The Emerging Challenges of Industrial Revolution 4.0: A Students' Perspective

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Abstract

The Fourth Industrial Revolution (IR 4.0) has emerged as one of the most influential contributor in the development and landscape of the modern world. Students in tertiary education are expected to get out of the way to meet the challenges posed by IR 4.0. One of the fields that is affected by this wave of revolution is Education, therefore it is pertinent for a University to provide space and opportunity for future graduates to have a sense of self-identity and competitive ability. Following this view, a student's university experience is significantly correlated with the development of his well-being. The development includes the acquisition of knowledge and skills in their field of choice, although it is generally preferable for a student to acquire skills in various fields. Competent students are those who are well-equipped with knowledge, skills and values that are relevant to current practice. Drawing from this idea, the purpose of this paper is to evaluate students' challenges, skills, and preparations at the University in facing the IR 4.0 era. A qualitative case study was conducted, employing interviews and document analysis to obtain data from 35 respondents. The respondents were comprised of university students who were selected through purposive sampling. The findings identified several main skills; career and life skills, learning and innovation skills, information, media and technology skills. This study discussed the possible scenarios that might be faced by the students and the university in depth. Based on the findings, proactive measures are needed to encourage students to improve their skills, particularly the skills related to information technology, knowledge, and personal soft skills. Such measures are crucial to fulfil the challenges of IR 4.0.

***Keywords:** University, Industry 4.0, Conducive infrastructure, 21st Century skills.*

1. INTRODUCTION

Throughout history, the development of science and technology has transformed the world in its entirety. The first revolution was marked at the point where human and animals were replaced by machines. Meanwhile, the second-generation industrial revolution was sparked by the emergence of electric power generation, allowing burning engines to be replaced by machines – a condition that was significantly observable in the transportation field (Ramirez-Mendoza et al. 2018; Sung, 2018; Reischauer 2018). Following the flow of innovation, high-tech gadgets such as telephones, trains, planes and other heavy machinery were invented,changing the face of the world significantly (Saucedo-Martinez et al., 2018). Then, the third generation industrial revolution began with the advent of digital technology and the internet. The fourth-generation industry revolution was correlated with the emergence of supercomputers, smart robots, unmanned vehicles, genetic modification, and neuro-technology developments that allow humans to optimise brain functioning (Guangli et al., 2018; Ciolacu et al., 2018; Fuchs, 2018). In the fourth-generation industry revolution, individuals' daily affairs are shared with customised robots to optimise human needs and comfort (Sousa et al., 2018).
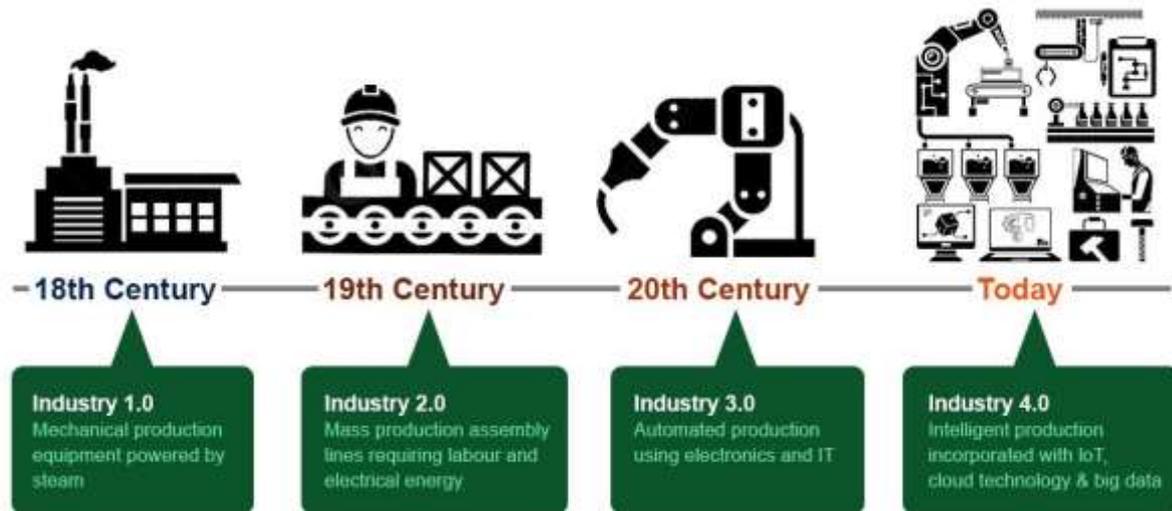
Figure 1: Source from http://nadisiswa.com/archives/2311

The Industrial Revolution 4.0 (IR 4.0) and its development of virtual reality technology with limited use of manpower havea significant impact on many aspects of life (Daricin et al., 2018, including tertiary education sector. World Bank's Senior Expert Francisco Marmolejo in the Seminar of Industry Revolution 4.0 announced that the higher education system across the country was to experience some changes during the Industrial Revolution 4.0. Following this, Malaysia is in need of a higher-education institute that can be ready to face new challenges to ensure that we are keeping up with the current globalisation and digitalisation era (Fairuz Yusof, 2017). The existence of Higher Education Institutes (HEIs), especially the Public Institutions of Higher Education (IPTAs) throughout the country generally produce quality human capital capable of fulfilling future vacancies.

The worldis approaching IR 4.0 and this revolution differs extensively from our previous expectations and imaginations. The world's population is expected to be living, communicating, working, and trading in a different environment compared to before. The differences include administrative management and human movement. One-third of the world's population uses social media to learn, to share information, and to connect with others. Such use of social media will change the role of technology, information processing, and storage (Ruslin Amir, Hamidun Bunawan & Firdaus Yahaya, 2018). For example, education will be seen as a regular repetition of self-study materials and attendance to scheduled classes will not be seen as compulsory. It is high time to revise and revalue the role of existing colleges and infrastructure to maintain its relevancy in facing IR 4.0.

Meanwhile, educational innovation demands a quick and valid response to the challenges and transformation of IR 4.0. This innovation and artificial intelligence require swift revolution with regards to future education. In preparing graduates to compete in the contemporary digitalised market, in which an increasing number of smart robots will replace humans in certain activity divisions, education should cultivate appropriate human skills that are irreplaceable by robots (Jones & Pimdee, 2018). The IR 4.0 put more focus on virtual, hyper, and customised learning for the students. Advanced skills such as Artificial Intelligence (AI), portable arrangement and distributed computing, handling big data and online networking, Augmented Reality (AR), and the Internet of Things (IoT) has changed the traditional teaching and learning methods to computerized teaching and smart classroom (Prisecaru, 2016). Given this current reality, academic institutions are in imperative need to investigate advanced and creative approaches to employ creativity and innovation in their campuses.

As aptly emphasised by Tan Sri Abdul Wahid Omar, the group chairman Permodalan Nasional Berhad:"[to] create an enabling environment for learners, academics and practitioners [need] to break barriers, imagine, innovate, create, and collaborate; develop a 4.0-ready ecosystem fitting to institutional contexts; stimulate greater human connectivity through the exchange of students and staff, which is enabled through

global and regional networks, and consortium of higher education institutions; incorporate spiritual values, ethics and morality, national identity and a sense of connection to the community, through curriculum delivery and technology transfer; and be mindful of the benefits and risks brought about by the 4th Industrial Revolution. "(MOLE, 2017).

The IR 4.0 has createda protean career for future graduates (Lent & Brown, 2013) by focusing on which attitudes, competencies, and behaviors that are considered to be desirable in the current economic weather. According to Lent and Brown (2013), adaptive career behaviors such as evolving work readiness and employability skills are likely to continue to be sought after in the future.It is fairly well-known that higher education (HE) should be the forefront runner in preparing the students for IR 4.0. Nonetheless, most HEs are only equipped with the tools to related to past industrial revolutions, not the current automation-laden revolution.

Qualified, knowledgeable and skilled students are the main assets of the State in producing a skilled workforce, but students must be flexible enough to adapt to the current flow of change. Nevertheless, there is a lack of studies that focus on the challenges, benefits, and implications of IR 4.0, especially the ones that consider the perspective of students in coping with the current innovative and digitalised industry (Jules, 2016). The available research on IR 4.0 is more attentive to developed-nations, while developing-nations such as Malaysia are out of focus.

Holden (2001) stated that demonising technology alone above all other social phenomena is unreasonable – this idea ignores students' preferences in spending their time using computers over socialising or engaging in beneficial activities. It is impossible to restrict or control technological development, but it is possible to compete and prepare for future challenges. Following this notion, this paper will discuss the students' challenges, skills, and preparations in facing the era of IR 4.0, aiming to answer the following questions:

1. What are the challenges faced by Malaysian students in Industrial Revolution 4.0?

2. What are the essential skills required by students to excel in their future career?

2. BACKGROUND

The Fourth Industrial Revolution (IR 4.0)

Over the past few centuries, industrial revolutions can be categorised into three phases: (a) mechanical production in the late 18th century, (b) mass industrial production in the later 19th century, and (c) personal computers and the Internet in the 1960s (Frey & Osborne, 2013). Recent transformations in the industry, human capital development, and technological advancement are often described as Industry 4.0 or fourth industrial revolution (IR 4.0) (Schwab, 2016).This IR 4.0 is generally characterised by key technologies such as artificial intelligence, cloud computing, nanotechnology, genetics, biotechnology, and 3-D printing. Brynjolfsson and McAfee (2014) in their well-known book called this period'a second machine age'. They contended that the key difference from previous industrial revolutions is that the present technologies are no longer intended to replace the supporting humans and physical labour in their work tasks, but rather at changing human workers and their cognitive work altogether(Brynjolfsson & McAfee, 2014; Ford, Mortara & Minshall, 2015).

Meanwhile, Arntz Gregory and Zierahn (2017) assessed the extent to which specific tasks might be automated and to what degree individuals in an occupation are able to perform such tasks. They employed a task-based approach and found that 9% of US workers, and between 6% (South Korea and Estonia) and 12% (Germany and Austria) of workers from the Organisation for Economic Co-operation and Development (OECD) countries are working in a job with a high risk of automation and computerisation. They also observed that workers with higher educational levels were less likely to be at risk compared to low-skilled employees.

The fourth industrial revolution is not without criticisms. Frey and Osborne (2013) argued that the industrial revolution and advancement in technology may lead to mass unemployment and dehumanised work. Nevertheless, there was yet to be any mass panic as Mokyr, Vickers, and Ziebarth (2015) highlighted that although potential job loss due to automation is obvious, people generally tend to overlook the possibility of new job creation. It is difficult to estimate the extent to which digitalisation and automation impact on job

reduction, as proven by the absence of consensus in the literature regarding this issue (Furman, 2018). Nonetheless, there is a consensus that we are about to witness major structural changes in the labour market, which will spark the demand of new and soft skills in the industrial revolution.

1. Structural Changes at Workplace

Increasing job polarisation is the result of technological progress around the globe (Autor & Dorn, 2013; Goos, Manning, & Salomons, 2009). Job polarisation refers to the situation where lower, high-skilled jobs and lower-level jobs are increasing disproportionately while middle-level jobs are hollowing out. A reason would be that middle-level jobs, for instance clerks and office administrators, consist of manual or cognitive chores that are replaceable with current technology. On the other hand, low-skilled service jobs (for example, cleaners, security guards, and personal caretakers) involve duties that are relatively easy to human and quite a hassle to be automated. In contrast, high-skilled jobs (for example, managers, technicians, and educators) mostly involve creative problem-solving and complex social interaction, making it almost impossible to automate. Structural changes at workplace pushed many middle-skill workers into lower-skilled and lower-paid occupations. It also raised the pressure to upsurge the necessary skills for graduates through lifelong learning and continued education to improve required skills of IR 4.0 (Frey & Osborne, 2013). Following this, higher learning institutions need to reshape their strategically approaches in accordance with recent workplace challenges for graduates.

2. Career and Life Skills

Career and life skills relate to how individuals are preparing for future career challenges. According to Sharita Abd Ghoni (2018), the willingness of the year 2 Polimas students to study IR 4.0 was low. Students should prepare themselves with special knowledge, skills, and values according to their respective fields. This is in line with a study conducted by Rashidi Abbas (2018) involving UMP students the university has established program aimed to strengthen students' character development. Logically, an engineering student should be prepared and willing to work as an engineer, while a student in a teaching course should prepare himself with relevant teaching skills.It is best if the preparation stage begins in a university of higher learning, as these institutions are comprised of specialist lecturer and have industry relationship with several entities. A current pressing problem is finding or creating a different job scenario for students to adapt. Ruslin Amir, Hamidun Bunawan & Firdaus Yahaya (2018) found that graduates exhibited some weaknesses related to soft skills, including their adaptation skills.

3. Learning and Innovation Skills

Learning skills are one's ability to learn and adapt to new strategies. Earlier observations by Ruslin Amir, Hamidun Bunawan & Firdaus Yahaya (2018) demonstrated that university students in IPT only had basic learning skills, missing specific skill or technique in mastering courses taken and innovation in problem-solving. Kamarudin Ilias and Che Aleha Ladin (2018) stated that the 21st-century graduates must equipthemselves with these five skills; complex problem-solving skills, leadership skills, oral and written communication skills, emotional intelligence, and integral moral values. Meanwhile, innovation relates to the modification of up-gradation of old objects, practices or methods, and should never be overlooked by students. An average student in Malaysia seems to have average innovation skills, mostly caused by the exam-oriented education system in Malaysia.

Innovation requires knowledge, higher thinking skills (HOTs) and operating capabilities to generate something new. A study by Ruslin Amir, Hamidun Bunawan & Firdaus Yahaya (2018) observed the lack of creative-thinking skills among graduates, including those with excellent academic results. One way to address this issue is to create a safe space for students to receive the space, opportunities, and guidance needed from the University's administration department.

4. Information, Media and Technology Skills

One's ability to acquire and adapt to new advanced skills, modern approaches and incessant social changes will make him a valuable asset in IR 4.0. Such a view is especially true considering the existence of advanced technology in Malaysia, including the youths' flair and intuition with anything related to media and technology information skills. Unlike the past century ideology that dictated the Internet, computers, and information were

limited and restricted to developed countries only, current century is made of an atmosphere of information blasts. We are now living in a borderless world. As observed by Mohd Azul Mohamad Salleh, Kamaliah Basir, Ali Salman & Nik Hairi Omar (2018), students nowadays use social media as a medium to communicate, search for information, and share things with their respective audiences. They use smartphones with access to the Internet to reach social media applications for everyday purposes, especially to communicate with residential colleges.

Technology is evolving alongside science, observable with the creation of new tools and applications. Gadgets are becoming increasingly complex throughout the years, making the once impossible things possible. The creation of computer chips, for example, allows knowledgw and technology to be detected at any time. Such development was driven by the significant use of the Internet around the globe, allowing access to information that allows innovation to take place, particularly in the era of IR 4.0.

5. **Thinking Skills**

IR 4.0 may influence one's belief would probably influence students in thinking skills if not guided truly. According to Yusuf Al-Qaradhawi (2001), Muslim scholars and academicians are increasingly influenced by concupiscence and Western culture in their daily life. Some say that this change is welcomed, as current civilisation is in need of updated philosophy and mission that may defer than Western civilisation. Furthermore, IR 4.0 increases the need for a strong 'soft skills', which include the ability to solve complex problems, creativity, communication skills, emotional intelligence, critical thinking skills, and relationship building skills. Critical thinking capabilities are essential for students to enhance interpersonal, intrapersonal, and cognitive competence.According to a World Economic Forum report, The Future of Jobs, there are ten skills that are needed throughout the Fourth Industrial Revolution. Critical thinking skills placed second. In addition, graduates and future graduates must be aware of the increasing demand for resiliency, adaptability, courage, and resourcefulness qualities in one's self.

6. Moral and Social Value

Students with moral and social values are well-equipped to cope with technology. Berita Harian reported on August 23, 2017, that failing to assimilate with technological advancement lead to students performing only the basic functions of an automated machine. Malaysia was once known as the 'Warrior of the Asian Tiger' during the economic boom the 1990s. According to Za'ba through his writings entitled "Jalan Keselamatan Bagi Orang Melayu" and the Poverty of Malays, in addition to being economically poor, the Malays are also poor in life and ideas, knowledge, attitude, and religion (Daily News, August 23, 2017, 10). If success is measured by the achievement of advanced technology and the rise of the IR, then we have failed. This situation will have a prominent impact on the country's economic environment. To heal the economic situation, students should have the courage to innovate and adapt to current technology usage in education with full confidence. Such approach will help the students to face the possible challenges of IR 4.0.

3. **METHODOLOGY**

This study utilised interview session as a case study design and collected data using documents. Interview method was chosen as it builds a holistic snapshot, analyses words, reports detailed views of informants, and enables interviewees to "speak in their own voice and express their own thoughts and feelings" (Berg, 2007: 96).As emphasised by Kvale (1996& 2003), interviews are more powerful than questionnaires in eliciting narrative data, allowing researchers to investigate people's views in greater depth. For this study, a sample of 35 students from University Technology Malaysia (UTM), University Tun Hussin Onn (UTHM), University Kebangsaan Malaysia (UKM), and Sultan Zainal Abidin University (Unisza) were chosen based on purposive sampling method.The number of participants was low due to purposive sampling. The interviews were conducted in a neutral and safe location with no intimidation or coercion. Furthermore, the data obtained were analysed using a thematic method through the construction of the main themes from interviews and selected documents.

4. RESULTS

In this study, a total number of 35 respondents (as shown in Table 1) comprised of females and males were recruited. The majority of the respondents were Malays, followed by Chinese and Indians. All respondents were between 19 and 30 years old and were first-year degree students.

Table 1. Characteristics of respondents

Characteristics	Respondents n=35	Percentage
Sex		
Male	16	45.72
Female	19	54.28
Marital status		
Married	4	11.42
Single	31	88.58
Age (range)		
19 – 22	18	51.42
23 – 26	13	37.14
26 – 30	4	11.42
30 and above		
Ethnicity		
Malaysian	16	45.72
Chinese	12	34.28
Indian	7	20

The initial analysis of 160 statements generated tenthemes based on the views and opinions of students about the challenges of IR 4.0 and the skills needed.Most of the students stressed the importance of teamwork and critical thinking skills. As emphasised by R1 (Andi, UTM);

"...nowadays, we need to be independent, get use to team work, good at making decisions, we have to think ahead, it's somehow like HOTs la"

Some respondents contended that technological or IT can possibly pose a challenge for them, but the challenge was perceived as an opportunity for career development. As mentioned by R20 (Dhia, UTM);

"I'm notreally good in IT, but i have to try to be good at it because I know I'm gonna ise it for my studies and work. So it's a challenge for me"

Among the many challenges reported by the students, the top five challenges were knowledge acquisition, expert thinking skills, development of self-potential, the formation of a global network, and communication skills (refer to Table 1).

Table 2: Frequency distribution and percentage of challenges encountered

Theme based challenge	Frequency /35	Percentage	Stages
Online learning/ *blended learning* and internet access	13	33	Low
Problem solving skills	23	66	Medium
Personal development	19	54	Medium
Networking skills	25	71	Medium High
Communication skills	19	54	Medium

In terms of skills, most respondents focused on online learning, communication skills, and problem-solving skills. As highlighted by R13 (Azhfar, UnisZa);

"In today's era (RI 4.0), we need to have to be good at discussing and communicating, it's also hard for me to be better, I don't often socialise before".

Other important skills pointed out by respondents wereinformation skills, high-level thinking skills (HOTs), teamwork skills, and time management skills. The themes are shown in Table 2.

Table 3: Frequency distribution and percentage of required skills

Theme	Frequency /35	Percentage	Stages
ICT and gadget handling skills	31	89	Very High
High level thinking skills (HOTs)	32	91	Very High
Teamwork skills	30	86	Very High
Communication skills	34	97	Very High
Time management skills	35	100	Very High

Overview of Thematic Analysis

| Codes | Basic Themes | Global Theme |

Figure 2. Thematical analysis of findings

Based on the thematical analysis, the present study found a number of themes, which are presented in Figure 2. The themes are further divided into basic themes and then constructed into a number of nodes. The global theme mentions the key important research area which requires further studies. In the present study, the researcher aims to explore the challenges of IR 4.0 and the skills required to face these challenges.After developing a global theme, some basic themes were discovered. Lastly, the codes represent a further exploration of views of respondents based on the phenomenological analysis. Multiple codes were observed for every basic theme.

5. **DISCUSION**

This study demonstrated students' awareness of the importance of online/blended learning and Internet access in facing IR 4.0. Interaction between fellow students and other parties in building a global network is needed to resolve the issues related to the new wave of revolution. Apart from that, most students were aware of the importance of personal formulation, effective communication skills, ICT skills, high-level thinking skills,

collaborative skills, and time management skills. Based on this study, the University should be able to provide the following;

- Adequate internet access to be used by the students
- Learning space for individuals and groups
- Courses related to personal development and career exposure
- Conduct a program in collaboration with Universities, residential colleges, and student committees to enhance leadership, communication, and teamwork skills.

It is widely known that the employment field is facing several challenges involving the quality of graduates produced by the current education system. Since graduates are expected to fulfil the expectations of employers, it is logical to expect a systemic approach from the Universities in addressing this issue. A thoughtful and calculated measure will go a long way in ensuring graduates' employability and assimilation in current environment, especially when most graduates nowadays are expected to work with Artificial Intelligence (AI). It is undeniable that conventional methods of learning and teaching will remain relevant throughout time, but there has to be a systemic space for innovation in teaching and learning methods. An example of the approach is increasing the collaboration intensity among universities, industry, and government. This approach can provide a platform for students to enhance their micro-learning abilities, adaptive learning skills, and upskilling to the idea and reality of AI.

As universities are increasingly becoming the hub of talent cultivation, these institutions should be ready to change their roles. For example, residential colleges should be well-equipped for students development as they are the second learning centre for the students. In addition, there should be a centre for students' talent and potential development which conduct activities and programs that involve both students and faculty members. Universities should also have alumni meeting centres where they invite icons and entrepreneurs to relay their knowledge and experience to the students.

Despite all the possible advantages of these approaches, there are still some constraints. Most Malaysia universities have no specific infrastructure for internet-based activities, group discussions and online learning. Money is also an issue as establishing these infrastructures comes with high financial costs. For example, wear and tear maintenance cost and up-gradation costs. New models of technology is also a challenge – it is unwise to regularly change the equipment available for the latest version, but it is also pertinent that the available devices are at least satisfactory.

A way to look forward

The current study has some limitations. Firstly, the data were based on students from four universities. Secondly, the respondents were first-year degree students. These two limitations inhibit variability, which may increase if the study was to include Masters and postgraduate students. There are several areas where further study can be directed to obtainmore comprehensive results in relation to IR 4.0. A quantitative or mixed-mode study with increased sample size may provide empirical results to develop a deeper understanding of the current research area. Future study should also target participants from private universities for more in-depth reviews and opinions.

6. **CONCLUSION**

The Fourth Industrial Revolution (IR 4.0) has emerged as one of the most influential contributor in the development and landscape of the modern world. Students in tertiary education are expected to get out of the way to meet the challenges posed by IR 4.0. One of the fields that is affected by this wave of revolution is Education, therefore it is pertinent for a University to provide space and opportunity for future graduates to have a sense of self-identity and competitive ability. Following this view, a student's university experience is significantly correlated with the development of his well-being. Competent students are those who are well-equipped with knowledge, skills and values that are relevant to current practice. This paper is to evaluate students' challenges, skills, and preparations at the University in facing the IR 4.0 era. The respondents were comprised of university students who were selected through purposive sampling. The findings identified several main skills; career and life skills, learning and innovation skills, information, media and technology skills. This study discussed the possible scenarios that might be faced by the students and the university in depth. Based on the findings, proactive measures are needed to encourage students to improve their skills, particularly the skills

related to information technology, knowledge, and personal soft skills. Such measures are crucial to fulfil the challenges of IR 4.0.

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