

Fourth Industrial Revolution and Educational Challenges

by Mirna Ari Mulyani & Abdur Razzq 1

Submission date: 26-Aug-2021 10:13AM (UTC+0700)

Submission ID: 1636071657

File name: plagiat_p_rozaq_n_bu_elok.pdf (240.65K)

Word count: 4054

Character count: 23161

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6 Firma Ari Mulyani
Dept. Dakwah & Communication
Universitas Islam Negeri Raden Fatah
Palembang, Indonesia
mirnaarimulyani_uin@radenfatah.ac.id

Syamsu Yusuf
Dept. Education Psychology &
Counseling
6 Universitas Pendidikan Indonesia
Bandung, Indonesia
syamsuyusuf@upi.edu

Pahri Siregar
Dept. Dakwah & Communication
IAIN Padangsidempuan
Padang, Indonesia **17**
pahrisrg@iain-padangsidempuan.ac.id

Juntika Nurihsan
Dept. Education Psychology &
Counseling
6 Universitas Pendidikan Indonesia
Bandung, Indonesia
juntikanurihsan@upi.edu

Abdur Razzaq
Dept. Dakwah & Communication
Universitas Islam Negeri Raden Fatah
Palembang, Indonesia
abdurrazzaq_uin@radenfatah.ac.id

Muhammad Anshari
School of Business & Economics
Universiti Brunei Darussalam
BSB, Brunei Darussalam
anshari.ali@ubd.edu.bn

29 *tract*— The paper attempted to discuss on the impact on the educat**32** system in the Industrial Revolution 4.0 era (IR 4.0). The IR 4.0 has changed the technological innovation environment in which it is controlled by artificial intelligence and digital physical frameworks which make interface between humans and machines more universal. Innovation's rapid **15** plution has provided another education model for the **15** are (Education 4.0). In order to prepare graduates for **4** ure life and work accomplished through IR 4.0 where more smart robots will replace people in certain di**4** ions of service or jobs, education should leverage relevant information and **4** pertise that could not be replaced by robots. Innovation interruption that creates Education 4.0 based on educational growth and skills has made future learning more custom, hyper, smarter, flexible, worldwide and interactive. As cutting edge educators, to improve future learning, we need to explore new and creative approaches to using educational creativity. In **8** is regard, this introduction hypothesizes the necessity that **8** chers re-examine their old teaching and learning originations, and update or upgrade the learning experiences of their understudies so that they meet the requirements of Education 4.0.

Keywords— industry 4.0, fourth industrial revolution, education 4.0

I. INTRODUCTION

Due to the fast development of technology, we are getting more and more connected globally, allowing for communication and relationships to occur across physical barriers, through the use of digital platforms and systems. As we are moving forward to a world where technology is advancing every day, it is not just humans that is getting more connected, even machine become more connected, allowing for transfer of information from one machine to another which lead to share of information and data in huge volume which increase capacity of machine to analyses and perceive data, thus making them smarter which lead to smart machine that is able to function by themselves without any input from human. This leads us to Industry 4.0 which is also referred to as the Fourth Industrial Revolution in which manufacturing processes become more digitalized through use of self-learning machine, AI, automation and robot [1].

Today information comes in all shapes and sizes, and is constantly uncontrollable. The arrival of millennial generations or (Gen-Zs) with advanced intelligence and technical capabilities has caused teachers with various

difficulties. The present Gen-Zs report in a dialect that may not fully understand more established generation; they have a computerized genre of their own genre. They have their own particular ways of thinking and communicating themselves.

Millennial generations take advantage of the tremendous web assets and computerized innovations to make something imaginative, inventive and expressive despite digital security issues [2]. These techno-addicts and the generation of Wi-Fi are also inclined towards an intelligent way of dealing with learning that combines data through the joining of frames by means of a complex montage of images, icons, sound, video, recreational activity, diversions and Artificial Intelligence (AI) [3]. Using flipped classroom, MOOCs, and chartroom, computerized education and mixed instructional methods are still necessary to support learning in this advanced age [4, 5].

While, the Fourth Industrial Revolution or 4IR transformed the landscap**4** of educational technology [6]. The rapid knowledge shifts have developed the new model of education for the future. Speed, fusion of various technologies, width and depth, and return to scale make the 4th IR different [7,8].

Since there are not many discussions on this topic, therefore, this paper looks into how education system could implement education 4.0 by looking at the skills set that will be crucial in industry 4.0 and the different learning approach that education 4.0 offered that could be beneficial for education system.

II. LITERATURE REVIEW

A. Industrial Revolution

Industrial revolutions are the backbones that support our routine and very daily life which led to significant improvements. In the history of the revolutions, there were four main and major industrial revolutions namely as Industrial Revolution 1.0 to 4.0. In addition, before the industrial revolutions happened, the period was known as Agrarian Revolution.

Industrial Revolution 1.0; the industrial revolution or also known as First Industrial Revolutions occurred in the years from 1760 to sometime in between 1820 and 1840 whereby the introduction of new manufacturing processes in Europe and United States. During this period, the establishment of steam power and mechanization productions were

thoroughly used. With these establishment, the steam power replaced muscle power by humans and increased human productivity drastically in the industry. Basically, human labor was cut down and products that were usually handmade could finally be mass produced by machines in factories such as textiles, iron making and many others [9]. Education during the first industrial revolution, formal education reached the poorest people as it was not available during the pre-industrial society.

Industrial Revolution 2.0: As the second industrial revolution made its way through the 19th century with the discovery and establishment of electricity and assembly line production. The idea behind this revolution came from Henry Ford whereby he took the concept of mass production of a slaughterhouse in Chicago. He then applied the concept into his automobile production and created a huge impact in the process of automobile industry in which cars were assembled in one station to another with steps through a conveyer belt. This drastically improved the effectiveness and efficiency in car production. Overall, the concept was eventually used in most factories to cut down time and to do mass productions [10].

Industrial Revolution 3.0: in the 20th century, the third industrial revolution came in place that was during the period of the early 70s. Partial automation was possible with the usage of electronic devices that were programmable by computers. Human assistance was replaced by these technologies and the production process was finally able to be automated. Programmable Logic Controller (PLC) appeared [11].

Industrial Revolution 4.0: currently, we are considered to be experiencing in the ongoing process of the fourth industrial revolution. In short, also known as Industry 4.0, it continues on the progress and development from the third industrial revolution. This era focuses on wireless connectivity and sensors that are connected to a system which can monitors a whole line of production and does decision making on its own without human assistance therefore, smart factories. In the industry, it is also the era of Cyber Physical Systems (CPS) that comprises smart machines, storage systems and production facilities. With the autonomous exchange of information and independent of control, these are possible with the activities of IIOT (Industrial Internet of Things) consisting of numerous sensors performing in real time and exchanging data at the same time into a local or cloud server. An example of industry 4.0's application in the medical world is surgery made possible by doctors remotely from far away hence the term 'smart surgeon'. Basically, doctors use a control to the robots with strong connection and bandwidth to execute a real-time surgery [12].

B. Jobs in Industry 4.0

The term industry 4.0 was coined by the German government back in 2011 at the Hannover Fair which was present as intelligent production. Hence Germany is taking the lead with the aim of combining information technology and industry. In industry 4.0 not only affects the business and governance but education as well hence the name Education 4.0 [13]. With the rapid development of IR4, it has disrupted most industries worldwide. Opportunities that are being brought forward by IR4 would be a better-quality lifestyle

from the technology, new products and markets, enhanced health services leading to longevity [14].

Figure 1 shows a job matrix diagram which serves to differentiate the types of occupation that require compassion in preserving human identity or machinery and technology that provides optimization. This job matrix diagram could be proven useful and be utilized by organizations in developing strategies to cope with and meet the demands of Industry 4.0. The diagram further distinguishes the essential qualities of the occupation between 1) machine to machine interaction, 2) human to machine interaction 3) complex human to human interaction and 4) routine human to human interaction [15].

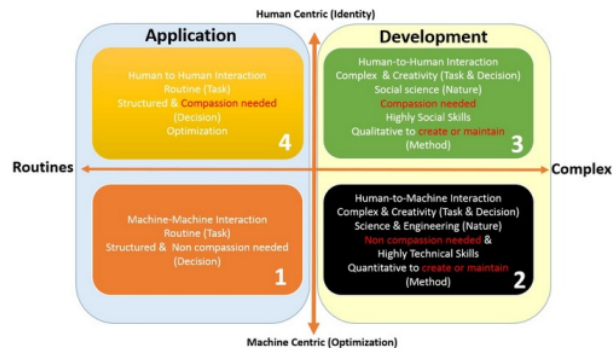


Fig. 1. Job Matrix Fourth Industrial Revolution (Source: Anshari, 2020)

The first dimension of the job matrix is the machine to machine interaction. The nature of these tasks require structure and does not require compassion. An example of such tasks is the assembly line involved in lean industrial manufacturing processes. Given how these tasks does not require expert skills, it can easily replace humans by performing repetitive, dull and simple tasks simultaneously helping organizations in increasing production consistency, speed and save operating costs. The human to machine interaction dimension is concerned with tasks that need creativity and complexity. Different from the routine human to human interaction and complex human to human dimensions, tasks that are concerned with human to machine interaction dimension does not require compassion yet require highly technical skills and are quantitative-oriented. An example of such jobs are bookkeeping clerks in which these roles are increasingly becoming automated. Computer applications such as Microsoft Offices, QuickBooks and FreshBooks offer programs that serves to execute bookkeeping for the organization, in turn increasing its effectiveness and efficiency.

For the complex human-to-human interaction dimension, these types of jobs are impossible for machines and technology to carry out as, other than requiring compassion, it also requires human creativity. An example of such jobs includes human resource managers which will always require humans to assume the role so as to make managing interpersonal conflict possible with the aid of reasoning and non-cognitive skills. Jobs that are complex that requires creativity, compassion, decision-making skills and innovation, such as those that are related to the two dimensions explained prior, will still be performed by humans throughout the fourth industrial revolution. Finally,

for the routine human to human interaction dimension, these tasks need compassion and structure for e.g. jobs that involve decision making skills such as managers or leaders. Take the example of sales managers, a job that necessitates high degree of emotional intelligence in order to network and work with customers, meet monthly quotas, interpret trends, analyze data and incite motivation among their sales team. In addition, sales managers are expected to adapt to unexpected changes and new situations, a valuable quality of which machines could not execute [15].

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changes and new situations, a valuable quality of which machines could not execute [15].

III. METHODOLOGY

The methods of this study is mostly derived from extensive literature reviews of journal articles to accommodate the development of the research on this topic and the most relevant information in regards to the study on Industry 4.0 and Education 4.0. Articles and research papers in English language were used in this paper. The concept that arises in Figure 1 was derived from systematic analysis and synthesis of the interaction between humans and machines in the context of IR 4.0.

IV. DISCUSSION

In order to define or explain Education 4.0, it is imperative to first explain what is Industrial 4.0. Throughout history, mankind has gone through four industrial revolutions in which the first one occurred in the 1700s where production was mechanized through the use of water and steam [16]. The second industrial revolution happened in the late 1800s in which mass production was facilitated by electricity. The third industrial revolution came about in 1969 where information technology and electronics served to automate production. Finally, the fourth industrial revolution, commonly known as Industry 4.0, brought upon a much more sophisticated and advanced new technology beyond those of which exist during the third industrial revolution and has blurred the lines between digital, physical and biological fields. Due to the fact these technological advancements are rapidly evolving, there have not been any official record that marked the start of Industry 4.0. Thus, the reason why these technologies are known as disruptive technologies such as the internet of things (IOTs), bio and nanotechnology, artificial intelligence, autonomous vehicles, robotics, quantum computing, 3D printing, energy storage and material science [14].

Given how Industry 4.0 had transformed the world through its advanced technologies, it had brought upon chances to major industries, including the way how jobs and education are performed and prepared for e.g. transforming the nature of manually performed jobs by replacing it with machine-handled tasks. Thus, the education system must prepare its current students with the necessary and relevant skills and knowledge to produce a workforce that are inherently capable and competent to work in the present technologically-driven era. This had prompted a revolution in education which made the learning process more peer-to-peer, personalized and a continuous process. The learning process involve the alignment of both technology and humans which enable new opportunities and possibilities [17]. Moreover, it allows the deployment of future open-source content, digital technologies and personalized data, as well as the creation of blueprints for future learning processes for e.g. from initial school-based learning to workplace learning.

Education 4.0 is an advanced education regarded as changes in the conventional teaching in Universities whereby teaching students on things related with technology should be included with the utilization of technology [18, 19]. Similarly, Education 4.0 focuses on the potential of digital technologies, personalized data, open sourced content and

the recent state of mankind where everyone is technologically connected [17].

Education 4.0 is often connected to smart learning. Smart learning environments are based on Information Communication Technology (ICT) that are centered on learners who can use the eco-system and adopt learning styles as well as learning abilities [20]. Furthermore, smart learning environments are high levels of digital environment that are considered convenient, engaging and results in effective learning. Simply put, it is a learning environment that can be accessed at any time, in any way and with any pace.

Education 4.0 can be related with 4IR as both have similar key idea which is the utilization of technology. 4IR has resulted in the emergence of Education 4.0 due to the need of alignment between human and technology to yield new possibilities [13]. Thus this basically shows that the emergence of 4IR has brought disruptive innovation to all sorts of industries including Education whereby in order to keep up with 4IR, the need to practice Education 4.0 is crucial. This is especially important for the future generation to be successful in their life.

To have Education 4.0, first of all, technologies must be made available and can be accessed by all in order to fulfill the students' needs. For instance, information must be more accessible and to ensure there is connectivity, the internet plays an important role. There are user-friendly modes of learning such as Learning Management Systems that is accessible for all students, as long as they have a valid authorization. For a better experience, there is a free internet for all students in many placeless which makes it easier for students to communicate. When students engage in online discussions, there is a machine-machine interaction taking place even though without the presence of each other in the real world.

The usage of smartphones can be also use learning aids in the classroom mainly due to its convenience, portability, comprehensive learning experiences, multi-sources and multi-tasking as well as being environmentally friendly [7, 15]. LMS partnered with smartphones can give a better learning experience for all students as they can be accessed at any time and place. Therefore, the smartphones are not just for communication purposes or payment methods but also as a sophisticated learning aid.

Basically, the roadmap for Education 4.0 is not always about how sophisticated the technologies are but more to how learners such as students can utilize the technologies. However, due to the digital environments of different households, not all student-learners have the privilege to incorporate technologies. Therefore, for Education 4.0 to take place, digital technologies such as the internet of things (IoT), among others, must be accessible and complimentary to the needs of the students.

4IR is the automation and interconnectivity of everything (IoT) where everything will be digitized and run by machines and sensors in order to ensure efficiency and productivity [21]. Thus, some pools of human capital will be deemed redundant and replaced by automations. The need for retraining these human capital and equipping future generations with necessary skills are crucial. Thus, to compensate for the change in educational system, knowledge management and creation will need to be revised.

The current educational system will be replaced, parallel to the implementation of IR4.0, into a more efficient way of learning, called Education 4.0. Inevitably, Education 4.0 will change the landscape of traditional education where there will be enhancement of interactions and communication between the teachers and students by means of utilization of technological devices i.e. teleconferencing using smartphones, from all parts of the world. Moreover, the learning process would be more personalized and tailored to the needs of the learners and the teachers, that would fit to their lifestyles and orientation i.e. part-time students' vs. full time students, but with the same or better impact on knowledge understanding in comparison to traditional learning methods.

The main pointers of Education 4.0 are able to cater to the needs of Industry 4.0, where the workforces (humans) and automations (machines) are to be integrated open up to more possibilities, diverse utilization of digital technologies, open-sourced contents and personalized data in this ever connected and technologically driven world, creation of new learning models or blue-prints, in replacement of the traditional school-based learning methods

V. CONCLUSION

Based from the context above, Education 4.0 is the new way of teaching students replacing the conventional way of teaching with the utilization of technology. Apart from this, Education 4.0 exposes students with areas related with technologies such as cyber-physical systems through their learning. Education 4.0 is important to be practiced in today's world as it helps to prepare students for the future that revolves around advancement of technologies.

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