded citizens, and literacy of the media and information available. Also, the curriculum must be able to direct and shape students ready to face the industrial revolution era with an emphasis on the fields of Science, Technology, Engineering, and Mathematics (STEM). Curriculum reorientation that refers to ICT-based learning, internet of things, big data and computerization, as well as entrepreneurship and internship, this needs to be a compulsory curriculum to produce skilled graduates in literacy, technology literacy, and human literacy aspects.

To ensure the adjusted curriculum is implemented optimally, then the competencies that must be possessed by the teacher at the same time to enter the era of the Industrial Revolution 4.0. *First*, educational competence. *Second*, competence for technological commercialization. *Third*, competence in globalization. *Fourth*, competence in future strategies. At least counselor competence. In addition to these competencies, teachers also need to have skills and friendliness with technology, collaboration, creative and taking risks, having a good sense of humor, and teaching as a whole (holistic).

Several things need to be considered by the school and the teacher in deciding how education and learning held. That is (1) The learning approach must be student-centered learning, (2) Learning must be collaborative, (3) Meaningful learning, and (4) Integrated with the community. To support the education and learning process in question, ways such as (1) Flipped classroom; (2) Integrating social media (3) Khan Academy (4) project-based learning, (5) Moodle, (6) Schoology,

and (7) PLATO Academy), can be integrated into the learning process.

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