International Journal of Engineering & Technology, 7 (4.19) (2018) 252-255

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Current Trends Overview on Malaysian Higher Education System towards Industry 4.0

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Abstract

Industrial revolution has taken its place globally with the term of Industry 4.0. Moreover, it triggers the new term of Education 4.0 as one of the impacts which came from the education sector. The aim of this study is to provide a view of the current trend in the industrial revolution – Industry 4.0, Education 4.0, followed by the look on higher education system in Malaysia. Focused on the efforts made by the Malaysian government of higher education (MoHE), it is shown that Malaysia is aware on this current global issue and is preparing to implement Industry 4.0 and Education 4.0 to their current system.

***Keywords*:** *Industry 4.0; Education 4.0; Higher-level Education*

1. Introduction

Technology has been and keep on evolving over time. Nowadays, everything could not be separated from technology, especially in the industrial sector. Current technology has brought into the industry which initiate the new industrial revolution named Industry 4.0. Research into Industry 4.0 has been going on in the past few years. The first term of Industry 4.0 was coined by the Germany as "Industrie 4.0" in 2011 [1] and it is considered as a great spark among the experts which led to ideas formation of a new industrial revolution. Industrial revolution has taken places and evolved in several steps since almost 200 years ago [2]. Table 1 shows the duration and movements on how industry has evolved from 1.0 up to the latest 4.0.

Table 1: Industry 1.0 to 4.0 Comparison

Industrial Revolution	Duration	Technology
Industry 1.0	Late 18th century	Mechanical production using water and steam power
Industry 2.0	Beginning of 20th century	Electrical production line
Industry 3.0	Beginning of 1970s	Digital automation
Industry 4.0	Present	Cyber-physical system

1780s was the initial year where water and steam power machines hit the mechanical production. The textile industry was the first field which experienced the impact of this first industrial revolution [3]. Ever since the industry 1.0 taken its place, the productionline has been massively increased.

This is followed by the second revolution which is industry 2.0, where the electricity has entered the industry in the beginning of 20th century. Henry's Ford first model T production process is the climax factor of the revolution along with the introduction of conveyor belt and higher labour demand in the manufacturing system.

Industry 3.0, the third industrial revolution, started when industry implemented the use of programmable electronic devices. The programmable devices higher the efficient and flexibility of production in digital automation. This revolution is still run today in modern automation system.

Industry 4.0, the latest revolution in the industry field which has been a big issue discussed in the past few years. There are two development directions which can define Industry 4.0 expected situation in the future [2]. The first direction is application-pull which refers to the need for changes in order to adapt on changing operative framework conditions. This direction leads industry towards flexibility in product development, shorten the product development time, and individualization of products by customers. While the second direction, known as technology-push, leads toward enhancement of automation, mechanization, digitalization, and networking in the industry. This direction focused on the technology used in the current time industry and manufacturing including the strategy on how to improve it.

In the Industry 4.0, there will be a fundamental paradigm shift caused by the combination of Internet technologies and future-oriented technologies. Devices, machines, sensors, and people are planned to be able to communicate with each other by using Internet technology known as Internet of Things (IoT) [4]. This process is known as cyber-physical system (CPS) where the whole elements in the system, machines-to-machines and machines-to-humans, could communicate with each other from the production to consumption process [5].

This industrial revolution will take impacts on many of other fields besides manufacturing, such as workforce recruitment, information and communication technology (ICT), business, education, and many more. The impact of Industry 4.0 on workforce recruitment is expected to be quite significant since the requirements of the talent needed will be changed. Talents will be required to possess some basic technical qualifications in Industry 4.0, including information technology (IT) knowledge, organizational and processual understanding, and ability to interact with modern interfaces.

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Industry 4.0 in business sector has made the small-medium enterprises (SMEs) face difficulty as they are not highly skilled in applications and technologies surrounds Industry 4.0 [6]. The cause of this situation is that most of SMEs do not have high qualification staffs who possessed all the basic skills to cope with current technology. In addition, most SMEs are not willing to invest more on the current technology which is uncertain whether it's a loss for their business.

In education sector, Industry 4.0 has taken a wheel for a big change. The industry will demand higher qualification candidates to be working in this new era of industrial revolution. Education sector acts as a provider of the candidates will have to adjust the way of training the students in order to prepare them to be a qualified candidate for the industry in the future [4]. Align with this, there is a term arise among the researchers and education practitioners which is Education 4.0. This term has been the starting point to the education system for a reshuffle.

Malaysia as a developing country, inevitably will face the same issue with Industry 4.0 and Education 4.0. Therefore, this paper aims to provide an overview on Malaysian higher education system towards the Industry 4.0. This paper includes a literature review of Industry 4.0 and Education 4.0 since in year 2011 followed by the new trends. There are various online sources used in this paper including Google Scholar, Science Direct, news articles, and Mendeley software. Since the topic of Education 4.0 is considered new, the snowballing method is used to gather more sources as possible.

The organization of this paper consists of 5 sections: Section 1 describes the industrial revolutions including Industry 4.0, followed by section 2 describes the Education 4.0 and section 3 describes the Higher Education in Malaysia. Section 4 will be about discussions and followed by section 5 for the conclusion and future work.

2. Education 4.0

Education 4.0 is a term that has become a public discussion during the rise of Industry 4.0 since it is inevitably influenced almost everything especially education field. Industry 4.0, in a certain sense, will demand more from the current education system along with the technology and the teaching method.

2.1. Education Revolution

Similar to Industry 4.0, education revolution could be categorized based on the level it has been evolved in the past centuries as it shown in Table 2. The evolution of education has started since decades ago – or even centuries ago – where the teaching activities were still conservative and mainly passive. Teacher acts as source of knowledge where students receive the information given.

Teaching and learning process in education have been evolved along with the development of technology. It is clear that teachers and students have their own roles to play in education system. Moreover, the vision towards Education 4.0 has been sculpted since almost a decade ago. In his paper, Harkins described the paradigm and practices of educational "Leapfrogging" [7]. Leapfrogging means to get ahead of the competition or the present state of the art through innovative, time-and-cost-saving means.

Table 2: Education 1.0 to 4.0 Comparison [7]

Education Revolution	Methods	Technology
Education 1.0	Dictation Instructivism Direct transfer of information	Not allowed during education process
Education 2.0	Progressivism Begins to open to internet access	Limited access
Education 3.0	Knowledge producing Co-constructivism	Full access for knowledge construction and transmission
Education 4.0	Innovation producing Replacing classrooms	Always changing Learners as major source technology evolution

In education 1.0, the learning process has been done in a classroom where teachers act as a knowledge-source while students act as knowledge-receiver. The method used is known as instructivism where the students receive knowledge passively, not much interactions happened during the process [8]. All of the learning processes mainly based on the teacher's decisions on what and how to deliver the knowledge.

Education 2.0 started with the booming of Web 2.0 which is acknowledged this education revolution [9]. Web 2.0 provides high interaction for users and the initial point of social media growth. Education 2.0 is based on progressivism where the knowledge not only transferred by teacher to student but also student to student. Internet became one of the sources used in learning activities. However, the access to internet is still limited.

Education 3.0 is the third revolution in education where it is happening nowadays. In this era, teaching methods are widely involved technology as the medium to create and transfer knowledge. There are not only licensed professionals titled as teachers who could conduct the learning activities, but everyone who has source of materials for knowledge production.

Education 4.0 is catering to the need of the society in 'innovative era'. It is in accordance to the changing behaviour with the special characteristics of parallelism, connectivism [10], and visualization. This learning management must help to develop the learner's ability to apply the new technology, which will help the learners to develop according to the changes in society. Education 4.0 is believed to empower students to produce innovations, the follow-on substantiations of knowledge production [11].

2.2. Technology Used

There are various technologies used in order to assist learning process. Figure 1 shows the timeline of technology which used in education. Started in 19th and 20th century, dated as in 1840s to 1950s, the first technology used in education is about correspondence and broadcast courses [12]. This technology involved mail to distribute the learning content which later followed by the usage of radio and television to broadcast the information.

In the late 20th century, the technologies developed in education mainly for computer-based training. Programmed Logic for Automatic Teaching Operations (PLATO) is one of the first software created in 1960 by Donald L. Bitzer to assist learning using computer [13]. From this, the similar technology started to be developed for learning assistance.

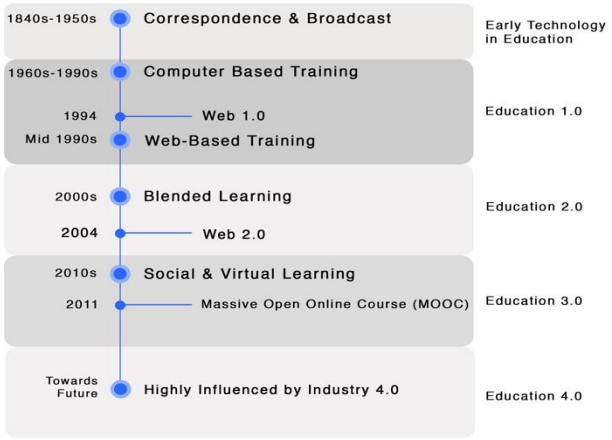


Fig. 1: Technology in education timeline [12]

The first revolution in education approximately started in 1990s aligned with the early development of World Wide Web (WWW). This revolution known as Education 1.0, was considered aligned with the first stage of WWW development which is Web 1.0 – a largely one-way process [8]. Web 1.0 provides static and one-way information without any interactions. This technology is rarely used in Education 1.0 as an additional source for mostly educators in the learning process.

The Web 1.0 has changed the way of information retrieval in education system especially the higher education level. Books as the main source of knowledge are slowly shifted to the WWW through Internet. Information access has gotten easier for students in searching for information. By using this WWW technology, the previous computer-based trainings started to move into the online based technology which known as web-based trainings. It provides more information which can be retrieved online via Internet.

This trend then followed by the second revolution, Education 2.0, which was triggered by the development of Web 2.0 [9]. This technology is the next stage of WWW with read and write feature which is considered as an enhancement from the previous stage – Web 1.0. It allows interaction between human and computer. This technology has triggered new learning and teaching method called blended learning in 2000s. Blended learning mixed the face-to-face interaction in classroom with e-learning. E-learning is a term where the learning process took place by using electronic devices via Internet. In this decade, electronic devices such as personal computer (PC), laptop, mobile phone, was increasing in production along with the rapid usage of Internet and WWW.

Internet has been a great medium of information sharing through WWW. The rapid increment of online sharing information and social media growth caused the third shift of educational revolution known as Education 3.0. It has been started since 2010 where the social media spread into the education sector up to this date including the virtual learning concept [12]. Massive Open Online Courses (MOOC) has been a great hit in this Education 3.0 up to this date. MOOC provides large data of knowledge in an open access for everyone via Internet.

Education 4.0 is predicted to be the new era of combining technology into almost every element in pedagogy education. Students or learners are expected to innovate and somehow a source of knowledge and the learning process can be done everywhere and whenever. Internet-of-Things (IoT) make almost everything happen in terms of connection especially among mobile devices [16]. Education process will rely much on the usage of Internet as the main medium of knowledge sharing, mobile devices and PC, and virtual environment.

The use of technology is crucial in Education 4.0 era in order to allow students to learn individually. There are three main factors of using technology to get the most out of it, which are: using the internet, creative thinking, and society interaction [14]. The internet happened to be the main source of information in learning process. Creative thinking refers to the way of thinking outside the box in order to solve problems, while society interaction refers to teamwork skills which needed for working in the society.

3. Higher Education in Malaysia

The new era of Education 4.0 will be the next thing happening in the world. Malaysia as a developing country will also be exposed on this matter. In order to welcome this new era, it is required for Malaysia to prepare the talent management to cope with the expected situation towards Education 4.0.

3.1. Blueprint 2015-2025

The Ministry of Higher Education (MoHE) in Malaysia has developed Malaysia Education Blueprint 2015-2025 known as MEB (HE) [15]. This program has been developed with the purpose of accomplishing Malaysia's education system in align with global trends and it is known as redesigning higher education program. The focus of this blueprint is to redesign the higher education system in Malaysia which highlights the balance between both ethics and morality (akhlak) along with knowledge and skills (ilmu) as shown in Figure 2.

There are three main points in ethics and morality focus. First point is about ethics and spirituality which refers to a good quality of students in moral and self-development. Second point is leadership skills which indicates the quality of students in intellectual level, being socially responsible, confident, and able to communicate well. Third point is about national identity where students are expected to be proud of being Malaysian and understand well about the country's relation with the world.



Fig. 2: Focus on redesign Malaysian higher education system [15]

Knowledge and skills in the blueprint also refer to three main parts which are language proficiency, thinking skills, and knowledge itself. Language proficiency point refers to mastering Bahasa Melayu and English in order to ease the information retrieval since most of sources of knowledge are written in English. However, the MoHE suggests students to learn one other global language. Second main point is thinking skills, refers to the importance of possess critical and innovative thinking, and entrepreneurial mind set. While the third point is knowledge where students are expected to understand well the field they studied, able to utilize and apply the knowledge on solving problem in real world.

In the Industry 4.0 era, there are some key competences which needed to be possessed in order to cultivate the good workplace learning habit for both employers and employees [17]. Communication and collaboration is one of the needed skills, focused on the ability to work well among the colleagues. Followed by the creativity and problem-solving thinking which are the soft skills needed to be survived in the fast-changing industry environment. This falls into the second main point from the blueprint which focused on the thinking skills. It shows that the blueprint created by MoHE is purposely focused on preparing the students to face the industrial environment especially in the Industry 4.0 era.

3.2. Programs Involved

There are some programs and technologies involved in redesigning higher education system in Malaysia which are CEO@Faculty, 2u2i, and MOOC. CEO@Faculty specifically designed in order to help university students along with the staffs by giving valuable guidance and information. Local and international CEOs are invited to give seminars and workshop to students, lecturers, and institutions in Malaysia. These CEOs are giving up to 30 hours in a year for this program. The main objective is to draw together industry and academic with the result that the university students are prepared and understand well the industrial field. Moreover, academic practitioners and lecturers are hoped to be aware on new trends in the industrial field.

2u2i is a study program which based on vocational training. In this program, students are exposed into industrial training throughout their study. The program provides 2 years of study plus 2 years of industrial training in order to learn and gain learning experience in real industrial life. MOOC will be widely used in the higher education system in Malaysia. It will help the students and lecturers to collect and share the materials needed in the learning process. MoHE projected this MOOC as one of the tools used in the future

learning where the usage of textbooks will be reduced in the class. MoHE blueprint has also stated the 10 shifts to continue improving the higher-level education in Malaysia as shown in Figure 3. The first 4 shifts are focused on the outcome while the other 6 are act as enablers.

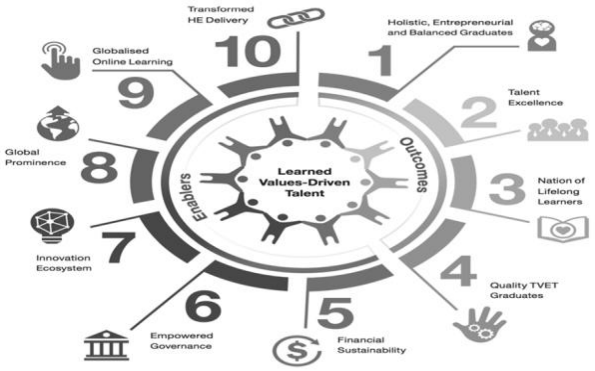


Fig. 3: 10 Shifts in MoHE blueprint [15]

This 10 shifts program stated by MoHE describes the key points of what to achieve in redesigning the higher education. It is not only focused on the teacher and learners but also on the other factors involved in the learning process. It is believed to be a program which will make Malaysia higher education system could meet the needs in the Education 4.0 era.

4. Discussion

Malaysia government has made a program of redesigning the higher education system, which is believed to improve the education system in Malaysia. The program includes the 10 shifts stated in the blueprint, as shown in the previous chapter in this paper.

In terms of the technology used in this blueprint, MOOCs has been used currently and it will be more commonly used especially in the university level. This will be aligned with the current trend in Education 4.0 where the information shared will be constantly evolved around the world. In this case, the students will be aware on the current information and technology while using MOOC rather than using only textbooks.

Other programs designed by MoHE – CEO@Faculty and 2u2i – are to be found very useful for the students. In this Industry 4.0 era, there will be some changes happened especially in the industrial field. With those programs, the students and teachers are going to take advantage out of it by having insights of how the current situations in the industry is. Especially for the 2u2i program, students are going to have hands on experience in the industry, hence better readiness for industry.

Learning and teaching in Education 4.0 are expected to be learners-centred where learners are everyone regardless. Self-learning is a pedagogy which need to be possessed by every learner in order to keep on progress in improving the learning process. Flexibility in learning process will also be predicted to fill in the needs of the learners. Additionally, problem-solving and critical thinking are soft-skills which need to be emphasized on during the learning process. Collaborative learning is one of the approach which can be used to promotes soft-skills development, improves academic performance and learning experience [18]. It is considered as one of the approaches which can be adapted into the Education 4.0 learning process which collaborate learning and social interaction.

5. Conclusion and Future Work

Education 4.0 is coined to be the future of education which responds to the need of Industry 4.0 where man and machine align to enable new possibilities. In order to be aligned with the Industry 4.0, education sectors must be well prepared to train the students – known as talents – especially in the higher level to be ready for this new era of industry.

Malaysia is in the stage of preparing the current higher education system to welcome the Education 4.0. From the literature, it shows that MoHE does aware of Industry 4.0 which reflected in their campaign of redesigning the higher education system and by creating the Malaysia Education Blueprint 2015-2025 includes the 10 shifts program. For future work, the authors' intention is to propose a conceptual framework for higher education system to support the implementation of Education 4.0 in Malaysia.

Acknowledgment

The authors would like to express our deepest gratitude to all members who have involved in this research directly and indirectly. Thanks to Universiti Teknikal Malaysia Melaka (UTeM) for the facilities given and variety of convenience in conducting this research.

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