Digital Competency among Students: A Case study at UiTM Kelantan Branch

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Abstract

IR4.0 technologies enable the learning to be conducted in an easier way and meaningful manner. Many online learning platforms such as Google Classrooms, Frog Classrooms and MOOCS are developed based on the IR4.0 technologies. Students should have necessary competencies in coping with IR4.0 learning technologies. However, there is a lack of digital skills among students as reported in the literature. This study investigates the level of digital competency among students in response to the prescribed issue. The samples were 389 students studying multiple academic programs in UiTM, Kelantan Branch. By adopting the questionnaires used in previous research, this study specifically measures the information and data literacy, communication, safety, digital content creation and problem-solving competencies following the DigComp Framework. The SPSS version 22 was employed for data analysis. The results indicate lowest score in digital content creations compared to other four competencies. The potential implication of this study is the emphasis on this competence as this skill requested is critical in digital gig economy.

Keywords*:* Digital competence, DigComp framework, UiTM Kelantan branch, digital skills.

1.0 Introduction

The term IR4.0 is derived from the German word for innovation, growth and processes in the manufacturing sector, including new developments in the industry. Today, the Fourth Industrial Revolution (IR4.0) gives a great impact towards individual's lifestyles, business operations and economic growth. IR4.0 is changing how we live, work and communicate and reshaping government, education, healthcare as well as commerce sectors (Trailhead, 2020). The Fourth Industrial Revolution (IR4.0) has had a great effect on daily human life, corporate practices and economic development of individuals today.

IR4.0 has been applied in various fields such as economy, business, legislation, health and education. For example, IR4.0 is applied in economics through the introduction of online banking (Sabri, 2019). In the field of business, IR4.0 is applied using cashless payments through block chain technology (Zuriati, 2019). The impact IR4.0 had been in legislation system with the implementation in civil cases, in which the judiciary permitted parties to apply for court hearings to be held remotely by means of the court's e-Review system, e-mail exchange or video conferencing, where consent and leave of court is obtained from the parties. In terms of health, Sharon Alita (2021) stated that IR4.0 involved the use of robotics and artificial intelligence (AI) in disease surgery using da Vinci Surgical System. In addition to the examples mentioned above, IR4.0 also applied in many other fields including education.

As for education, the IR4.0 technology makes the learning process easier. The Google Classrooms, Frog Classrooms, MOOCS, Google Meet, Zoom and Kalam among others are an IR4.0 technology enables the learning delivery. A study conducted by Hasnah (2020) found that 89.5 percent of students one Malaysian public university

used Google Meet app as a platform to follow online classes and 2.6 per cent using Kalam. It is apparent that the IR technology enables the teaching and learning processes anytime and anywhere.

The use of IR4.0 technology in teaching and learning raises the issue digital technology-related skills and knowledge. Digital competency encompasses the knowledge and skills required for an individual (United Nations, 2019). Digital competency is among the vital competences for the 21st century in the age of 21st century (Lumbar et al., 2019). Lumbar et al. (2019) also said that virtual competence means that students no longer understand the grounded simple IT capabilities most effectively, e.g. using computer systems to retrieve, analyze, manage, create, gift and alter information, but also to speak and engage in interactive networks across the internet.

This is in line with the view Ismail (2020) that says that the marketability of graduates of the IR4.0 age not only emphasizes the expansion of high thinking and technical skills, but also highlights the importance of promoting problem-solving abilities and digital innovation.

The skill mentioned above is crucial to enable students to master effective learning in accordance with the development of IR4.0. However, past studies conducted among Malaysian students on ICT competency among pre-university students were somewhat limited (Tenku Putri Norishah et al. 2012; Teck Soon Hew, 2011; Ahmad, Ayub, & Khambari, 2019). The limitation eventually did not provide an overall picture of the digital competency and students' digital abilities in the face of virtual learning and online distance learning. The study reported in this paper enriches the literature on students' digital competency by examining the level of digital competency among university students at the Kelantan Branch. In conducting this study, the framework of DigComp Framework 2.1 was adopted. In general, this framework comprises the dimension of information and data literacy, communication and collaboration, digital content creation, safety and problem solving which are adequate to measure the students' digital competency skills.

In establishing the aim of this paper, the following arrangement is identified. Next section presents the review of literature in relation to Industrial Revolution (IR) 4.0, IR4.0 in human life domain, IR4.0 and digital competency among students and digital competence. Section 3 discusses the method that this paper adopts. The discussion follows in Section 4 and Section 5 concludes the paper.

2.0 LITERATURE REVIEW

The Industrial Revolution (IR) 4.0 has a long and colorful history. It was first coined by renowned Historian Arnold Toynbee (1889-1975) (Dzulkifli Abdul Razak, 2020). There are 4 levels of Industrial Revolution; Industrial 1.0 that uses of steam silent in industrial activity, Industrial 2.0 that involves electricity power, Industrial 3.0 that is based on information and computer technology and automation technology and now Industries 4.0 or Industrial Revolution 4.0. Industrial Revolution 4.0 that is characterized by a combination of digital, physical, or biological technology systems involving new capabilities namely machinery, human and new technological methods (Universiti Teknologi Malaysia & Ismail, 2018). Among the growing trends of IR4.0 technologies are simulation technology, IoT, cloud computing, manufacturing of additive manufacturing, reality strengthening systems (augmented reality), big data analysis (big data analytics) and automation robots. The development of innovation and technology, driven by digital power and the Internet makes IR4.0 drives human life in all aspects of life.

The IR4.0 penetrated all human life segments including economy, business, legislation, health and others. According to Schwab (2011), The Industrial Revolution (IR) 4.0 changes the way people work and live life. These include changes in various aspects of human life such as in the form of communication from telephone to smartphones use of e-commerce in shopping activities, introduction to smart homes technology, schools, and smart factories as well as drone applications in agriculture and safety. This is supported by Jumadi (2020) who stated that IR4.0 is a major change that will take place in providing convenience to human life.

The IR4.0 technology significantly affects the education segment of human life. Teaching methods at present have been transformed to the technology-based learning in which the learning and teaching (T&L) sessions between students and lecturers are now connected to various digital communication platforms such as Massive Open Online Learning (MOOC), Open Educational Resources (OER) and Flipped Classroom and communication relationships between students and lecturers can also use applications such as WhatsApp, Telegram, Google Classroom and so on.

The use of IR technology in T&L gives concerns about the skills in operating such technology. As a result, the digital competency gained attention by authorities around the world. European Commission (2006) for example

recognized digital competency as one of eight competences for lifelong learning (European Commission, 2006). Malaysian Qualifications Agency (MQA) through its Malaysian Qualifications Framework (MQF) 2.0 (MQF 2020) include the digital competency as one of the attributes for curricular design by Malaysian academic institutions. These universal and national initiatives indicate that digital competency is a critical skill as world is now overwhelmed by IR4.0.

Literature offers huge conception about digital competency. It is defined as a "set of knowledge, skills, and attitudes, strategies and awareness that is needed when using ICT and digital media" (Ferrari, 2012). Digital competence is an interest against attitudes and abilities of individuals in using digital technology and communication tools (Setyaningsih et al. 2019). The above statements imply that graduates need to strengthen their knowledge in the field of digital and information technology as well as diversify their skills to stay relevant for future job markets. Hariharasudan and Kot (2018, p. 227) emphasized that students need to be trained instead of being taught to compete in today's driven digital world to be more experienced and skilled for today's industrial operations. The statement also aligns with the research done by Ismail (2020) which indicated that the only difference is that in the IR4.0 era, the skills needed today are very different from previous human resource skills.

Digital literacy is viewed from multiple attributes. As for European Commission (2006), Digital competence are attributed by Media Literacy, ICT Literacy, Information Literacy and Literacy These competences are used to identify and analyze students' achievement with digital technology (Hatlevik and Christophersen, 2013). On top of EC's framework of digital competency, DigComp Framework is another digital framework for measuring the digital competency. This study applies the DigComp framework as it is the current framework adopted in measuring digital competency in many human life domains such as business, educations, economy and public administration.

3.0 RESEARCH FRAMEWORK

As mentioned earlier, this study adopted DigComp Framework as a research framework. DigComp framework provides detailed descriptions of all qualifications required to be sufficient in the digital environment and explains these competences in terms of knowledge, skills and attitudes (Hazar, 2019, p. 958). The European Commission's Joint Research Centre first published the Digital Competence Framework for Citizens (DigComp) in 2013 and updated it in 2017. The framework includes five competence areas: (1) information and data literacy; (2) communication and collaboration; (3) digital content creation; (4) safety; and (5) problem solving. DigComp has been used as a foundation for developing strategy, education programmes and assessment tools in over 20 countries in Europe and around the world (Kluzer and Pujol Priego, 2018, p. 8). In the context of DigComp framework, the term "digital competence" refers to the use of ICT, to achieve goals related to citizens' work, employability, learning, leisure time, citizenship participation, skills and attitudes (Chanias et al., 2019, p. 23). Digcomp was established in order to measure the level of digital competency among students because the framework aims to describe what and how students acquire, use, adapt to and learn with technology (Siddiq et al., 2017, p. 31).

According to Ferrari (2014), the five areas of digital competences can be summarized as follows:

1. *Information and data literacy* – to identify, to locate, to retrieve, to store, to organize and to analyze digital information judging its relevance and purpose.

2. *Communication* - to communicate in digital environments, to share resources through online resources and online tools, to link with others and to collaborate through digital tools, to interact with and to participate in communities and networks, cross –cultural awareness.

3. *Content creation* – to create and edit new content (from word processing to images and video), to integrate and re-elaborate previous knowledge and content; to produce creative expressions, media outputs and programming to deal with and apply intellectual property rights and licenses.

4. *Safety* - personal protection, data protection, digital identity protection, security measures, safe and sustainable use.

5. *Problem Solving* – to identify digital needs and resources, to make informed decisions on most appropriate digital tools to the purpose or need, to solve conceptual problem through digital means. To creatively use technologies, to solve technical problems, to update own and others competence.

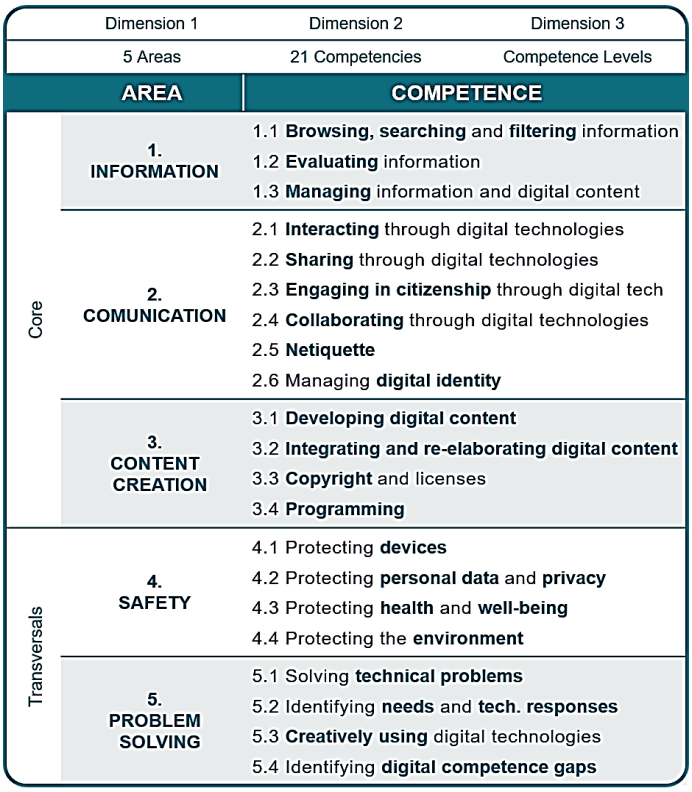

Figure 1: Digital Competence Framework

4. METHODOLOGY

This research adopts the quantitative approach in order to determine digital competence. The study setting was Universiti Teknologi MARA (UiTM) Kelantan Branch located in Machang. The research instrument was questionnaire with six (6) sections following the DigComp framework namely Demographic Profile, Information and Data literacy, Communication and Collaboration, Digital Content Creation, Safety and Problem Solving with three (3) scales of Likert measurement. The questionnaire was administered online to 400 respondents from both diploma and degree level of studies. The convenience (non-probability) sampling was used in the sampling approach. Out of the 400 questionnaire sets out, a total of 389 sets of questionnaire were returned and valid for analysis. The analysis was conducted using the SPSS Version 22 package and the simple descriptive analysis techniques was applied.

5. RESULTS AND DISCUSSION

As the objective of the study is to identify the students' digital competency level, the descriptive analyses are used in the analysis. The results of descriptive statistical analysis using SPSS Version 22 are tabulated as following.

5.1 Demographic Profiles

Table 1 below represents the demographic profile of the respondents involved in the study. It indicates the gender in which female represent 83.0% and male 17.0% of the respondents. It also shows the level of study in which that 62.5% are diploma students and 37.5% are degree students. With respect to faculty, respondents from Faculty of Business and Management are 33.2%, Faculty of Computer and Mathematical Sciences 19.5%, Faculty of Information Management 18.5%, Faculty of Accountancy 15.4%, Faculty of Arts and Design 7.5% and Faculty of Administrative Science and Policy Studies 5.9%).

Table 1. Respondent's Profile

Profile	Category	Frequency	Percentage
Gender	Male	66	17.0
	Female	323	83.0
Education	Diploma	243	62.5
	Degree	146	37.5
Faculties	Information Management	72	18.5
	Business and Management	129	33.2
	Accountancy	60	15.4
	Computer & Mathematical Sciences	76	19.5
	Administrative Science and Policy Studies	23	5.9
	Arts And Design	29	7.5

Source: Author (2021)

5.2 Descriptive Statistics

5.2.1 Reliability Analysis

Two descriptive analyses are reported in this paper. First is the reliability analysis and the other is summary of descriptive analysis. Table 4 below shows the Cronbach's Alpha value for each item in the DigComp framework. It is noted that the Cronbach's Alpha value for all items is higher than 0.7 and this indicates that all items are reliable.

Table 2. Reliability Analysis

DigComp AREAS	CCODE	COMPETENCE	CRONBACH
Information and data literacy	CM 1-8	Scanning, searching and filtering Information	0.857
	NM 1-5	Evaluating information	0.796
	SM 1-7	Store and retrieve information	0.897
Communication	INT 1-6	Interaction through technology	0.877
	KOG 1-4	Information sharing and content	0.870
	TER 1-5	Engagement with the online community	0.825
	PE 1-4	Ethical related knowledge	0.917
	ID 1-5	Managing digital identity	0.878
Digital Content Development	BKD 1-4	Digital content development	0.844
	IKD 1-4	Digital content integration	0.875
	HCL 1-3	Copyright and license	0.688
	ATR 1-4	Programming	0.866
Safety	LPr 1-3	Protect the device	0.800
	LPP 1-6	Protects personal data and privacy	0.806
	LK 1-3	Protect health and well-being	0.870
	LAS 1-3	Protect the environment	0.886
Problem Solving	SMT 1-3	Solve technical problems	0.849
	KTT 1-3	The need to identify and respond to technology	0.876
	KTD 1-3	Creative using digital technology	0.816
	JKD 1-4	Identify digital efficiency gaps	0.884

Source: Author (2021)

5.2.2 Descriptive Analysis

The descriptive analysis shows that digital competence levels of respondents for all measured items are dividable into two categories that High and Moderate. No Low score is observed from the result. Table 5 shows the summary of descriptive statistic of the study.

Table 3. Summary of Descriptive Statistics

Areas	Label	N	Mean	Std Deviation	Total Overall	Overall by Area	%	Scales	Rank
Information	cm	389	2.66	0.362	82.0%	87.1%	88.6%	High	3
	nm	389	2.62	0.381			87.4%	High	6
	sm	389	2.56	0.441			85.3%	High	7
Communication	int	389	2.73	0.360		85.3%	91.1%	High	1
	kog	389	2.65	0.427			88.5%	High	5
	ter	389	2.45	0.457			81.7%	High	14
	pe	389	2.49	0.504			83.0%	High	9
	id	389	2.47	0.471			82.2%	High	11
Digital Content Development	bkd	389	2.15	0.570		70.6%	71.6%	Moderate	19
	ikd	389	2.23	0.575			74.4%	Moderate	17
	hcl	389	2.16	0.536			72.0%	Moderate	18
	atr	389	1.93	0.606			64.2%	Moderate	20
Safety	lpr	389	2.41	0.557		84.9%	80.3%	High	15
	lpp	389	2.45	0.452			81.8%	High	12
	lk	389	2.66	0.464			88.8%	High	2
	las	389	2.66	0.471			88.6%	High	4
Problem Solving	smt	389	2.26	0.554		80.5%	75.3%	Moderate	16
	ktt	389	2.50	0.493			83.4%	High	8
	ktd	389	2.48	0.501			82.7%	High	10
	jkd	389	2.42	0.532			80.6%	High	13

Source: Author (2021)

From five areas of digital competence, Information and Data Literacy identified as first, rank or highest score areas with overall percentage 87.1%. This finding is significant with the findings conducted by Khan and Vuopala (2019b, p. 26) that showed Information and Data Literacy is the highest core competency. The result is also similar to a study done by Evangelinos and Holley (2015) in their paper "A Qualitative Exploration of the DIGCOMP Digital Competence Framework: Attitudes of students, academics and administrative staff in the Health Faculty of a UK HEI", that the most prominent area was information. From the results, it was agreed that UiTM Kelantan Branch students have a high level of competence with an overall percentage (87.1%) in terms of information and data literacy areas, but the results showed that while students are good at searching and filtering as well as storing and preserving information, students seem to have problems evaluating information and digital content.

Online learning has now become the key forum for performing university teaching and learning events. Google Meet, WebEx, Zoom and other platforms are the most common platform for online learning activities in UiTM Kelantan Branch. In addition, most students participate in and connect with friends and families via social networking sites such as Instagram, WhatsApp, or Facebook. From the results, we can conclude that students in UiTM Kelantan Branch are able to communicate, collaborate, interact, and participate in virtual teams and networks with overall percentage around 85.3%.

Following Information and Communication, safety has become the third most important field. As can be seen in Table 6, with a percentage of 84.9%, defense is the least established competency. Generally, in digital settings, respondents are seen to have knowledge of security aspects and security concerns such as identity theft, computer viruses, cyber fraud such as "phishing" and "scam" emails.

Problems solving competency areas can be defined as an individual's capacity to engage in cognitive processing to understand and resolve situational problem where a method of solution is not immediately obvious. It includes "the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen" (Vuorikari, Punie, Gomez, & Van den Brande, 2016). Based on the result, it shows that problem solving competency's overall percentage is 80.5% and be ranked as the fourth place. The lowest subcategory score was creative in using technology with 75.3% and the results revealed that most students are not creative in utilizing digital technology.

The lowest score among five competencies was Content Creation Development with overall percentage was 70.6%. From the survey, the result has revealed that most respondents encountered problems in developing digital content creation. The results have revealed that most respondents encounter problems in developing programming codes because it achieved 64.2%. Ala-Mutka (2012) and Guzdial (2003) stated that generally, learning programming was considered a difficult process with high dropout rates, aligned the finding with previous study. This statement was supported by a study conducted by Krpan, Rosić, and Mladenović (2014) that showed most undergraduates students specifically first year students from the Faculty of Science, University of Spilt, Croatia encountered difficulties in programming environment, language syntax knowledge, problem understanding and debugging. Besides that, from the total of 389 respondents, only 19.53% or only 76 respondents were from the Faculty of Computer and Mathematical Sciences while the rest are from the Faculty of Art and Design, Faculty of Information Management, Faculty of Accountancy and Faculty of Business and Management. It therefore also led to the above result because, opposed to students from the Faculty of Computer and Mathematical Sciences, these groups of respondents have not been exposed to programming languages in their syllabus courses.

The descriptive analyses have unveiled some useful statistics about the level of digital competence among UiTM Kelantan Branch students. The survey has adopted Digital Competency European Digital Competence Framework (DigComp) 2.0 version. It was noted that respondents had the lowest results in the development of digital content, but high results in information and data literacy were registered. Statistics shows that respondents (students) lack the ability to create programming codes and only at the medium level to develop content and to incorporate and re-elaborate digital content. Respondents were also found to have an average knowledge of how material and content are protected by copyright and licenses.

It is learned that the overall score for five competence areas in DigComp is 82 percent, which is considered as High Level, based on the results generated from statistical analysis and discussion that follows. However, it was interesting to know that even the average score considered high-level respondents were not very competent in two areas out of five main areas of problem solving and digital content creation. These skills are among the main skills looking forward by the future employer towards graduates. A study done by Tanius et al. (2019, p. 13) reported that employability issue among Malaysian new graduates arised due to skills gaps which refer to the mismatch between employers' expectations and the graduates' employability skills. From the findings results, university students at UiTM Kelantan Branch are still not yet considered as digital competent as they have lack of skills in two main areas in DigComp. Faculties and top management of the institution should address this issue because without enhancement programs to upgrade or upskill their digital competence, they are not compatible with the current needs of job market.

6.0 CONCLUSION

This research aims at measuring digital competence among university students as fewer research have been conducted in Malaysia regarding digital competence especially in the context of public Malaysian universities. Despite the intended aims have been achieved, this study has some limitations in its locality and sampling in particular. Future research can include respondents from Malaysia private universities. Therefore, in order to develop the digital skills of students and to be digital competent to survive and ready to adapt to the demanding working environments, more research can be explored and carried out, particularly in digital library literacy skills.

REFERENCES

Ahmad, N. A., Ayub, A. F. M., & Khambari, M. N. (2019). Gender Digital Divide: Digital Skills among Malaysian Secondary School. *International Journal of Academic Research in Progressive Education and Development*, *8*(4), 668–687.Retrieved from

https://hrmars.com/papers_submitted/6692/Gender_Digital_Divide_Digital_Skills_among_Malaysian_Secondary_School.pdf

Ahmad, S. (2018, January 1). *Revolusi Industri 4.0 beri pelbagai kesan pada kehidupan*. Universiti Teknologi Malaysia. https://news.utm.my/ms/2018/01/revolusi-industri-4-0-beri-pelbagai-kesan-pada-kehidupan/

Ala-Mutka, K. (2012). *Learning in Online networks and communities*. JRC Scientific and Technical Report.

Bozkurt, A. (2019). From Distance Education to Open and Distance Learning: A Holistic Evaluation of History, Definitions, and Theories. Retrieved October 21, 2020, from https://www.researchgate.net/publication/332652740_From_Distance_Education_to_Open_and_Distance_Learning_A_Holistic_Evaluation_of_History_Definitions_and_Theories

Calvani, A., Fini, A., Ranieri, M., & Picci, P. (2012). Are young generations in secondary school digitally competent? A study on Italian teenagers. *Computers & Education*, *58*(2), 797–807. https://doi.org/10.1016/j.compedu.2011.10.004

Chanias, S., Myers, M. D., & Hess, T. (2019). Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *The Journal of Strategic Information Systems*, *28*(1), 17–33. https://doi.org/10.1016/j.jsis.2018.11.003

Dzulkifli. A. R. (2020). *Mampukah Menginsankan Teknologi?.* Universiti Islam Sains Malaysia. Retrieved from https://www.usim.edu.my/news/in-our-words/mampukah-menginsankan-teknologi/

European Parliament and the Council. (2006). Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. *Official Journal of the European Union*, L394/310.

Evangelinos, G., & Holley, D. (2015). A Qualitative Exploration of the DIGCOMP Digital Competence Framework: Attitudes of students, academics and administrative staff in the health faculty of a UK HEI. *EAI Endorsed Transactions on E-Learning*, *2*(6), e1. https://doi.org/10.4108/el.2.6.e1

Ferrari, A., Brečko, B. N., & Punie, Y. (2014). DIGCOMP: A framework for developing and understanding digital competence in Europe. *eLearning Papers*, (38), 3-17.

Gutiérrez Porlán, I., & Serrano Sánchez, J. L. (2016). Evaluación y desarrollo de la competencia digital de futuros maestros en la Universidad de Murcia. *Journal of New Approaches in Educational Research*, *6*(1), 51–56. https://doi.org/10.7821/naer.2016.1.152

Guzdial, M. (2003). A media computation course for non-majors. In Proceedings of the 8th annual conference on Innovation and technology in computer science education (pp. 104-108)

Hariharasudan, A., & Kot, S. (2018). A Scoping Review on Digital English and Education 4.0 for Industry 4.0. *Social Sciences*, 7(*11*), 227. https://doi.org/10.3390/socsci7110227

Haron, H. (2018, September). Education in the Era of IR 4. 0. In The 2018 International Conference on Information Management and Technology (ICIMTech). Jakarta.

Hasnah Hussiin. (2020). *Kesan COVID-19 Kepada Pelajar UMP: Satu Kajian Ringkas*. UMP News. https://news.ump.edu.my/experts/kesan-covid-19-kepada-pelajar-ump-satu-kajian-ringkas

Hatlevik, O. E., & Christophersen, K.-A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & Education*, *63*, 240–247. https://doi.org/10.1016/j.compedu.2012.11.015

Hazar, E. (2019). A Comparison between European Digital Competence Framework and the Turkish ICT Curriculum. *Universal Journal of Educational Research*, *7*(4), 954–962. https://doi.org/10.13189/ujer.2019.070406

Hussain, A. (2019). *Industrial revolution 4.0: implication to libraries and librarians*. Library Hi Tech News.

Internet users must take proactive measures to prevent identity theft -- RAMCI. (2019, August 10). *BERNAMA*. https://www.bernama.com/en/news.php?id=1776166

Ismail, L. H. (2020, June 9). *Manfaat cabaran pandemik perkukuh penguasaan IR4.0*. Https://Www.Bharian.Com.My/. https://www.bharian.com.my/rencana/komentar/2020/06/698132/manfaat-cabaran-pandemik-perkukuh-penguasaan-ir40

Jumadi, A. (2020, November 12). *Mengadaptasi norma baharu ke arah IR4.0*. Berita Harian. https://www.bharian.com.my/rencana/komentar/2020/11/753365/mengadaptasi-norma-baharu-ke-arah-ir40

Krpan, D., Rosić, M., & Mladenović, S. (2014). Teaching basic programming skills to undergraduate students. *Contemporary issues in economy and technology*.

Khan, F., & Vuopala, E. (2019). Digital Competence Assessment Across Generations. *International Journal of Digital Literacy and Digital Competence*, *10*(2), 15–28. https://doi.org/10.4018/ijdldc.2019040102

Kluzer, S. & Pujol Priego, L. (2018). DigComp into action - Get inspired, make it happen. A user guide to the European Digital Competence Framework. (JRC Science for Policy Report). Publications Office of the European Union. 10.2760/11294

Lim, I. (2020, May 30). Reality for Malaysia's university students: Online learning challenges, stress, workload; possible solutions for fully digital future until Dec. *Malay Mail*. https://www.malaymail.com/news/malaysia/2020/05/30/reality-for-malaysias-university-students-online-learning-challenges-stress/1870717

Malaysian Qualification Agency. (2020). *Malaysian Qualification Framework (MQF) 2nd edition*. https://www.mqa.gov.my/.

Nyikes, Z. (2018). Contemporary Digital Competency Review. *Interdisciplinary Description of Complex Systems*, *16*(1), 124–131. https://doi.org/10.7906/indecs.16.1.9

Sabri Bayani. (2019). Revolusi industri 4.0 dalam pendidikan. Academia.edu - Share research. https://www.academia.edu/42951450/REVOLUSI_INDUSTRI_4_0_DALAM_PENDIDIKAN

Schwab, K., & Sala-i-Martin, X. (Eds.). (2011, September). The global competitiveness report 2011-2012. Geneva: World Economic Forum.

Setyaningsih, R., Abdullah, A., Prihantoro, E., & Hustinawaty, H. (2019). Model penguatan literasi digital melalui pemanfaatan e learning. *Jurnal Aspikom*, *3*(6), 1200-1214.

Sharon Alita. (2021, January 29). *Malaysia rapidly employing IR4 tech in healthcare*. OpenGov Asia. https://opengovasia.com/malaysia-rapidly-employing-ir4-tech-in-healthcare/

Siddiq, F., Gochyyev, P., & Wilson, M. (2017). Learning in Digital Networks – ICT literacy: A novel assessment of students' 21st century skills. *Computers & Education*, *109*, 11–37. https://doi.org/10.1016/j.compedu.2017.01.014

Tanius, E., Johari, H., Yulia, A., Siong, H. C., & Pazim, K. H. (2019). The Employability Skills Performance of Business Graduates in Malaysia: Do Employers, Graduates and Academicians Speak the Same Language? *International Journal of Asian Social Science*, *9*(1), 11–17. https://doi.org/10.18488/journal.1.2019.91.11.17

Teck, S. H., & Lai, Y. L. (2011). An empirical analysis of Malaysian pre-university students' ICT competency gender differences. *International Journal of Network and Mobile Technologies*, *2*(1), 15-29.

Tenku Putri N. T. S. (2020). Digital Literacy Competence for Academic Needs: An Analysis of Malaysian Students in Three Universities. Elsevier Ltd. International Conference on Education and Educational Psychology. Retrieved from https://core.ac.uk/download/pdf/82032669.pdf

Trailhead. (2020). Understand the Impact of the Fourth Industrial Revolution on Society and Individuals. Retrieved January 4, 2021, from https://trailhead.salesforce.com/en/content/learn/v/modules/impacts-of-the-fourth-industrial-revolution/understand-the-impact-of-the-fourth-industrial-revolution-on-society-and-individuals

United Nations. (2019). Building Digital Competencies to benefit from frontier technologies. Https://Unctad.Org/En/PublicationsLibrary/Dtlstict2019d3_en.Pdf. https://unctad.org/system/files/official-document/dtlstict2019d3_en.pdf

Universiti Teknologi Malaysia, & Ismail, Z. Z. (2018, June). Cabaran Industri Pembinaan di Malaysia Terhadap Revolusi Industri 4.0. https://bic.utm.my/files/2018/08/ZUREEN-ZULAIKA-ISMAIL.pdf. https://bic.utm.my/files/2018/08/ZUREEN-ZULAIKA-ISMAIL.pdf

Vuorikari, R., Punie, Y., Gomez, S. C., & Van Den Brande, G. (2016). *DigComp 2.0: The digital competence framework for citizens. Update phase 1: The conceptual reference model* (No. JRC101254). Joint Research Centre (Seville site).

Zulnaidi, H. Z., Abdul Rahim, S. S., & Mohd Salleh, U. K. (2020). The Readiness of TVET Lecturers in Facing the Intelligence Age IR4.0. *Journal Of Technical Education And Training*, *12*(3), 89–96. https://doi.org/10.30880/jtet.2020.12.03.009

Zuriati Ahmad Zukarnain. (2019, August 30). UPM: Cashless payments and digital certification using blockchain technology. Infocomm Development Centre (iDEC). https://idec.upm.edu.my/article/upm_cashless_payments_and_digital_certification_using_blockchain_technology-51527