Integration and Trends of Technology IR 4.0 In Malaysian Education System

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Abstract - This current study aims to identify the trends in the use of IR4.0 technology activities implemented in the Malaysian education. The research methodology is based on the PRISMA model (Preferred, Reporting Items for Systematic Reviews and Meta-Analysis) which is used as a method of obtaining data analysis using the main electronic databases namely Web of Science (WoS) and Scopus. A comprehensive survey through data analysis has found 23 studies on IR4.0 technology in the publication period between 2018 to 2020 implemented in education context of studies in Malaysia based on the specified criteria. IR4.0 technology activities as teaching aids in teaching and learning are more implemented than as a syllabus that needs to be learned. While the level of education that integrates IR4.0 technology is dominated by higher education institution through the involvement of lecturers, students and administration compared to teachers and school students. The field of Engineering and Computer Science is ahead of other fields. The study was synthesized using ATLAS.ti 8 software based on general characteristics such as how activities using IR4.0 technology were integrated, level of education, and field of education were implemented as well as the potential integration of IR4.0 technology to the Malaysian education system. Some suggestions for future scholars will be discussed at the end of this study.

Key words:- Digitalization, Industrial Revolution 4.0, Teaching Aid, Technological Activities.

INTRODUCTION

The Fourth Industrial Revolution 4.0 (IR 4.0) has changed emerged in the way people live, work, learn and communicate with each other, as people in the 21st century are inseparable from information technology. The Fourth Industrial Revolution 4.0 (IR 4.0) was incepted under the advocacy of World Economic Forum (WEF) and has emerged with a network of nine technological variables namely simulation, augmented reality (AR), internet of things (IoT), big data analytic, cloud computing, cyber security, additive manufacturing, advanced manufacturing and horizontal and vertical integration (Schwab, 2016). Such intervention has changed both working pattern and lifestyle. Ministry of International Trade and Industry (MITI) Malaysia, 2018 further argued that the implication of IR4.0 had travelled to national boundary keeping its pace to international competition.

Education 4.0 in Malaysian education system was introduced Ministry of Higher Education (MOHE) with the theme "Higher Education 4.0: Knowledge, Industry and Humanities" in 2018. In the context of education 4.0, technological variables that are synonymous with IR 4.0 are also listed, such as digital technology, as well as information and communication technology (Büchi *et al.*, 2020; Maksimchuk and Pershina, 2017; Shahroom and Hussin, 2018). The Ministry of Education Malaysia (MOE) then comprehensively introduced the Industrial Revolution Education Colloquium 4.0 to the secondary and primary education system, with the theme "Imagineering Education in The Fourth Industrial Revolution (IR 4.0)" in 2019. In addition, the main factor for the successful implementation of IR 4.0 is the innovative integration of the cyber and physical world of knowledge and skills in all areas of education through integration and functionality (Amiron *et al.*, 2019). Ironically, Education 4.0 highlights the penetration of digital technology into daily life, bringing the benefits of IR 4.0 into the education system for it to be more competitive and sustainable.

Education 4.0 emerged as a response in line with the current development of IR 4.0. The use of technology and the internet has become increasingly popular and widely used. For example, in terms of education, especially during the Covid 19 pandemic, this has limited every movement and restricted educational activities. However, to ensure the effective teaching activities during the Covid 19 pandemic, online learning is necessary. Therefore, there is no doubt that the emergence of technology has immerged into education to ensure high-quality learning for students (Mustakim, et al., 2021; Sulaiman, et al.,2017). The emergence of technology such as the use of smartphones, tablets and other smart gadgets provides opportunities for online learning.

On the other hand, the emergence of technology provides a learning experience with new norms and practice. Students using smartphones have been able to increase opportunities and participation in online learning (Abd Majid et al., 2020; Krishan et al., 2020). However Ling and Matore (2020), view the implementation of teaching and learning using mobile devices is still new and immature and requires careful implementation planning. In contrast Krishan *et al*. (2020) suggests that the incorporation of technology in this education scenario still needs to maintain a culture of social interaction between teachers, students, and peers to improve analytical skills and critical thinking skills. As a foreseeable long-term pandemic scenario, educators have the responsible to make education be more interesting and exciting by incorporating new technologies as a part of learning in this IR 4.0 era (Hussin et al., 2019). This effort is to

create a conducive and interesting learning environment to attract students to master in learning and increase their motivation (Abd Majid et al., 2020; Halili, 2019). The integration of IR 4.0 era technology can be implemented in stages to bring the education system closer to industry standards. According to Maksimchuk and Pershina (2017), implementation begins with policymakers, administrators, educators, and students, and leads to a complete overhaul of the educational system. This approach will minimize the impact of the implementation burden in order to be ready to change the structure of education towards Education 4.0.

Education 4.0 responds in line with the current development of IR 4.0, it is an impetus and a trend of global development to ensure the transformation of the future education system. The traditional education system is needs to be evaluated and revised to educate students and the entire education community about the emergence of new technologies in the IR 4.0 era (MOE, 2019). Vision 2020 hopes to turn Malaysia into a developed country driven by industrial and agricultural sector by the year 2020 (Sulaiman & Abdul Rahim, 2009). Redevelopment of a flexible education system that meets student needs, key knowledge disciplines and resource provision requires due attention without giving up the National Philosophy of Education foundations (Curriculum Development Division, 2014). Through technology, human resources, teaching and learning information, and data on education will present new challenges in the 21st century education system (Mokhtar et al., 2019). On the other hand, the integration of education with mobile digital technology has the potential to increase productivity in teaching and learning, while building flexible spaces to support interactive communication between educators and students in exploring scientific concepts with relevant information (Kung-Teck *et al.*, 2020; Wijngaards-de Meij and Merx, 2018). This makes education in this age of digitalization to demand the integration of all levels in the education system, especially proactive educators, to make it a reality for learning to be through expertise, planning, and teaching and learning analysts focused on Education 4.0.

Through the Secondary School Standard Curriculum (SSSC) two new subjects, which are Basic Computer Science and Design and Technology, have been implemented since 2016 at the lower secondary level by the MOE. These two new subjects are implemented by introducing the technological elements of the IR 4.0 era which is computational thinking and programming, as part of the syllabus that students need to competences (Curriculum Development Division, 2017). Through the new curriculum, students aim to master the changes and use of technology to solve problems creatively and innovatively in the learning environment by applying 21st century skills (Ministry of Education, 2016). In addition, public universities also strive to provide future available curriculum structures with organic and changeable features, collaboration with the industry, and implement of transformative delivery in learning by integrating IR 4.0 era technologies (HEI, 2018). As the current education system has led to the integration of Education 4.0 and IR 4.0, the entire formal education needs to be given attention to explore whether the implementation of technological activities of the IR 4.0 era has a significant impact on the development of Education 4.0 in Malaysia. Therefore, this study was conducted to identify the technological activities, education level and education field of the IR 4.0 era implemented in the context of Malaysia education. In order to achieve this focus, the research questions used as a guide for this study are as follows:

- What are the technological activities of the Industrial Revolution 4.0 era implemented in Malaysian education?
- What are the level of education that integrates the technology of the Industrial Revolution 4.0 era in Malaysian education?
- What are the field of education that applies the technology of the Industrial Revolution 4.0 era in Malaysian education?

RESEARCH METHODOLOGY AND PROCEDURES

Study on activities, levels and areas of education that integrate IR 4.0 technology activities are analyzed based on the Systematic Literature Review method better known as SLR, using Atlas.ti 8 which is comprehensive computer software (Elmonem et al., 2017). This study uses PRISMA based on four steps, identification, screening, eligibility, and inclusion, as used by (Mohd Kusnan et al., 2020; Shaffril et al., 2018). The identification phase is to identify some keywords used in the article relevant to this study. The keywords which are listed according to the priority for this study are "industrial revolution 4.0", "education", and "Malaysia". Apart from that, the use of synonymous and alternative terms is also used, namely "Industry 4.0" and "education 4.0", using the word "OR". The use of "AND" in the search string is to ensure that keyword searches are found in a wider range of findings, while the use of "OR" is to find synonymous meanings of the study (Cruz-Benito, 2016; Kitchenham, 2004) as stated in Table 1 below:

TABLE I

SEARCH STRING

Database	Search String
Scopus	TITLE-ABS-KEY (("Industrial Revolution 4.0" OR "Industry 4.0" OR "Education 4.0") AND ("education") AND ("Malaysia"))
WoS	TS=(("industrial revolution 4.0" OR "Industry 4.0" OR "education 4.0") AND ("education") AND ("Malaysia"))

Source of literature review search in this study was done through two major journal databases namely Web of Science (WoS) via link (https://mjl.clarivate.com/search-result) and Scopus through link (https://www.scopus.com/home.uri). The WoS database was established by Clarivates Analytics and is considered one of the main databases that is a comprehensive reference for scholars comprising 256 scientific fields including social sciences, sciences as well as the arts and humanities since 1900 on a global scale (Yong-Hak, 2013). WoS also supports more than 95% of research institutions, gathering over 20 million researchers over 34,000 indexed journals covering 171 million data over the past 119 years. Meanwhile, Scopus is the largest database platform that collects abstracts from researchers over 23,000 journals among 5,000 international publishers. Scopus presents a glimpse of global scholarly studies in the fields especially science, technology, medicine, social sciences, and the arts and humanities up to 51 years ago. However, in the study context of IR 4.0 technology in Malaysian education, WoS found 8 articles while Scopus found 51 published articles. The selection of these two databases is to ensure that the data required for this study is valid and covers a wider range of article coverage and can produce more accurate study findings (Zhao, 2014). In addition, this is to ensure that the selection of published articles obtained is relevant and relevant to the purpose of the study (Kitchenham and Charters, 2007a; Povsic *et al*., 2019).

This literature reviews only found articles related to the study published between 2018 and 2020 only, although the initial search was not limited to a specific publication period. This effort has obtained 59 articles and conferences related to IR 4.0 technology in Malaysian education. The screening phase aims to detect duplicate articles by specifying as many as three excluded articles. Meanwhile, a total of 56 articles were screened next in order to select articles that are relevant for this study based on the eligibility and exclusion criteria. The remaining articles are then screened in more detail and in-depth, focusing on the title and abstract of articles for the purpose of shrinking and excluding articles that are not related to the trend of IR 4.0 technology activities in Malaysian education. Articles that do not meet the criteria and purpose of the study will be removed and caused 20 articles to be excluded. Staples and Niazi (2007), stressed the need to record what happens when conducting a literature review survey to prove that survey reporting does not deviate from the purpose of the study. Entries for the screening phase of entry and exclusion criteria are shown in Table 2.

TABLE II

INCLUSION AND ELIGIBILITY CRITERIA

| Criteria	Inclusion	Eligibility
Type of Literature	Research articles, Conference articles	Systematic review articles, book series, books, chapters in books
Language	English and Malay	Other English and Malay
Time frame	2018 until 2020	<2018
Index	Index of Social Science citations	None
Implementation	Advanced technology, level and field of education towards the implementation of Industrial Revolution 4.0.	Without the use of technology, the level and field of education on the implementation of the Industrial Revolution 4.0
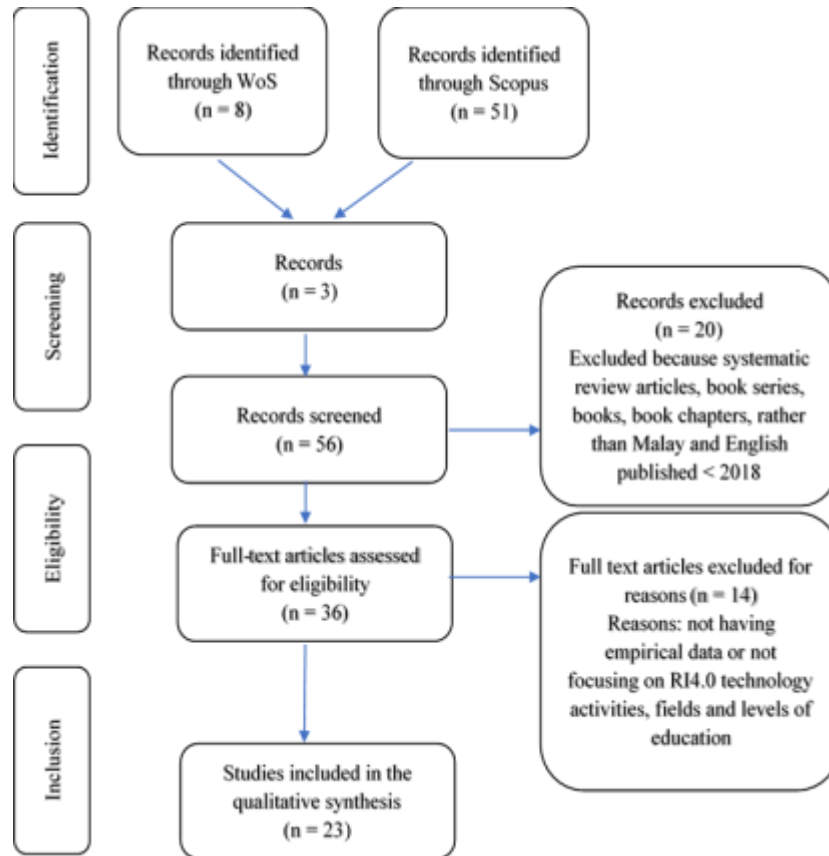
FIGURE 1

PRISMA REVIEW FLOWCHART

As a result, a total of 23 articles were selected to represent the literature review study which explicitly discussed the three entry criteria, namely determining the activities, level of education, and field of education that integrate IR 4.0 era technology in education in Malaysia. Therefore, a comprehensive and in-depth literature review study was conducted to meet the purpose of the study. Figure 1 shows the literature review phase used in this study.

TABLE III

LIST OF ACTIVITY TRENDS, EDUCATION LEVEL, AND FIELDS OF EDUCATION INTEGRATE IR 4.0 TECHNOLOGY IN MALAYSIAN EDUCATION

Author and Year	IR 4.0 Technology	Activity Trend	Education Level	Education Field
Kowang et al., (2020)	Information Communication and Technology (ICT)	Innovative and flexible teaching and learning ecosystem in the classroom characterized by future employment (contemporary learning ecosystem)	Graduate student	Education Pedagogy
Airil Haimi Mohd Adnan et al., (2020)	VR	Language translation activities using 360-degree spherical video software online	Under-graduate student	Foreign Language

Ratnasingam *et al.,* **(2020)**	Simulation	The Eramus + program simulates the automation of industrial technology 4.0	Graduate student	Furniture and Wood Manufacturing
Yusof *et al.,* **(2020)**	Digital Communication	Collaborative Community Model with the use of new digital communication media such as WhatsApp, Telegram and digital communication devices	School admin and PTA	Education Administration
Kung-Teck et al., **(2020)**	Future Classroom	M-Heutagogy applies Teaching and learning online	University lecturer and graduate student	Education
Rahmalan *et al.,* **(2020)**	Computer Systems and Automation	Game database development programming model	Graduate student	Computer Science (Database Management)
Azman *et al.,* **(2020)**	E-learning Platform	MYGURU, as a Learning Management System (LMS) platform to coordinate Teaching and learning activities online	University lecturer	Education Administration
Yaakop *et al.,* **(2020)**	Web-based Learning	Web 2.0, as a new method of Teaching and learning	University lecturer and graduate student	Educational Pedagogy
Abdul Bujang *et al.,* **(2020)**	Digital Learning	e-learning platform	Polytechnic student	Engineering
A. H.M. Adnan, (2020)	VR	ELSA 360 °, to teach advanced communication skills in real -life situations of future employment	Under-graduate student	Technical and Vocational Training Education (TVTE)
Karim *et al.,* **(2020)**	Mobile Learning Technology	Google Form, as a medium of assessment and evaluation	Under-graduate student	Across all faculties
Karim *et al.,* **(2020)**	Simulation	Simulation in Healthcare in Realm of Education 4.0	Graduate student	Health Education
Sham *et al.,* **(2019)**	Digital Technology	Google Form, as a method of obtaining survey data: public awareness on the readiness and preparedness of IR 4.0	Graduate student	Engineering

Ghani and Muhammad, (2019)	Simulation	Simulations incorporate various technologies in the accounting work environment during Teaching and learning implementation	Graduate student	Accounting
Singh and Kasim, (2019)	New Teaching and Learning Technology	You Tube, as a Teaching and learning approach	TESL training teacher	English
Mohammad *et al.*, (2019)	Prototype (functional system)	The Smart Factory Prototype, as a functional modular production system for learning purposes. Connect to servers and internet using SCADA software.	Graduate student	Systems Engineering
Mokhtar *et al.*, (2019)	Big Data	Data-driven and Learning analytic, to support and enable more accurate planning and decision making.	Lecturer and university management staff	University Admin and Management
Ismail and Hassan, (2019)	New Technology 4.0 knowledge and skill	Competency 4.0, reorganizing teaching and learning through software, network systems, programming to master Big data technology	Polytechnic lecturer and student	Civil, Mechanical, Electrical and Electronic Engineering and visual com-munication design.
Shahbodin *et al.*, (2019)	Digital Technology	iBakery, an electronic courseware application	Secondary special education pupils	Special Education
Hussin *et al.*, (2019)	Programming and Automation	CRYsTaL program, to improve students' analytical skills and solve problems practically using Arduino programming language and ATMega 328P microcontroller	Technical high school student	Electrical and Electronic Engineering Studies
Sirat, (2019)	VR	Google Sightseeing, a learning experience about the actual situation of the physical change of location in a virtual situation	University geographer	Geography
Majid and Majid, (2018)	AR	AR Chemistry Kit, is a learning application that combines 3D models of atoms and real experimental videos.	Form 4 secondary school pupils	Chemistry
Zamin *et al.*, (2018)	Robotic	LEGO Mindstorms EV3, is a learning kit with a robotic approach	Children with special needs	Special Education

The results of the systematic literature review analysis found 23 studies that met the criteria related to the trend of technological activity of the IR 4.0 era in Malaysian education based on the purpose of the study. The findings found six trends in the IR 4.0 era technological activities, namely Augmented Reality (AR) and Virtual Reality (VR), simulation, robotics and prototyping, digital and communication technology, big data analytic as well as programming and automation. Meanwhile, the trend of activities occurs as early as the level of school students, higher institution students, lecturers, teachers, and the education administration. Next, the integration of IR 4.0 era technological activities took place in 11 areas, being focused more as teaching aids to facilitate teaching and learning sessions. The study conducted showed that there was an increase in the trend of the use of IR 4.0 era technology in education in Malaysia conducted by scholars from 2018 to 2020. This increase in trend shows the development of education to be on par with the needs of the industry in Malaysia and has shown positive potential to achieve Education 4.0. The increasing trend of master's studies is shown in Figure 2 below;
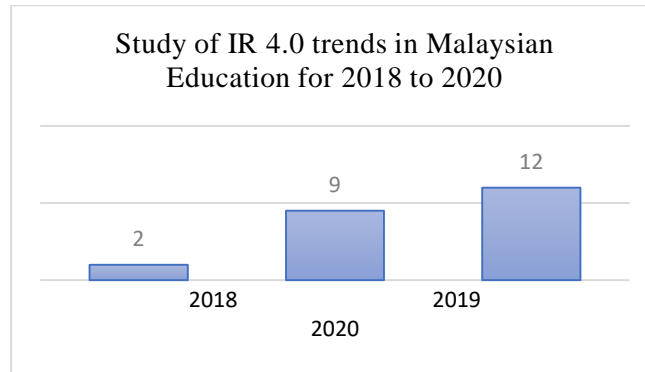

FIGURE 2

THE INCREASING TREND OF THE STUDY OF IR 4.0 IN MALAYSIAN EDUCATION

I. Technological Activities of the IR 4.0 era

The first finding is technological activities of the IR 4.0 era analysis, it shows that the trend of technological activities of the IR 4.0 era was implemented through the use of AR, VR, simulation, robotics and prototyping, digital and communication technology, big data analytic and programming and automation. However, the use of the technological activities of the IR 4.0 era as a syllabus as part of the curriculum document is still limited, and changes need to be made so that the understanding of technology is not only for the purpose of teaching aids in teaching and learning, but also to master about IR 4.0 era technology itself. Analysis of IR 4.0 era technological activities found in Malaysian education using ATLAS.ti 8 software is shown as in Figure 3.

FIGURE 3

WORD CLOUD TECHNOLOGICAL ACTIVITIES OF TECHNOLOGY IR 4.0 ERA GENERATE FROM 23 ARTICLES

II. Education Level

Next, the finding is regarding the education level of the applicant in implementation IR 4.0 technological activities in education, there are students of higher education institutions, lecturers of higher education institutions, teachers, students and children as well as school administrators. In general, it shows that the education system in Malaysia needs to inculcate technological elements of the IR 4.0 era to all levels involved in education so that the development of Education 4.0 can be implemented holistically.

III. Education Field

Lastly, with regard to the education field of implementing IR 4.0 in technological activities in the teaching process, eleven fields related to IR 4.0 in their teaching method. There are language, engineering, computer science, accounting, health, special education, geography,

chemistry, pedagogy, educational management and administration. The findings of this systematic literature review show that the integration of technology in the IR 4.0 era is suitable for application to the diverse but diversified education fields in Malaysia. In addition, in the IR 4.0 era integration of technology in the is implemented as a teaching aid in teaching and learning. However, there is a lack of implementation of technology integration in the IR 4.0 era which is made a part of the syllabus that needs to be mastered and studied, apart from the fields of Computer Science and Engineering. Thus, the mastery of IR 4.0 technology from the education level is in line with the agenda of the Malaysian Education Development Plan (MEDP) 2013-2025 as well as fulfilling the national Industry4wrd policy, towards achieving Education 4.0.

DISCUSSION

Base on the findings, first research question has been answered pertaining to the trend of technological activities of the IR 4.0 implemented in Malaysia education. In preparation for the development of education, educators needed to explore various technology tools and makes teaching and learning strategies to be motivate and stimulate students interest in learning. At the same time, as more and more technologies involve into education field, educators need to equip themselves with current developments in the use of the latest technology tools and digital equipment and (Abdul Bujang *et al*., 2020; Singh and Kasim, 2019). In Malaysia, the use of technologies and equipment that involved IR 4.0 elements in teaching are AR and VR (Airil Haimi Mohd Adnan *et al*., 2020; Majid and Majid, 2018; Sirat, 2019), simulation (Ghani and Muhammad, 2019; Mahdy *et al*., 2020; Ratnasingam *et al*., 2020), robotics and prototyping (Mohammad et al., 2019; Zamin et al., 2018), digital and communication technology (Abdul Bujang *et al*., 2020; Azman *et al*., 2020; Ismail and Hassan, 2019; Kowang *et al*., 2020; Kung-Teck *et al*., 2020; Shahbodin *et al*., 2019; Sham *et al*., 2019; Singh and Kasim, 2019; Yaakop *et al*., 2020; Yusof *et al*., 2020), big data analytic (Mokhtar et al., 2019) as well as programming and automation (Hussin et al., 2019; Rahmalan et al., 2020). The use of this technology is mainly as a teaching aid in the implementation of teaching and learning by teachers and lecturers. The use of teaching aids with the integration of digital and communication technology can drive students' interest, curiosity, and increase confidence while learning scientific concepts (Kung-Teck et al., 2020).

Furthermore, the findings for the second research question found that the level of education that integrates the technology of the IR 4.0 era in Malaysian education are the level of students of higher education institutions (Abdul Bujang *et al*., 2020; A.H.M. Adnan, 2020; Airil Haimi Mohd Adnan *et al*., 2020; Ghani and Muhammad, 2019; Ismail and Hassan, 2019; Karim *et al*., 2020; Kowang *et al*., 2020; Kung-Teck *et al*., 2020; Mahdy *et al*., 2020; Mohammad *et al*., 2019; Mokhtar *et al*., 2019; Rahmalan *et al*., 2020; Ratnasingam *et al*., 2020; Sham *et al*., 2019; Yaakop *et al*., 2020), lecturers of higher education institutions (Azman *et al*., 2020; Ismail and Hassan, 2019; Kung-Teck *et al*., 2020; Mokhtar *et al*., 2019; Sirat, 2019; Yaakop *et al*., 2020), secondary school students (Hussin *et al*., 2019; Majid and Majid, 2018; Shahbodin *et al*., 2019), children (Zamin et al., 2018), teachers (Singh and Kasim, 2019) as well as administrative management (Mokhtar et al., 2019; Yusof et al., 2020). In this regard, the use of IR 4.0 era technology is suitable to be implemented from the level of children, school children, teachers, higher education institution students, lecturers, and administrative management in Malaysian education. Indirectly, lecturers and teachers need to be prepared to equip themselves with the rapid technological change based on IR 4.0 (Zulnaidi and Majid, 2020), while students get the optimal benefits and become more skilled and knowledgeable in future career (Ahmad et al., 2020; Juhdi et al., 2018). Moreover, the administrative management needs to be aggressive in managing strategies relevant to the implementation of IR 4.0 (Zulnaidi and Majid, 2020).

Answering to the third research question, field of education that applies the technology of the IR 4.0 era in Malaysian education, it was found that there were eleven fields that integrate the technological activities of the IR 4.0 era such as Language (Airil Haimi Mohd Adnan *et al*., 2020; Singh and Kasim, 2019), Engineering (Abdul Bujang *et al*., 2020; Hussin *et al*., 2019; Ismail and Hassan, 2019; Karim *et al*., 2020; Mohammad *et al*., 2019; Sham *et al*., 2019), Computer Science (Karim et al., 2020; Mohammad et al., 2019; Rahmalan et al., 2020), Accounting (Ghani and Muhammad, 2019), Health (Mahdy et al., 2020), Special Education (Shahbodin et al., 2019; Zamin et al., 2018), Geography (Sirat, 2019), Chemistry (Majid and Majid, 2018), TVET (A. H.M. Adnan, 2020; Ratnasingam et al., 2020), Pedagogy (Kowang et al., 2020; Kung-Teck et al., 2020; Yaakop et al., 2020; Yusof et al., 2020) as well as Educational Management and Administration (Azman et al., 2020; Mokhtar et al., 2019; Yusof et al., 2020).

IMPLICATION AND RECOMMENDATION

This systematic review is a remark of educators who are responsible for intergrating technology into teaching. Especially in the context of the current Covid 19 pandemic, teachers need to constantly update, explore and practice the latest technology and integrate it into education. This is not only for the continuation of the syllabus, but also to expand the use of technology into the education field to bring learning into a more international field. For example, a Malay teacher can teach a student in a rural area or can teach an international student studying a Malay language course in another country. This is important because this is a moment educator must form an alliance. From this study, educators shall also realize that IR 4.0 or Education 4.0 is not limited to educational level and educational field. Additionally, through the practice of Education 4.0 knowledge, the emergence of technology also helps students prepare for the future life in the 21st century, from the perspective of Education 4.0, technologies enable teaching become more interesting and exciting, this is because technology makes learning more worldwide, virtual and customized (Shahroom & Hussin, 2018).

In Malaysia, exposure to the development of IR 4.0 which started since 2018 has been welcomed by all economic and social sectors including education. However, to face the challenge of IR 4.0, changes towards Education 4.0 must occur in line with current developments. IR 4.0 elements were first introduced in MOE schools through the revision of the new primary and secondary school standard curriculum, in the subjects of Basic Computer Science and Design and Technology, among which are programming and

computational thinking. Therefore, activities involving IR 4.0 era technology are focused on implementation that focuses on those two subjects only, based on the elements set out in   MOE's Curriculum and Assessment Standard Documents (CASD). However, IR 4.0 era technology activities need to be extended to other subjects such as studies from abroad that apply IR 4.0 era technology through teaching and learning activities, or part of the curriculum such as Physics (Asfiati, 2019), Mechanical Engineering (Hamid *et al*., 2019; Poor and Basl, 2020), and Science, Technology, Engineering, Arts and Mathematics (Bai et al., 2020; Tziortzioti et al., 2019). For the proposed improvement of future studies, it is recommended to conduct studies with a wider scope of research such as the acceptance of IR 4.0 era technology integration in the education system that is not limited to Malaysia only. Apart from that, it is recommended to use several more databases that will provide a wider coverage of journal articles and articles. This is to contribute to findings that are broader and more generalized

CONCLUSION

In conclusion, this systematic literature review study aims to contribute to knowledge of the use of IR 4.0 era technology in teaching and learning, as well as to provide an overview based on an article analysis on the IR 4.0 era technology activity trends, level of education, and field of education that integrates IR 4.0 era technology in education in Malaysia, towards Education 4.0. Based on the findings of the literature review, this study is relevant as there are still lacking systematic literature studies found focusing on the integration of IR4.0 era technology, especially on the IR 4.0 era technology approach which are effective for teaching and learning activities in Malaysian education.

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REFERENCES

[1] Abd Majid, S. N., Ismail, R., & Abu Bakar, A. H. (2020). Learners' Perspective of Using 360-degree Video in Reading Classroom. Malaysian Journal of Social Sciences and Humanities (MJSSH), 5(10), 238–246. https://doi.org/10.47405/mjssh.v5i10.501

[2] Abdul Bujang, S. D., Selamat, A., Krejcar, O., Maresova, P., & Nguyen, N. T. (2020). Digital learning demand for future education 4.0-case studies at Malaysia education institutions. Informatics, 7(2), 1–11. https://doi.org/10.3390/informatics7020013

[3] Adnan, A. H.M. (2020). From interactive teaching to immersive learning: Higher Education 4.0 via 360-degree videos and virtual reality in Malaysia. IOP Conference Series: Materials Science and Engineering, 917(1), 0–14. https://doi.org/10.1088/1757-899X/917/1/012023

[4] Adnan, Airil Haimi Mohd, Shak, M. S. Y., Karim, R. A., Tahir, M. H. M., & Shah, D. S. M. (2020). 360-degree videos, VR experiences and the application of education 4.0 technologies in Malaysia for exposure and immersion. Advances in Science, Technology and Engineering Systems, 5(1), 373–381. https://doi.org/10.25046/aj050148

[5] Ahmad, A. R., Segaran, P. A. P., & Sapry, H. R. M. (2020). Industry revolution 4.0 and job creation for the university students. International Journal of Advanced Trends in Computer Science and Engineering, 9(3), 2968–2971. https://doi.org/10.30534/ijatcse/2020/73932020

[6] Amiron, E., Latib, A. A., & Subari, K. (2019). 9-Industry Revolution 4.0 Skills and Enablers. International Journal of Recent Technology and Engineering (IJRTE), 8(1C2 May), 484–490.

[7] Asfiati. (2019). The Use of Application Neuroscience in Facing the Industrial Revolution 4.0 the Principals of Senior High School over the Branch of the Education Department. Journal of Physics: Conference Series, 1387(1), 0–6. https://doi.org/10.1088/1742-6596/1387/1/012112

[8] Azman, M. N. A., Kamis, A., Kob, C. G. C., Abdullah, A. S., Jerusalem, M. A., Komariah, K., & Budiastuti, E. (2020). How good is myguru: The lecturers' perceived usefulness and attitude. Cakrawala Pendidikan, 39(2), 422–431. https://doi.org/10.21831/cp.v39i2.30790

[9] Bai, Y., Peng, D., & Yang, J. (2020). Design of Virtual Physics Laboratory Based on STEAM Education. Advances in Social Science, Education and Humanities Research, 428(Iceeim 2019), 18–21. https://doi.org/10.2991/assehr.k.200401.006

[10] Büchi, G., Cugno, M., & Castagnoli, R. (2020). Smart factory performance and Industry 4.0. Technological Forecasting and Social Change, 150, 1–10. https://doi.org/10.1016/j.techfore.2019.119790

[11] Cruz-Benito, J. (2016). Systematic Literature Review Step-By-Step. https://doi.org/10.5281/zenodo.165773

[12] Curriculum Development Division. (2014). National Curriculum Development Policy. Ministry of Education Malaysia.

[13] Curriculum Development Division. (2017). Secondary School Standard Curriculum (SSSC): Subject Curriculum Framework. Ministry of Education Malaysia. http://bpk.moe.gov.my

[14] Elmonem, M. A. A., Nasr, E. S., & Geith, M. H. (2017). Benefits and challenges of cloud ERP systems: A systematic literature review. Future Computing and Informatics Journal, 1, 1–9. https://doi.org/10.1016/j.fcij.2017.03.003

[15] Ghani, E. K., & Muhammad, K. (2019). Industry 4.0: Employers' expectations of accounting graduates and its implications on teaching and learning practices. International Journal of Education and Practice, 7(1), 19–29. https://doi.org/10.18488/journal.61.2019.71.19.29

[16] Halili, S. H. (2019). Technological advancements in education 4.0. The Online Journal of Distance Education and E-Learning, 7(1), 63–69. www.tojdel.net

[17] Hamid, H., Jalinus, N., Inra, A., Ambiyar, A., Waskito, W., Sukardi, S., & Herlin, N. (2019). Development of Fourth Industry Oriented Mechanical Engineering Mechatronics Learning Devices 4.0. Journal of Education Research and Evaluation, 3(4), 266–275. https://doi.org/10.23887/jere.v3i4.23204

[18] Hussin, H., Kamal, N., & Ibrahim, M. F. (2019). Inculcating problem solving and analytical skills in STEM education practices: The CRYsTaL initiatives. International Journal of Innovation, Creativity and Change, 9(6), 260–272.

[19] Ismail, A. A., & Hassan, R. (2019). Technical competencies in digital technology towards industrial revolution 4.0. Journal of Technical Education and Training, 11(3), 55–62. https://doi.org/10.30880/jtet.2019.11.03.008

[20] Juhdi, N., Hashim, J., & Rahman, R. A. (2018). Job embeddedness and retention: A study among teachers in private islamic schools in Malaysia. Malaysian Journal of Consumer and Family Economics, 21(S1), 125–138.

[21] Karim, R. A., Adnan, A. H. M., Salim, M. S. A. M., Kamarudin, S., & Zaidi, A. (2020). Education Innovations through Mobile Learning Technologies for the Industry 4.0 Readiness of Tertiary Students in Malaysia. IOP Conference Series: Materials Science and Engineering, 917(1), 0–12. https://doi.org/10.1088/1757-899X/917/1/012022

[22] Kitchenham, B. (2004). Procedures for performing systematic reviews. In Joint Technical Report (Issue 1). https://doi.org/10.5144/0256-4947.2017.79

[23] Kitchenham, B., & Charters, S. (2007a). Guidelines for performing Systematic Literature Reviews in SE. Guidelines for Performing Systematic Literature Reviews in SE, 1–44. https://userpages.uni-koblenz.de/%7B~%7Dlaemmel/esecourse/slides/slr.pdf

[24] Kitchenham, B., & Charters, S. (2007b). Guidelines for performing Systematic Literature Reviews in Software Engineering.

[25] Kowang, T. O., Bakry, M. F., Hee, O. C., Fei, G. C., Yew, L. K., Saadon, M. S. I., & Long, C. S. (2020). Industry 4.0 competencies among lecturers of higher learning institution in Malaysia. International Journal of Evaluation and Research in Education, 9(2), 303–310. https://doi.org/10.11591/ijere.v9i2.20520

[26] Krishan, I. A., Ching, H. S., Ramalingam, S., Maruthai, E., Kandasamy, P., Mello, G. De, Munian, S., & Ling, W. W. (2020). Challenges of Learning English in 21st Century: Online vs. Traditional During Covid-19. Malaysian Journal of Social Sciences and Humanities (MJSSH), 5(9), 1–15. https://doi.org/10.47405/mjssh.v5i9.494

[27] Kung-Teck, W., Muhammad, M. binti, Abdullah, N. binti, & Hamdan, A. (2020). Mobile-heutagogical practices among student teachers: Its pedagogical affordances and challenges. International Journal of Interactive Mobile Technologies, 14(2), 130–143. https://doi.org/10.3991/ijim.v14i02.11819

[28] Ling, T. J., & Matore, M. E. @ E. M. (2020). Kesediaan guru dan pelajar terhadap penggunaan pembelajaran mobil dalam pembelajaran dan pemudahcaraan (PdPc): Sorotan literatur bersistematik. 5(10), 83–94.

[29] Mahdy, Z. A., Maaya, M., Atan, I. K., Abd Samat, A. H., Isa, M. H., & Saiboon, I. M. (2020). Simulation in healthcare in the realm of education 4.0. Sains Malaysiana, 49(8), 1987–1993. https://doi.org/10.17576/jsm-2020-4908-21

[30] Majid, N. A. A., & Majid, N. A. (2018). Augmented reality to promote guided discovery learning for STEM learning. International Journal on Advanced Science, Engineering and Information Technology, 8(4–2), 1494–1500. https://doi.org/10.18517/ijaseit.8.4-2.6801

[31] Maksimchuk, O., & Pershina, T. (2017). A new paradigm of industrial system optimization based on the conception "industry 4.0." MATEC Web of Conferences, 129. https://doi.org/10.1051/matecconf/201712904006

[32] Ministry of Education Malaysia. (2016). Secondary School Standard Curriculum: Form 2 Design and Technology. Curriculum Development Division Ministry of Education Malaysia.

[33] Ministry of Education Malaysia. (2019). Text of keynote speech and inauguration of honorable Maszlee Malik, Minister of Education in conjunction with the Industrial Revolution 4.0 Education Colloquium.

[34] Ministry of Higher Education. (2018). Malaysia future ready curriculum framework: An introduction. Ministry of Higher Education Malaysia.

[35] Ministry of International Trade and Industry (MITI). (2018). Industry4WRD: National Policy on Industry 4.0. Prime Minister Malaysia Office (Issue October).

[36] Mohammad, U., Cheng, Y. L., Abd Rahman, R., Johar, M. A., Ching, T. K., Roman, D., Martin, R., Asmar, L., & Kamaruddin, S. (2019). Smart factory reference model for training on industry 4.0. Journal of Mechanical Engineering (JMechE), 16(2), 129–144. https://jmeche.uitm.edu.my/

[37] Mohd Kusnan, R., Tarmuji, N. H., & Omar, M. K. (2020). Systematic Literature Highlights: Computational Thinking Activities in Education in Malaysia. Malaysian Journal of Social Sciences and Humanities (MJSSH), 5(12), 112–122. https://doi.org/10.47405/mjssh.v5i12.581

[38] Mokhtar, S., Alshboul, J. A. Q., & Shahin, G. O. A. (2019). Towards Data-driven Education with Learning Analytics for Educator 4.0. Journal of Physics: Conference Series, 1339(1), 0–7. https://doi.org/10.1088/1742-6596/1339/1/012079

[39] Mustakim, S. S., Sulaiman, T., Manaf, U. A., Minghat, A., & Rabindarang, S. (2021). Exploring Best Practices of Technical and Vocational Education and Training (TVET)

[40] Teachers in the 4th Industrial Revolution (4IR). Annals of the Romanian Society for Cell Biology, 1128-1137.

[41] Poor, P., & Basl, J. (2020). Machinery maintenance model for evaluating and increasing maintenance, repairs and operations within Industry 4.0 concept. IOP Conference Series: Materials Science and Engineering, 947(1), 0–7. https://doi.org/10.1088/1757-899X/947/1/012004

[42] Povsic, M., Enstone, A., Wyn, R., Kornalska, K., Penrod, J. R., & Yuan, Y. (2019). Real-world effectiveness and tolerability of small-cell lung cancer (SCLC) treatments: A systematic literature review (SLR). PLoS ONE, 14(7), 1–21. https://doi.org/10.1371/journal.pone.0219622

[43] Rahmalan, H., Ahmad, S. S. S., & Affendey, L. S. (2020). Investigation on designing a fun and interactive learning approach for Database Programming subject according to students' preferences. Journal of Physics: Conference Series, 1529(2), 6–13. https://doi.org/10.1088/1742-6596/1529/2/022076

[44] Ratnasingam, J., Yi, L. Y., Azim, A. A. A., Halis, R., Liat, L. C., Khoo, A., Daud, M. M. M., Senin, A. L., Latib, H. A., Bueno, M. V., Zbiec, M., Ganido, J., Ortega, J., Gomez, M. V., Hashim, R., Zakaria, S., Abidin, S. Z., & Amin, M. N. Z. M. (2020). Assessing the awareness and readiness of the Malaysian furniture industry for industry 4.0. BioResources, 15(3), 4866–4885. https://doi.org/10.15376/biores.15.3.4866-4885

[45] Schwab, K. (2016). The fourth industrial revolution. World Economic Forum.

[46] Shaffril, H. A. M., Krauss, S. E., & Samsuddin, S. F. (2018). A systematic review on Asian's farmers' adaptation practices towards climate change. Science of the Total Environment, 644, 683–695. https://doi.org/10.1016/j.scitotenv.2018.06.349

[47] Shahbodin, F., Maria, M., Mohd, C. K. N. C. K., & Jaafar, N. A. (2019). Supporting future career of autistic learners via technology: Design and development of iBakery courseware. Journal of Technical Education and Training, 11(3), 110–115. https://doi.org/10.30880/jtet.2019.11.03.013

[48] Shahroom, A. A., & Hussin, N. (2018). Industrial Revolution 4.0 and Education. International Journal of Academic Research in Business and Social Sciences. https://doi.org/10.6007/ijarbss/v8-i9/4593

[49] Shahroom, A. A., & Hussin, N. (2018). Industrial revolution 4.0 and education. International Journal of Academic Research in Business and Social Sciences, 8(9), 314-319.

[50] Sham, R. M., Senik, Z. C., & Danial, M. A. (2019). Exploring engineering-educators' perceptions and challenges on the IR 4.0 at a Technical University in Malaysia. International Journal of Advanced Trends in Computer Science and Engineering, 8(1.6 Special Issue), 497–503. https://doi.org/10.30534/ijatcse/2019/7281.62019

[51] Singh, C. K. S., & Kasim, Z. M. (2019). Pre-service teachers' mastery of technological pedagogical content knowledge for teaching English language. Universal Journal of Educational Research, 7(10 D), 24–29. https://doi.org/10.13189/ujer.2019.071705

[52] Sirat, M. (2019). Geography, Geographers and the Future Scenario: Malaysia. IOP Conference Series: Earth and Environmental Science, 286(1). https://doi.org/10.1088/1755-1315/286/1/012001

[53] Staples, M., & Niazi, M. (2007). Experiences using systematic review guidelines. Journal of Systems and Software, 80(9), 1425–1437. https://doi.org/10.1016/j.jss.2006.09.046

[54] Sulaiman, T., Abdul Rahim, S.S. (2009), "Perspectives of science teaching: Comparison between Western Australian teachers and Malaysian teachers", International Journal of Learning, 16(2), pp. 63–76

[55] Sulaiman, T., Kuppusamy, S.K., Ayub, A.F.M. and Rahim, S.S.A. (2017), "Relationship between critical thinking disposition and teaching efficacy among special education integration program teachers in Malaysia", AIP Conference Proceedings, AIP Publishing LLC, Vol. 1795, No. 1, p. 020027.

[56] Tziortzioti, C., Mavrommati, I., & Chatzigiannakis, I. (2019). Evaluating a design-based learning approach using IoT technologies for STEM education. CEUR Workshop Proceedings, 2492, 75–83.

[57] Wijngaards-de Meij, L., & Merx, S. (2018). Improving curriculum alignment and achieving learning goals by making the curriculum visible. International Journal for Academic Development, 23(3), 219–231. https://doi.org/10.1080/1360144X.2018.1462187

[58] Yaakop, A. Y., Mahadi, N., Ariffin, Z. Z., Hasan, Z. R. A., & Harun, M. (2020). Examining students' continuance usage intention for web-based educational tools: A developed integrated structural model approach. Asian Academy of Management Journal, 25(1), 25–41. https://doi.org/10.21315/AAMJ2020.25.1.2

[59] Yong-Hak, J. (2013). The definition resource for global research: Web of Science. In Thomson Reuters. http://wokinfo.com/media/pdf/WoSFS_08_7050.pdf

[60] Yusof, M. R., Dayang Rafidah Syariff, M. F., Yaakob, M. F. M., Don, Y., & Ibrahim. (2020). Digital communication: Priorities in the relationship of principal leadership and collaborative community at Malaysian School. Universal Journal of Educational Research, 8(4), 1149–1154. https://doi.org/10.13189/ujer.2020.080404

[61] Zamin, N., Arshad, N. I., Rafiey, N., & Hashim, A. S. (2018). Robotic teaching aid for disabled children: A sustainable solution for industrial revolution 4.0. International Journal of Engineering and Technology(UAE), 7(2), 200–203. https://doi.org/10.14419/ijet.v7i2.28.12912

[62] Zhao, J. G. (2014). Combination of multiple databases is necessary for a valid systematic review. International Orthopaedics, 38(12), 2639. https://doi.org/10.1007/s00264-014-2556-y

[63] Zulnaidi, K., & Majid, M. Z. A. (2020). Readiness and understanding of technical vocational education and training (TVET) lecturers in the integration of industrial revolution 4.0. International Journal of Innovation, Creativity and Change, 10(10), 31–43.

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