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The Fourth Industrial Revolution and Its Impact on Malaysian Higher Education

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Abstract
The rapid growth of technology during this century resulted in the Fourth Industrial Revolution on a global scale. Malaysia has only recently begun to experience the fourth industrial revolution, which is characterized by a strong emphasis on cyber-physical systems. Through the introduction of new curriculum design, delivery methods, and evaluation technologies, this shift will eventually affect every part of our lives, including our educational institutions. Additionally, with the outbreak of Covid-19 pandemic on 2020, the educational landscape has altered substantially away from face-to-face teaching and toward online and digitalized instruction. This scenario is congruent with the 4IR goals, which anticipate technology being integrated into almost every aspect of human life. Thus, the goal of this study is to provide an overview of the impact of the fourth industrial revolution on education systems, particularly those of higher education in Malaysia.

Keywords: Fourth Industrial Revolution, Education, Impact, Higher Education

Introduction

The term IR 4.0, which refers to the fourth industrial revolution, has received considerable attention in recent years globally. Myanmar, Thailand, and Vietnam are among south-east Asian countries that have gradually transitioned to the fourth industrial revolution (Ganapathy-Wallace, 2017). Malaysia is also not exempted to the revolution (Ooi *et al.*, 2018). This scenario is largely driven by the digital revolution, specifically the Industrial Revolution 4.0, which is heavily focused on automation and data exchange (Kagermann et al., 2013; Ruban, 2017). All stakeholders must be prepared for IR 4.0, since it poses new challenges in a variety of disciplines, including education, and not just in the manufacturing sector.

The first industrial revolution began in the late 17th century and ended in the early 18th century; it was centred on mechanical production powered by water and steam. Following that, the second industrial revolution began in the twentieth century, with electricity playing a critical part in commencing the process of mass manufacturing. During the 1970s, the third industrial revolution, automated production based on electronics and information technology (IT) was implemented (Bloemet al., 2014). Today, the fourth industrial revolution has only begun as a result of significant technological advancements that highlight the use of Cyber-Physical Systems in industrial automation. In summary, the fourth industrial revolution was primarily fueled by the digitization and fusion of physical elements under the control of advanced intelligent systems (Sanieeet al., 2017).

The transition from IR 3.0 to IR 4.0, fueled by the technological revolution, will eventually transform human life, working styles, and modes of communication, among other things. Whether ready or not, an education system that encompasses the management of primary schools, secondary schools, colleges, and even universities must incorporate an aspect of IR 4.0 to assure the sustainability of all associated organizations (Sung, 2017). IR 4.0 will significantly advance the introduction of new technologies and methodologies. In education, this revolution will imply the introduction of new curriculum design, delivery methods, and assessment tools.

Method

Multiple articles on the impact of the fourth industrial revolution on higher education in Malaysia are discussed in this paper. As a result, this article addresses key features of the fourth industrial revolution elements and the teaching and learning methodologies that include them. The corpus for the literature review was generated by searching and selecting publications from internet databases such as scientific direct, Elsevier, Springer, IEE Explore, and Google Scholar. Industrial revolution 4.0, technology in higher education, teaching style, and technology 4.0 were all utilised as keyword combinations in the search for linked articles. Additionally, this study incorporates sources from books obtained from the library of Universiti Teknologi Malaysia.

Elements of the Fourth Industrial Revolution

Industrial revolution 4.0 entails the incorporation of internet technology into the manufacturing process, allowing us to substantially alter our daily lives through connectivity to the cyber world. Industrial revolution 4.0, according to Drath and Horch (2014), integrates Cyber-Physical Systems (CPS) into industrial production systems. It entails the construction of cyber-physical systems, as well as the assurance of their security, dependability, and data protection (Jazdi, 2014). Industrial revolution 4.0 is defined by the following features or characteristics: a) big data; b) the internet of things; c) real-time optimization; d) cloud computing; e) cyber-physical systems; f) additive manufacturing; g) cobots; and h) augmented reality and machine learning.

Big Data

The increase in the speed of information demonstrates that an excess of data can pose significant problems for humans. However, there is considerable potential in the massive volume of data referred to as big data (Chen & Zhang, 2014). The term "big data" refers to massive data collections that may be computationally analysed to discover patterns, trends, and relationships, most notably regarding human behaviour and interactions. The Four V's, or defining qualities of big data, will divide the data into four dimensions: volume, velocity, variety, and value (Zikopoulos & Eaton, 2011; McAfee & Brynjolfsson, 2012).

i. Volume- Volume is how much data we have – what used to be measured in Gigabytes is now measured in Zettabytes (ZB) or even Yottabytes (YB). This gives companies an opportunity to work with many petabyes of data in a single data set—and not just from the internet.
ii. Velocity- Velocity is the speed in which data is accessible. For many applications, the speed of data creation is even more important than the volume.
iii. Variety- Big data takes the form of messages, updates, and images posted to social networks; readings from sensors; GPS signals from cell phones, and more. Many of the most important sources of big data are relatively new. Variety describes one of the biggest challenges of big data. It can be unstructured and it can include so many different types of data from XML to video to SMS. Organizing the data in a meaningful way is no simple task, especially when the data itself changes rapidly.
iv. Value- Value is the end game. After addressing volume, velocity, variety, variability, veracity, and visualization – which take a lot of time, effort and resources – you want to be sure your organization is getting value from the data.

This critical information aids in the identification of a solution that will improve efficiency. Additionally, data analytics enables the early detection of defects in product design by aggregating and analysing part-per-million defect data. Thus, data analytics enables the identification of abnormalities or faults in new product design prior to customers identifying them after making a purchase from you.

Internet of Things

The Internet of Things (IoT) enables new applications by enabling the interconnection of physical devices with the assistance of intelligent decision-making. It enables objects to communicate with one other and with other suitable devices in order to complete a task (Whitmore et al., 2015). Recently, IoT has garnered widespread interest, particularly in the manufacturing and commercial sectors, for its potential to expand the limits of industries and boost their competitiveness (Wortmann & Fluchter, 2015). The combination of sensors and actuators embedded in physical things, as well as the data generated by the sensors, enables manufacturers to develop strategies for increasing production efficiency through the Internet of Things (Atzori, 2010).

Real-time Optimization

Real-time or nearly real-time information makes it possible for a company to be much more agile than its competitors. The IoT and the information and production systems in a smart manufacturing environment in its broader context of collaboration and ecosystems already are all about the development of real-time capabilities. Speed in a context of optimization, automation and enhanced productivity, it is a benefit in many other ways as well. Considering the rapid generation of data and the required timely analysis, real-time decision systems are of major interest for I40. Operation research can contribute with the development of appropriate real-time optimization models and methods.

Cloud Computing

Cloud Computing will play a crucial role in Industry 4.0 to harness the full potential of robotics and artificial intelligence. The key to easily and effectively manage workloads across the full spectrum of devices created by Industry 4.0 is to integrate compute services with a cloud platform. New computing model called cloud computing are used to store and analyse the enormous datasets typical of I40 applications. In cloud computing, the resources are provided as general utilities that are on-demand leased and released by users through Internet. Computing and storage capacity is shared by partitioning the physical resources using virtualization technologies (Zhang et al., 2010).

Cyber Physical System

A cyber-physical system aims at the integration of computation and physical processes. This means that computers and networks are able to monitor the physical process of manufacturing at a certain process. The networked systems sensorized to acquire real-time data from the field require a proper architecture, named Cyber Physical System (CPS), to manage the interconnection between their physical assets and computational capabilities (Lee et al., 2015). Manufacturing industry was the first to use Artificial Intelligence (AI) for product assembling and packaging. AI has a lot to do with data as cyber-physical systems communicate with each other and humans by sending and receiving data in real time over the Internet of Things. Collection and analysis of large amounts of data optimizes the manufacturing process and revolutionizes mass production. Besides, AI-powered machines are capable of performing tasks 24 hours a day, which gives a significant boost to productivity.

Additive Manufacturing

Additive manufacturing technology currently is expanding on some industrial sectors (Bikas, Stavropoulos &Chryssolouris, 2016) and has been researched and developed for more than 20 years. According to ASTM Standard, Additive Manufacturing (AM) is defined as “process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining”. AM used to be applied for Rapid Prototyping (RP) which is used as tools for communication and inspection (Santos et al., 2006). It is also a tool that can help increase the “design freedom” in creating unique products which can be manufactured in an economical way. With great interests towards AM technology application, it has started to exhibit a great potential and advantages in the automotive, biomedical, aerospace and energy field.

Cobot

Another component of industrial revolution 4.0 is Cobot. Cobot or also known as collaborative robots are designed for direct physical interaction with human operator (Peshkin, *et al.,* 2001; Gillespie et al., 2001). Cobot cannot move on its own but rather depends on the human operator to produce the desired motion. According to Gillespie, Colgate and Peshkin (2001), cobot is used to assist human operator to complete a task and is strategically in a shared workspace. It actively cooperates with human operators in completing the task for work activities (Bortolini, *et al.,* 2017). Usually, robots are equipped with sensors to avoid them touching humans forcefully or give injuries. Thus, the installation of robot within the area with human operators does not comply with the safety conditions based on the recent European Union (EU) regulations. However, there are regulations provided for human-robot interaction based on the recent International Standards (ISO 10218) which enables the operations of robot in the same workplace as human (Bortolini*et al.,* 2017).

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Augmented Reality

Augmented reality can be defined as virtual objects or elements being overlaid with the real environment simultaneously which enables people to interact with both virtual and real world (Kauffman, 2003; Lee, 2012; Bower *et al.,* 2013). This technology is also called interactive visualization systems (Riva *et al.,* 2016) where it allows people to experience virtual world without eliminating the real world (Kesim & Ozarslan, 2012). There are some properties that augmented reality systems should presents such as:

i. Must consists of combination of real and virtual objects in real environment
ii. Real and virtual objects must be aligned together
iii. Run interactively in real-time

This technology has gained massive attention in various field as it offers many interactive and effective functions that can help overcome the limits found in the previous technologies. Some of the field that has been implementing this technology is medicine (Berryman, 2012; Azuma *et al.,* 2001), military (Berryman, 2012; Liarokapis, Lister & White, 2002), engineering design and manufacturing (Azuma *et al.,* 2001). Even recently, there are still various studies done in order to maximize the use of this technology in any potential field.

Machine Learning

Machine learning is one of the most rapid growing technical fields which lies in the intersection between computer science and statistics (Jordan & Mitchell, 2015). According to Ghahramani (2015), machine learning is about learning, reasoning and acting based on data. It is about the methods or techniques to automatically allow machines to utilize the data in solving the tasks. There are various terms used to describe machine learning according to various field such as artificial intelligence for computer science, data mining for statistics, computational linguistics for cognitive science and psychology and signal processing for engineering (Schon, 2016). Machine learning is about the use of algorithms to predict the outcomes by searching and analyzing through a vast numbers of reliable variables to solve complex problems (Obermeyer & Emanuel, 2016). In short, it is an ability to transform data into knowledge. Within artificial intelligence, examples of some practical application of machine learning are computer vision, speech recognition and robot control (Jordan & Mitchell, 2015).

Impact of the Fourth Industrial Revolution on Higher Education

The elements discussed in the section on the elements of the fourth industrial revolution are the elements of the Fourth Industrial Revolution, which occurs as a result of our civilization's transformation into an industrial society centred on internet technology. Thus, it is critical for millennials to stay current with technological advancements in order to meet current industrial needs. The fourth industrial revolution has altered and expanded our formal education systems, necessitating transdisciplinary teaching, research, and innovation (Xing & Marwala, 2017). Nowadays, education's role has evolved to meet the needs of society in the "innovative era" (Puncreobutr, 2016). Jobs currently performed by humans are expected to be replaced by machines in the near future due to the rapid growth of technology (Caccavello, 2017). As a result of technological advancement, more new and productive occupations are likely to arise. To facilitate these developments, teaching in the fourth industrial revolution must emphasize the growth of students' abilities to apply new technologies while also emphasizing knowledge and skill gain. To learn in the fourth industrial revolution age, students must possess 21st century abilities such as critical thinking, creativity and invention, cross-cultural awareness, information and media literacy, and career and learning skills (Puncreobutr, 2016).

Teaching in the fourth industrial revolution era shows an increasing trend on the use of advanced technologies. Massive Open Online Courses (MOOC)and augmented reality are among the technologies that recently becoming a trend among educators in teaching and learning in Malaysia. In short, MOOC is design for the purpose of promoting lifelong learning among the students who wants to explore other subjects of interests and also for their own professional development (Sandeen, 2013). Most of people using MOOC are those who are currently employed, educated, originated from developed countries and have higher levels of formal education (Dillahunt, Wang & Teasley, 2014). It is apparent that MOOC is providing open access online courses for everyone and can support an indefinite number of students (Yuan & Powell, 2013). With the information and communication technology being made available for everyone, the implementation and usage of MOOC had increaseespecially for higher education. Similarly, MOOC is the example of the implementation of cloud computing in educational field which enables students to access the learning materials anywhere and anytime with the availability of internet access.

Besides MOOC, the use of augmented reality in teaching and learning also have significantly increased in the recent year due to its potential towards increasing students' learning experiences and effectiveness. Augmented reality also listed as one of the elements in the fourth industrial revolution. Thus, it is important to inject the familiarity of this technology among future engineers who will soon be the one to drive the fourth industrial revolution. Leighton and Crompton (2017) wrote that using augmented reality in classroom could allow the students to develop higher levels of thinking due to the connection of this technology with the real world. Findings shows that the implementation of augmented reality in higher education positively affects students' motivation and interests towards learning (Wei et al., 2015; Abdullah et al., 2017; Akçayır, et al., 2017). Apart from that, augmented reality also has proven to show potential towards improving students' skills (Sorby, 2009; Wei, et al., 2015; Akçayır, et al., 2017). To sum up, there are great potential for augmented reality to be implemented in higher education to ensure the high quality of teaching and learning process and is on par with the technological innovation in this era.

Recommendation for Future Research

This study focuses on the features of the fourth industrial revolution as well as its impact on education systems, particularly higher education in Malaysia. There is a substantial impact on the usage of flexible teaching and learning systems, such as MOOC, and the use of cuttingedge technologies, such as augmented reality technology, in teaching and learning. As a result of this review paper, future researchers in this subject might investigate how this innovative strategy remains relevant post-pandemic, when educational institutions resume normal operations and are open to all students. This is an essential topic since a great deal of work has been expended to urge educators to apply technological approach and open access online learning during pandemics, as well as a great deal of data evaluating the efficacy of implementation. According to a study by Chung et al (2020), the majority of undergraduates are prepared for online learning, with female students being more prepared than male students. This survey identifies student-preferred platforms such as Google Classroom and YouTube. Another study by Kamal et al (2020) investigates the shift to online learning during the pandemic. Students at the pre-university level are more positive and accepting of integrating online learning during the pandemic, according to their findings. In addition, it was discovered that students viewed online learning as a benefit to academic achievement throughout the pandemic. According to the conclusions of the research undertaken to determine the influence of online learning and the readiness to use online learning during a pandemic, it would be a waste to completely return our educational system to its pre-pandemic state. We must devise a strategy to ensure that our efforts during the pandemic have not been in vain.

Conclusion

This paper discussed the impact of the fourth industrial revolution on higher education in Malaysia. Recently, our country has seen an increase in the use of advanced technologies for teaching and learning purposes, particularly in higher education, owing to the restrictions on face-to-face contacts for class sessions in higher institutions following the pandemic. Lecturers frequently use online and virtual classrooms to conduct classes throughout the pandemic. Even if there are drawbacks to employing technology to conduct classes, this scenario really helps our country get one step closer to fulfilling the fourth industrial revolution's integration into our educational settings, particularly higher education. Thus, these developments necessitate a reform of Malaysia's education system to better connect it with current needs in order to create well-balanced graduates capable of meeting the demands of the fourth industrial revolution.

References

Abdullah, F., Kassim, M. H. B., &Sanusi, A. N. Z. (2017). Go Virtual: Exploring Augmented Reality Application in Representation of Steel Architectural Construction for the Enhancement of Architecture Education. Advanced Science Letters, 23(2), 804-808.

Akçayır, M., Akçayır, G., Pektaş, H. M., & Ocak, M. A. (2016). Augmented reality in science laboratories: The effects of augmented reality on university students' laboratory skills and attitudes toward science laboratories. Computers in Human Behavior, 57, 334-342.

Andrew McAfee and Erik Brynjolfsson, (2012). Big Data: The Management Revolution. Harvard Business Review. http://tarjomefa.com/wp-content/uploads/2017/04/6539-English-TarjomeFa-1.pdf

Barba, P. D., Kennedy, G. E., & Ainley, M. D. (2016). The role of students' motivation and participation in predicting performance in a MOOC. Journal of Computer Assisted Learning, 32(3), 218-231.

Bikas, H., Stavropoulos, P., & Chryssolouris, G. (2016). Additive manufacturing methods and modelling approaches: a critical review. The International Journal of Advanced Manufacturing Technology, 83(1-4), 389-405.

Bloem, J., Van Doorn, M., Duivestein, S., Excoffier, D., Maas, R., & Van Ommeren, E. (2014). The Fourth Industrial Revolution. Things Tighten.

Caccavello, G. (2017). Education 4.0. Retrieved from: www.epicenternetwork.eu

Chung, E., Subramaniam, G., & Dass, L. C. (2020). Online learning readiness among university students in Malaysia amidst Covid-19. Asian Journal of University Education, 16(2), 45-58.

Dillahunt, T. R., Wang, B. Z., & Teasley, S. (2014). Democratizing higher education: Exploring MOOC use among those who cannot afford a formal education. The International Review of Research in Open and Distributed Learning, 15(5).

Drath, R., & Horch, A. (2014). Industrie 4.0: Hit or hype?[industry forum]. IEEE industrial electronics magazine, 8(2), 56-58.

Gillespie, R. B., Colgate, J. E., & Peshkin, M. A. (2001). A general framework for cobot control. IEEE Transactions on Robotics and Automation, 17(4), 391-401.

Jazdi, N. (2014). Cyber physical systems in the context of Industry 4.0. In Automation, Quality and Testing, Robotics, 2014 IEEE International Conference on (pp. 1-4). IEEE.

Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. Science, 349(6245), 255-260.

Kamal, A. A., Shaipullah, N. M., Truna, L., Sabri, M., & Junaini, S. N. (2020). Transitioning to online learning during COVID-19 Pandemic: Case study of a Pre-University Centre in Malaysia. International Journal of Advanced Computer Science and Applications, 11(6).

Leighton, L. J., & Crompton, H. (2017). Augmented Reality in K-12 Education. In Mobile Technologies and Augmented Reality in Open Education (pp. 281-290). IGI Global.

Martin. (2017). Industry 4.0: Definition, Design Principles, Challenges, and the Future of Employment. https://www.cleverism.com/industry-4-0/

Obermeyer, Z., & Emanuel, E. J. (2016). Predicting the future—big data, machine learning, and clinical medicine. The New England journal of medicine, 375(13), 1216.

Peshkin, M. A., Colgate, J. E., Wannasuphoprasit, W., Moore, C. A., Gillespie, R. B., &Akella, P. (2001). Cobot architecture. IEEE Transactions on Robotics and Automation, 17(4), 377-390.

Puncreobutr, V. (2016). Education 4.0: New Challenge of Learning. St. Theresa Journal of Humanities and Social Sciences, 2(2).

Sandeen, C. (2013). Integrating MOOCs into traditional higher education: The emerging "MOOC 3.0" era. Change: The magazine of higher learning, 45(6), 34-39.

Saniee, I., Kamat, S., Prakash, S., & Weldon, M. (2017). Will productivity growth return in the new digital era? An analysis of the potential impact on productivity of the fourth industrial revolution. Bell Labs Technical Journal.

Santos, E. C., Shiomi, M., Osakada, K., Laoui, T. (2006). Rapid manufacturing of metal components by laser forming. International Journal of Machine Tools and Manufacture 46(12–13), 1459–1468.

Wei, X., Weng, D., Liu, Y., & Wang, Y. (2015). Teaching based on augmented reality for a technical creative design course. Computers & Education, 81, 221-234.

Whitmore, A., Agarwal, A., & Da Xu, L. (2015). The Internet of Things—A survey of topics and trends. Information Systems Frontiers, 17(2), 261-274.

Wortmann, F., & Fluchter, K. (2015). Internet of things. Business & Information Systems Engineering, 57(3), 221-224.

Xing, B. (2015). Massive online open course assisted mechatronics learning_a hybrid approach. Furthering Higher Education Possibilities through Massive Open Online Courses, 245-268.

Xing, B., & Marwala, T. (2017). Implications of the Fourth Industrial Age on Higher Education. arXiv preprint arXiv:1703.09643.

Yuan, L., Powell, S., & CETIS, J. (2013). MOOCs and open education: Implications for higher education.