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Towards Digital TVET: A Comparative Study on Students' Readiness in The Industry Digital Demands in Indonesia and Malaysia

Iwa Kuntadi[1], Ana, A.[1*], Dedi Rohendi[1], Dedy Suryadi[1], Fazlinda Ab Halim[2], Ana Ramdani Sari[1], Muktiarni[1], Vina Dwiyanti[1]

[1]Universitas Pendidikan Indonesia,
Jl. Dr. Setiabudi No. 229, 40154, INDONESIA

[2]Universiti Tun Hussein Onn Malaysia,
Parit Raja, 86400 Batu Pahat, Johor, MALAYSIA

*Corresponding Author

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Abstract: One of the current challenges in the industrial revolution 4.0 is the acceleration of digitalization in vocational education, which is also required to meet various industrial demands, including digital skills. This study aims to measure and analyse the digital skills level possessed by students who have experience in the industry. The study involves two universities, Universitas Pendidikan Indonesia (UPI) and University Tun Hussein Onn Malaysia (UTHM). By using an online questionnaire, 259 students from UPI and UTHM answered 21 questions to measure five digital competence domains as described in the European Digital Competence Framework, which are information, communication, content creation, safety, and problem-solving. Each option on the questions indicates the level of digital competences measured by scores. The data were analysed using descriptive statistics, such as frequency distribution, mean, standard deviation and independent sample t-test. The result shows that on average, both UPI and UTHM students scored in the intermediate level, with UTHM students scoring slightly higher than UPI students on average. Interestingly, both UPI and UTHM students scored the highest in the information domain and the lowest in problem-solving. It shows that the hypothesis was not accepted as there is a significant difference in the digital skills of the students from both countries. Based on the findings, the result is expected to provide input and improvement in the targeted aspects based on the findings.

Keywords: Comparative study, digital competence, Industrial Revolution 4.0, students' readiness

1. Introduction

One of the main goals of TVET is to prepare the workforce upon entering the world of work. Therefore, it is important to ensure that TVET can adjust to the transformation of trends and needs in the industry. Being skilled in a particular field is no longer enough to satisfy the current needs of the industry. It is crucial for employees to have multi-dimensional capabilities and versatile skills to deal with many tasks in the workplace. These skills should be introduced early in school, especially in educational institutions that focus on TVET, as they are specialised in preparing students to enter the workforce.

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*Corresponding author: ana@upi.edu

1.1 Industrial Revolution 4.0 Impact on TVET

The rise of industrialization since the 18th century is highly tied to technological advancement, which eventually became known as the industrial revolution. According to Lasi et al., (2014) Industrial Revolution 4.0 (I.R. 4.0) encompasses the application of the internet of things, machine automation and big data, artificial intelligence, networks technology, and data exchange. Lasi et al, stated that IR 4.0 means the future projects will face profound transformation to the changes in operation caused by economic, social, and political conditions (Lasi et al., 2014). The concept itself is widely varied depending on which industry it focuses on.

These changes significantly affect the demand for employment as a specific skill set is required to operate in facing IR 4.0 (Lasi et al., 2014). Maisiri et al., stated that the challenge comes from the decrease in job opportunities (Maisiri et al., 2019) as Lasi et al., manual and repetitive jobs can be easily replaced by automated machines and systems. On the other hand, companies demand more employees to have multidisciplinary cognitive skills, social skills, practical skills, and a better understanding of management skills (Gebhart et al., 2016). In addition, it is also widely accepted that future employees are required to have more creativity, critical thinking skills, decision-making, and other non-routine tasks (OECD, 2018). It has also been suggested to incorporate those skills for future graduates early in educational institutions, especially in universities, in addition to vocational education (Gebhart et al., 2016). Technical institutions should be modernised and informed by industry requirements. Technical institutions, especially, are relevant in the digital transformation ecosystem since they are the primary source to supply a technically skilled workforce and support economic growth (Bhurtel, 2015; Majumdar, 2011).

Digitalisation is one of the first steps that should be taken to move forward and adapt to current demands, both in the industry and educational institution, considering how important education is to prepare graduates upon entering the workforce. The need for digitalization in the industry cannot be fulfilled without integrating what TVET Institutions have to offer. Furthermore, education, more specifically TVET, will hold an essential role in developing the required skills and knowledge at the individual, corporation, and society (Parida, 2018).

Digitalisation as a change in human life where the physical and digital environments combine (Fors, 2010). This can also be marked by the widespread application of virtual environments in various aspects of life and how physical things are virtually connected to multiple aspects of life (Stolterman & Fors, 2004). Another study describes digitalization as a variety of ways in which social life builds around digital communications and media infrastructure (Brennen & Kreiss, 2016). Digitalization impacted many aspects of life, such as business systems, production, social life, media, and education. Five digitalisation challenges that also correlate with digitalization in TVET (Parida, 2018), as follow:

- Implementing political digitalisation agenda
- Digital platforms for entrepreneurship
- Workforce requirements and new skill development
- Digitalisation forces business model innovation
- Unrealised value of big data analytics

Digitalisation, both in the educational and industrial context, creates massive opportunities to make learning in TVET institutions more demand-driven and adequate to serve the purpose of producing highly skilled graduates. However, many challenges need to be overcome for digitalization in TVET to be utilised.

To keep up with the actual condition in the industry, it is important for TVET to continuously improve to prepare the students prior to entering the workforce. Many studies give insights into how digitalization affects the industry and educational institutions. To be more specific, it is common to find research revolving around certain skill sets needed in facing the industrial revolution (Maisiri et al., 2019; Sari et al., 2021) and the industrial needs in Industrial Revolution 4.0 (Lasi et al., 2014; Schumacher et al., 2019). In terms of education, many studies have been conducted to find the effect of digitalization in TVET teaching and learning (Brolpito, 2018) as well as how digitalization is incorporated into learning through various media or learning management systems (Abd Rashid et al., 2016; Koroivulaono & Seth, 2013; Kotsik et al., 2009; Monterubbianesi et al., 2022).

However, a limited amount of research still focuses on the students and how they perceived digitalization in their education. While it is essential to know how industries and educational institutions alike adapt to the shifting needs, students are still the most significant part of the whole picture in TVET. Research about digitalization in industrial revolution 4.0 that is student-centered is not yet fully explored. There is no standardised way to measure students' and vocational school graduates' readiness in facing the digitalization era, which is why this study aims to set generalised indicators that define how prepared the students are in facing the IR 4.0 workforce and its measurements.

Moreover, the existing studies are widely dispersed, and there is still limited research that compares digitalisation in two different countries. Amid globalization, it is important to know where to stand in the global market. The early step to determine that is by comparing ourselves to the country with almost similar characteristics in terms of geographical location, societal norms, and cultural characteristics, which in this case, by comparing students' readiness in facing digitalization in Indonesia and Malaysia.

1.2 Understanding Digital Competence

Digital education has been recognised as one of the three key initiatives to build inclusive and cohesive societies by the European Commission in 20018 (Brolpito, 2018). There are three priorities in the Digital Education Action Plan: developing relevant digital skills and competencies for digital transformation. The notion resonates with the findings in another study. OECD identified several key points about the future skills needed in 2030 (OECD, 2018). Among those is the students' digital skills that need to evolve with technological developments. Digital skills were also listed as one of the eight key competencies in the EU for lifelong learning (Brolpito, 2018).

To better understand the context and the framework, it is important to have a consensus on what encompasses digital skill/competence. The definition of digital skills or digital competencies itself depends on the context. It is strongly linked to several terms such as ICT skills, technology skills, 21st-century skills, digital literacy, etc (Ilomäki, 2011). Digital competence as "the set of knowledge, skills, attitudes, abilities, strategies, and awareness that are required when using ICT and digital media to perform tasks, solve problems, communicate, manage information, collaborate, create and share content, and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, and socializing." (Ferrari, 2012). Ilomäki stated that digital competence consists of 1) technical skills to use digital technologies, 2) abilities to use digital technologies in a meaningful way for working, studying, and for everyday life in general in various activities, 3) abilities to critically evaluate the digital technologies, and 4) motivation to participate in the digital culture (Ilomäki, 2011).

In recent years, the term digital competence has been seen preferable to digital skills. It contains more complexity and goes beyond technical skills and social and emotional aspects of using and understanding digital devices (Ilomäki, 2011). Ferrari listed seven components of digital competence (Ferrari, 2012), as follow:

i) Information management refers to the required knowledge, attitudes, and skills (KAS) for identifying, locating, accessing, retrieving, storing, and organizing information
ii) Collaboration refers to the required KAS to connect with other users and collaborate with responsibilities
iii) Communication refers to required KAS for communication using online platforms while taking privacy, safety, and netiquette into account
iv) Creation of content and knowledge refers to the creation of new knowledge or elaboration of previous knowledge through online and digital media as an expression of creativity
v) Ethics and responsibility mean the awareness of ethical and legal frames in using digital technology
vi) Evaluation and Problem Solving refer to the ability in assessing information and media as well as identifying and solving problems encountered while using technology
vii) Technical operations mean the required KAS for effective, efficient, safe, and correct use of technology and media

Ferrari further simplifies and elaborates on the framework of digital competence, which is especially applicable in Europe (Ferrari, 2013). However, as the framework does not specifically target the EU market only, the framework still could be adopted in any region. The framework itself encompasses five domains of digital competence.

1.3 Industry Demands in Indonesian and Malaysian

1.3.1 Indonesia Context

As a country with more productive citizens, Indonesia faces opportunities as well as challenges to take advantage of demographic bonuses by preparing various skills, especially skills that are closely related to mastery of technology with the rapid changes in the world of work in the era of digitalization. However, most of the population aged 25-64 years in Indonesia still have education below high school (62.1%), and there is still room to pursue educational attainment with the OECD average (OECD, 2022).

There has been an increase in the working population from university graduates or higher education in the last two years, 2020-2021. The phenomenon was affected by various supporting factors such as Information, Communication and Technology (ICT) skills. Figure 1 shows an overview of ICT skills by Province. Most provinces in Indonesia have relatively good ICT skills. This condition was caused by the COVID-19 pandemic that "forces" or helps "accelerate" the Indonesian people to have ICT skills. The various activities in learning for students, work activities, and daily activities are all closely related to ICT because they use various tools—online platform.

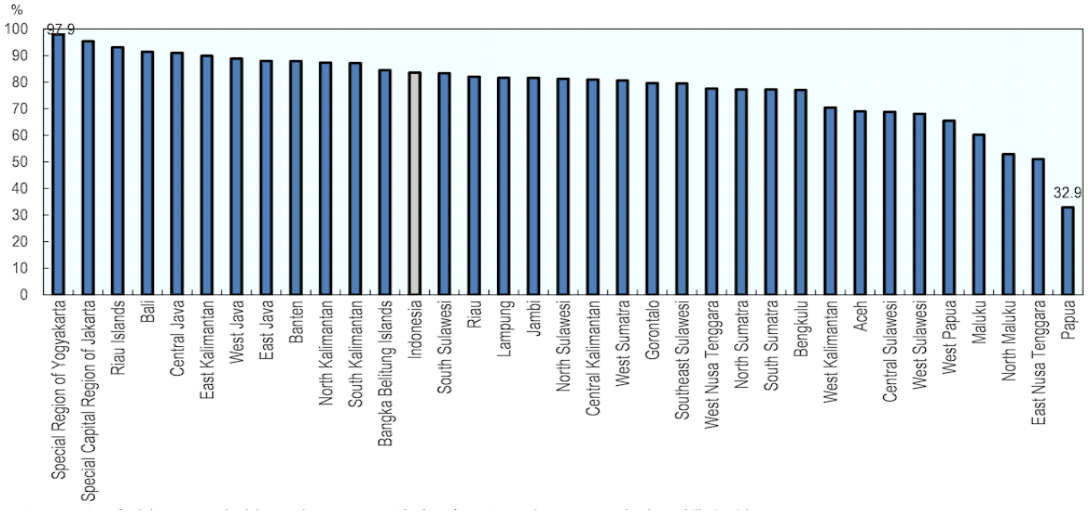

Fig 1 - Overview of ICT skills by Province
Source: (BPS, 2019)

The data illustrates the necessity of workers starting to shift to activities in the digitalization era at work. The phenomenon of skills disruption, including digital skills, has been a concern of the Government of Indonesia, which resulted in the placement of skills development on the political agenda. They recognised that increasing training opportunities could promote the development of a work-ready workforce, put people in good jobs, and help increase productivity. Therefore, with this aim in mind, the government has introduced the pre-employment card, which provides access to vocational training and skills upgrading opportunities for job seekers, workers, and people facing a career transition. The direction of work given is various digital-based training in employment, especially opening a business. The challenge for educational institutions, especially higher education oriented to Technology and Vocational Education is to prepare vocational-specific digital skills. It is known that vocational education has unique characteristics for each field of science that digital skills must support to help graduates prepare to compete competitively and win the competition in the World of Work in the future.

1.3.2 Malaysia Context

According to the Department of Statistics Malaysia (DSM), there was an increase in the unemployment rate among graduates from tertiary education institutions, from 17.43% in 2010 to 30.67% in 2014 (Department of Statistics Malaysia, 2015). The Higher Education Minister reported that almost 55,000 graduates remained unemployed in 2016, six months after the completion of their studies (Ministry of Higher Education Malaysia, 2016).

The percentage of graduates unemployed from 2011 until 2015 has remained the same. The Graduate Trace study by the Ministry of Education found that the graduates were finding it difficult to obtain jobs after 6 months of completing the degree (Ministry of Higher Education Malaysia, 2015), The Ministry of Education Graduate Tracer study in 2018 shows that almost 60 percent of the graduates remain unemployed even after one year of graduation (Ministry of Higher Education Malaysia, 2018).

With the dynamically changing job market and progressive technological change, employees are expected to keep abreast of global economics (Singh et al., 2018). Therefore, it is very important to ensure that graduates are equipped with employability skills highly valued by the current industry.

Research by Jamaludin, Alias, DeWitt, Kenayathulla, and Abdul Razzaq mentioned that the employability skills emphasised in the MQF (Jamaludin et al., 2019) (Malaysian Qualifications Agency (MQA), 2017) are found to be relevant to the current industry settings. In almost all selected studies, employers from various sectors value basic skills, thinking skills, personal qualities, workplace competencies, and entrepreneurship skills. This research question of this study is “to what degree are vocational students in UPI and UTHM prepared to face digitalization demand in the industry?”. The hypothesis of the research is:

H_0: There is no difference in the average readiness of students at UPI and UTHM in facing the demands of industrial digitalisation

H_1: There is a difference in the average readiness value of students at UPI and UTHM in dealing with industrial digitalisation tensions

2. Methodology

To answer the research question in measuring UPI and UTHM students' digital skills; the research used descriptive quantitative method. Online survey was carried out in both universities, specifically in the faculties with TVET background. The survey itself consists of 21 questions which can be divided into five domains: information, communication, content creation, safety, and problem-solving. The survey was presented through google form and was distributed using emails and WhatsApp.

2.1 Sample and Populations

The population of this research is students majoring various disciplines in the Faculty of Technology and Vocational Education (Universitas Pendidikan Indonesia) and the Faculty of Technical and Vocation Education (Universiti Tun Hussein Onn Malaysia) who have experience in the respective industries. It includes students who are currently doing or have completed internship. The study gathered 154 respondents from UPI dan 95 respondents form UTHM.

2.2 Instrument

The instrument of this research is based on the European Commission's Digital Competence Framework (Ferrari, 2013). It consists of 21 questions divided by 5 domains, which are information (3 questions), communication (6 questions), content creation (4 questions), safety (4 questions), and problem solving (4 questions) which can be seen in the Table 1.

Table 1 - Digital Competence Framework for the instrument

Dimension 1 Competence areas	**Dimension 2** Competences
1. Information	1.1 Browsing, searching, and filtering information 1.2 Evaluating information 1.3 Storing and retrieving information
2. Communication	2.1 Interacting through technologies 2.2 Sharing information and content 2.3 Engaging in online citizenship 2.4 Collaborating through digital channels 2.5 Netiquette 2.6 Managing digital identity
3. Content creation	3.1 Developing content 3.2 Integrating and re-elaborating 3.3 Copyright and licenses 3.4 Programming
4. Safety	4.1 Protecting devices 4.2 Protecting personal data 4.3 Protecting health 4.4 Protecting the environment
5. Problem-solving	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Innovating and creatively using technology 5.4 Identifying digital competence gaps

Source: (Ferrari, 2013)

Each question has three options that would determine their competence skill on the competency into three categories, which are advanced, intermediate, and elementary. The instrument was validated using a pilot survey that involved 33 students who fulfilled the sample criteria. Based on the pilot survey and reliability test using Cronbach-alpha, all items in the instruments are valid with high reliability (0.925).

2.3 Data Analysis

The data were processed by decoding the three types of answers into scores, which are beginner (score 1), intermediate (score 2), and advanced (score 3). The data were then analysed using mean, standard deviation, and frequency distribution to depict students' digitalisation skills. As the data was categorised into five domains; overall, the data were normally

distributed and homogenous, therefore the test performed is a parametric test. An independent sample t-test was performed to compare the result from UPI and UTHM in each domain and overall. This study uses Levene's Test to know the result from each university in Indonesia (UPI) and Malaysia (UTHM). In the lack of Levene's Test has the main objective to find out the differences between two groups of data with different variances. The calculation results from this test will show the significance value (p) of the two different data groups. To determine the level of digital competence, the means can be categorised into three proficiency levels, Elementary (0-1.50), Intermediate (1.51-2.50), Advanced (2.51-3.00).

3. Result and Discussion

3.1 Respondents' Characteristics

The survey managed to gather 253 students from both universities, specifically 154 students form UPI and 95 students from UTHM. As the requirements for the respondent are students who is doing or have completed their internship, the respondents can be separated into three groups based on their academic level. Fig. 2 shows that from UPI, 50.98% students are in the 8th semester, while students in 7th and 6th semester are 41.18% and 7.84% respectively. On the other hand, respondents from UTHM are predominantly in 7th semester (47.18%) followed by 6th semester student (29.11%) and 8th semester students (23.60%).

3.1.2 Respondents' Study Program

The respondents consist of students from different fields that are related to TVET. Out of 154 students, the largest percentage from UPI respondents are from Home Economics Study Program (24.18%), Mechanical Engineering (16.99%), and Culinary Art Education Study Program (16.34%). The rest of the respondents are recorded to be majoring in Agriculture (24%), Civil Engineering (15%), Culinary (13%), Electrical Engineering (6%), and Fashion Design (4%). On the other hand, UTHM respondents has the highest percentage from Electrical Engineering Study Program (38.20%), followed by Culinary Arts Study Program (24.72%) and Air Conditioning and refrigeration (19.10%). The rest of the respondents are majoring in Mechanical Engineering (8%); Welding and Metal Fabrication (4%), Creative Multimedia (2%), Industrial Electronic Automation (2%); Electric and Electronic (2%); Civil Engineering (6%) and Vocational Education (15%).

3.2 Discussion

The result shows that in all five domains, students in UPI and UTHM placed in the intermediate level with average scores of 1.8790 (*SD*=0.37) and 1.8799 (*SD*=0.41) respectively. It shows that UTHM students possess a slightly higher level of digital competence than UPI students even though the difference is not much. The result show can be seen in the Table 2 below.

Statistical analysis using an independent sample t-test shows there is no significant difference between the overall result of UPI and UTHM with the t score of .454 and significancy score (p) of .986 (Table 3). It means that both students in UPI and UTHM are identified as intermediate level. It shows that the students in both universities are familiar with digitalisation at work environment, they can use variety of tools and adjust well to non-routine situations. However, there is a limitation of their competency such as actively making innovation or initiating work-related strategies. The result is consistent with the data presented by the Indonesian Bureau of Statistics which shows that Indonesians who went to university are more familiar with various ICT tools (BPS, 2021). In Malaysia, the concerns to build digital workforce that can meet the expectations for digital economy keeps growing. Khan et al argues that the responsibility of training graduates lies within the universities' roles. However, the government and industry also must work hand in hand in preparing digitally skilled workforce (Khan et al., 2021). The result independent sample t-test for overall score can be seen in the Table 3 below.

Table 2 - Group statistics

	University	*N*	Mean	Std. Deviation
Overall	UPI	154	1.8790	.37750
	UTHM	95	1.8799	.41281
Information	UPI	154	1.9782	.48463
	UTHM	95	1.9897	.44673
Communication	UPI	154	1.8784	.47760
	UTHM	95	1.8578	.48776
Content-creation	UPI	154	1.8166	.50085
	UTHM	95	1.8711	.56712
Safety	UPI	154	1.9237	.46646
	UTHM	95	1.9053	.56514
Problem-solving	UPI	154	1.7987	.50494
	UTHM	95	1.7763	.54878

Table 3 - Independent sample *t*-test for overall score

	Levene's Test		*t*-test for Equality of Means						
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.562	.454	-.017	247	.986	-.00087	.05105	-.10142	.09968
Equal variances not assumed			-.017	185	.987	-.00087	.05215	-.10374	.10201

3.2.1 Information and Data Literacy

According to Ferrari (2013), information in the digital competence context includes identifying, locating, storing, organizing, and analysing information, judging its relevance and its purpose. Information and data literacy in accordance with DigiComp 2.0 in 2016 consist of 3 competencies context includes browsing, searching and filtering data, information and digital content; evaluating data, information and digital content; and managing data, information and digital content (Carretero et al., 2017; Vuorikari Rina et al., 2022). The data shows that in this area, UPI students show slightly lower means (M=1.9782, SD=.48463) than UTHM students (M=1.9897, SD=.44673). Both UPI and UTHM students has intermediate level in the competence area 1 which is information and data literacy. There is no significant difference between UPI and UTHM in this competence area based on t-test [t (249) =-.187, p=852].

Table 4 - Independent sample t-test for information and data literacy score

		Levene's Test		*t*-test for Equality of Means						
		F	**Sig.**	***t***	***df***	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
information	Equal variances assumed	.946	.332	-.187	247	.852	.01150	.06139	-.13242	.10941
	Equal variances not assumed			-.191	211.532	.849	-.01150	.06021	-.13020	.10720

From a closer look as seen from Figure 5, UPI students particularly scored the highest (52% in advanced level) in storing and retrieving information while UTHM students who identified as advanced level is the highest in the browsing, searching, and filtering information competence (33% in advanced level). Interestingly, both UPI and UTHM students has the highest percentage in elementary proficiency in the same category (57% and 41% respectively). Students who perform in intermediate level of this competency indicate that they can find information from the internet easily and precisely, can store and retrieve information with flexibility. However, they still have some limitation in the critical thinking process when filtering the data as well as using wide range of tools and means when organizing information (Carretero et al., 2017; Vuorikari Rina et al., 2022).

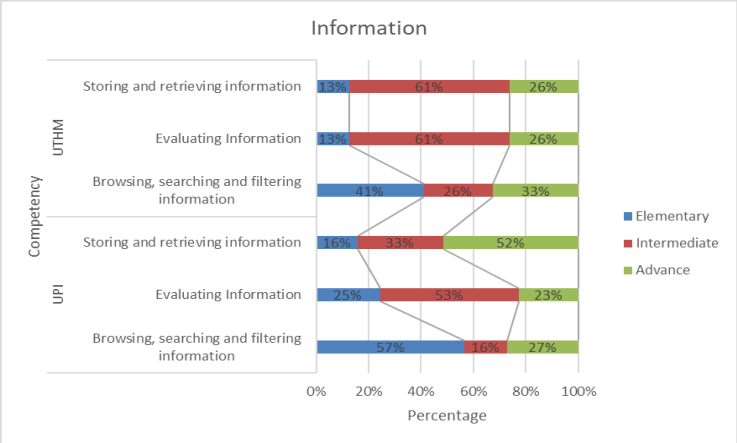

Fig. 2 - Respondents' proficiency level in information and data literacy

3.2.2 Communication

According to Carretero et al (2017), communication in the digital competence context includes interacting through digital technologies, sharing through digital technologies, engaging in citizenship through digital technologies, collaborating through digital technologies, netiquette and managing digital identity. The data shows that in this area, UPI students perform better (M=1.8784, SD=.47760) than UTHM students (M=1.8578, SD=.48776). Both UPI and UTHM students has intermediate level in the competence area 1 which is information and data literacy. There is no significant difference between UPI and UTHM in this competence area based on t-test [t (249) =.328, p=.743].

As seen from Figure 3, there are 35% of UPI students who are in the advanced level in collaborating through digital competency. The score is higher compared to the UTHM in this area of competency. On the other hand, UTHM students scored highest in the netiquette competency with 35 % of students scored in the advanced level. In terms of the lowest category, UTHM students scored the lowest in the 'sharing information and content' category as there are 44% students in elementary category. Meanwhile, UPI students has the highest percentage of intermediate level in the 'managing digital identity category with 39%. Students who perform in intermediate level of this competency indicate that they can select a variety of digital technologies to interact and select a variety of appro-priate digital communi-cation means for a given context, use a variety of digital technologies in order to interact and show others the most appropriate digital communication means for a given context (Carretero et al., 2017; Vuorikari Rina et al., 2022).

		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
communication	Equal variances assumed	.000	.993	.328	247	.743	.02059	.06282	-.10314	.14431
	Equal variances not assumed			.326	195.959	.745	.02059	.06313	-.10392	.14509

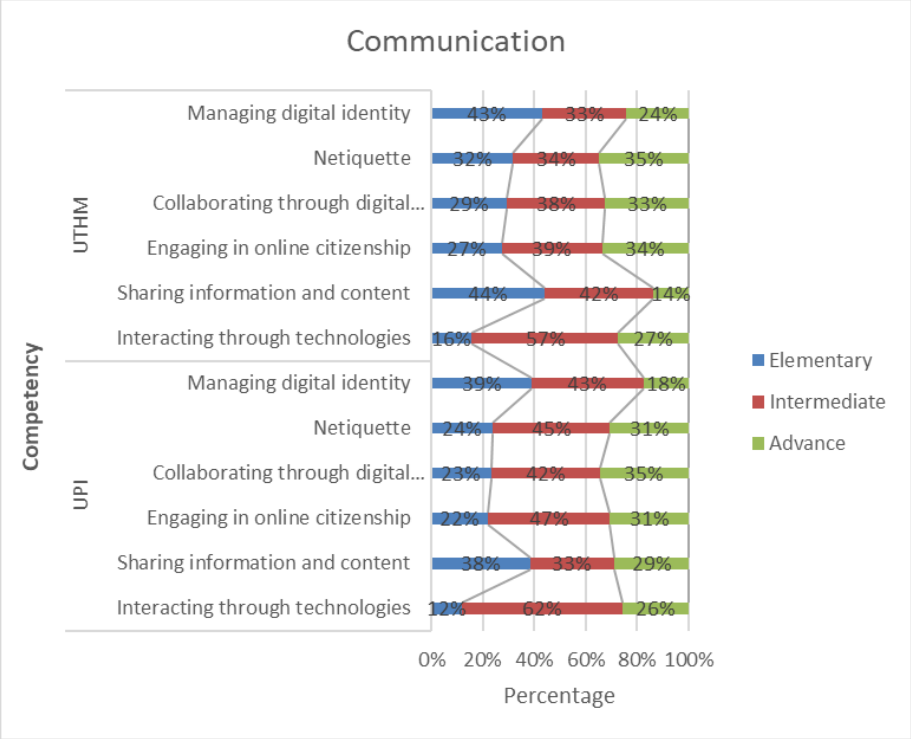

Fig. 3 - Respondents' proficiency level in communication

3.2.3 Content Creation

According to Stephanie Carretero et al (2017), content creation in the digital competence context consists of developing digital content, integrating and re-elaborating digital content, copyright and licenses and programming competencies. The data shows that in this area, UTHM students perform better (M=1.8711, SD=.56712) than UPI students (M=1.8166, SD=.50085). Both UPI and UTHM students has an intermediate level in the competence area 1 which is content creation. There is no significant difference between UPI and UTHM in this competence area based on t-test [t (249) =-.793, p=.429].

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
content creation	Equal variances assumed	2.487	.116	-.793	247	.429	-.05449	.06876	-.18992	.08094
	Equal variances not assumed			-.770	180.537	.443	-.05449	.07081	-.19422	.08523

Figure 4 shows that both UPI and UTHM students have the highest advanced level in the 'programming' competency (50% and 43% respectively). Interestingly, the number of students who are in the elementary level is also high in almost all competencies, with the most prominent ones being UPI students in the 'integrating and re-elaborating' competency (48%) and UTHM students in the 'copyright and licenses' competency (42%). It means that there is a discrepancy in skills in the Content Creation domain. Correa stated that young adults are particularly proficient in using the internet, although it highly depends on various factors (Correa, 2010). The study also concluded that online content creation is influenced by gender, race, and age. Aside from gender, both UPI and UTHM students mostly have the same characteristics. Therefore, the result is consistent with another similar study.

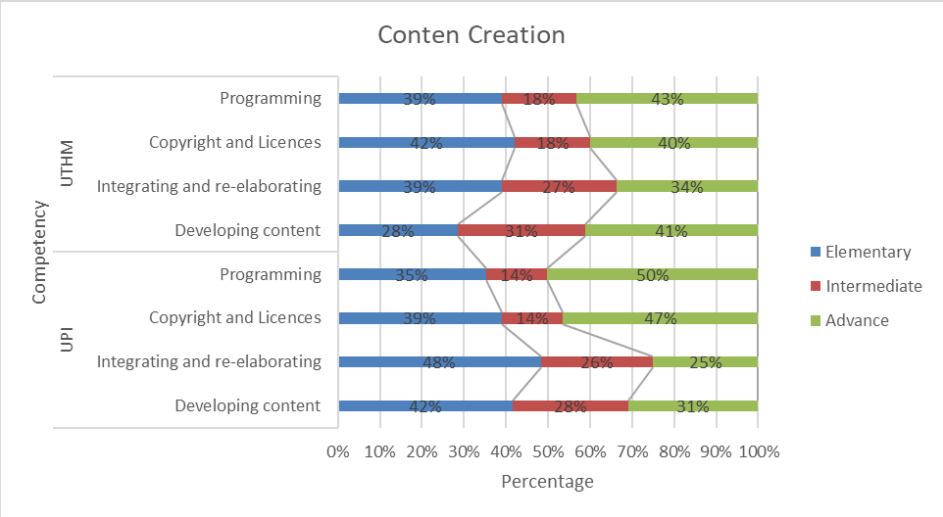

Fig. 4 - Respondents' proficiency level in content creation

3.2.4 Safety

According to Carretero et al (2017), content safety in the digital competence context includes protecting devices, protecting personal data and privacy, protecting health and wellbeing, and protecting the environment. The data shows that in this area, UPI students perform better (M=1.9237, SD=.46646) than UTHM students (M=1.9053, SD=.56514). Both UPI and UTHM students have an advanced level in competence area 1 which is safety. There is no significant difference between UPI and UTHM in this competence area based on the t-test [t (249) =.279, p=.780].

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Safety	Equal variances assumed	3.968	.047	.279	247	.780	.01844	.06605	-.11166	.14853
	Equal variances not assumed			.267	171.051	.790	.01844	.06910	-.11796	.15484

Figure 5 shows that UPI students particularly scored the highest (56% in advance level) in protecting the environment while UTHM students showed the best result in the 'protecting health' competency (49% in advanced level). Interestingly, students from both universities scored the lowest in protecting personal data and protecting devices, with 47% of UPI students at the elementary level in both competencies. Similarly, UTHM also shows that 44% of students are in the elementary level in the same competencies. Ideally, safety issues in the digital environment have become a huge concern during the COVID-19 pandemic. With a lot of data stored on the internet and sharing files or documents is done virtually (Huang et al., 2020), the skills can be introduced to students by academic institutions, for example by teaching students to preserve their privacy when signing up on online platforms, be careful when using social media, or clearing personal data after learning online. European countries, for instance, have implemented General Data Protection Regulation (GDPR) in various agencies and companies to protect the users including in higher institutions. A study suggests that improving information literacy is one of the best measures for better protection of personal information (Gligora Marković et al., 2019)

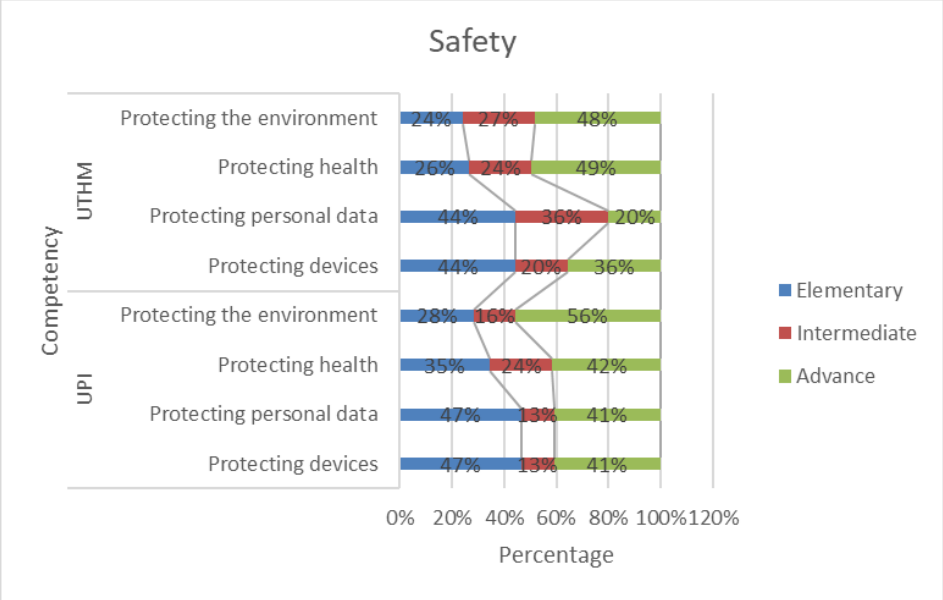

Fig. 5 - Respondents' proficiency level in safety

3.2.5 Problem Solving

According to Stephanie Carretero et al (2017), content problem-solving in the digital competence context includes solving technical problems, identifying needs and technological responses creatively using digital technologies and identifying digital competence gaps. The data shows that in this area, UPI students perform better (M=1.80, SD=.505) than UTHM students (M=1.77, SD=.549). Both UPI and UTHM students have an advanced level in competence area 1 which is problem-solving. There is no significant difference between UPI and UTHM in this competence area based on the t-test [$t(249)$=.329, p=.743].

		Levene's Test		*t*-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Difference	95% Confidence Interval	
									Lower	Upper
Problem solving	Equal variances assumed	.161	.689	.329	247	.743	.022	.06811	-.11176	.15653
	Equal variances not assumed			.322	186.561	.748	.022	.06947	-.11466	.15943

In detail, UPI and UTHM students show similar result as seen in the Figure 6. The highest percentage is shown to be in 'innovating and creatively using technology' with 57% and 53% students from UTHM and UPI are in the intermediate level. In the same competency, both students also show the lowest percentage of advanced level (19% and 18%). Similar percentage distribution of proficiency is also shown in other competencies as well, aside from solving technical problems where more UPI students show a larger percentage of elementary level users (35%) compared to UTHM students (24%). A study suggests that to improve problem solving ability for learners, it is important to give practical, instructional, and applicable examples (Quann & Ponder, 2015). Frank and Castek also state that problem solving skills is attributed to digital literacy and in what context the problems lie (Frank & Castek, 2017). It means that in educational context, academic institutions need to expose students to real-life problem-solving examples (Kiong et al., 2020) which also can be gained by internship program. Problem-solving also should be taught in school, especially in teaching and learning process (Hadi et al., 2015). The same study also suggests that strong partnership between TVET institutions and job agencies can contribute greatly to problem-solving skills as it is important for curriculum formulation.

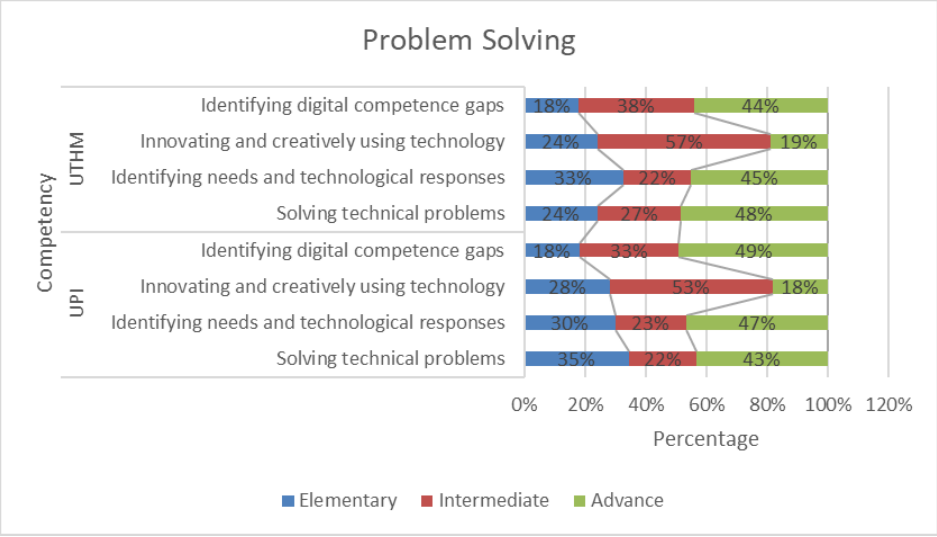

Fig. 6 - Respondents' proficiency level in problem solving

In all five competence domains, students from both universities show almost similar proficiency level, which falls to the intermediate level. Although the result is similar, the slight difference of the proficiency level can be the basis of improvement in certain areas for UPI and UTHM. As seen in Figure 7, both UPI and UTHM students show the strongest skill in Information and Data Literacy. In communication and safety, UPI students (M=1.98 and M= 1.92 respectively) perform better than UTHM students (M=1.86 and M=1.91). On the contrary, UTHM students (M=1.99, and M=1.87) are leading in the information and content creation domain compared to UPI (M=1.98 and M=1.87). Interestingly, students from both universities show the lowest proficiency in the problem-solving domain although UPI is leading by a slight margin. Therefore, both UPI and UTHM need to create focused strategies to improve students' skills in problem-solving. Both universities can also learn to improve other areas that their counterparts are more skilled in.

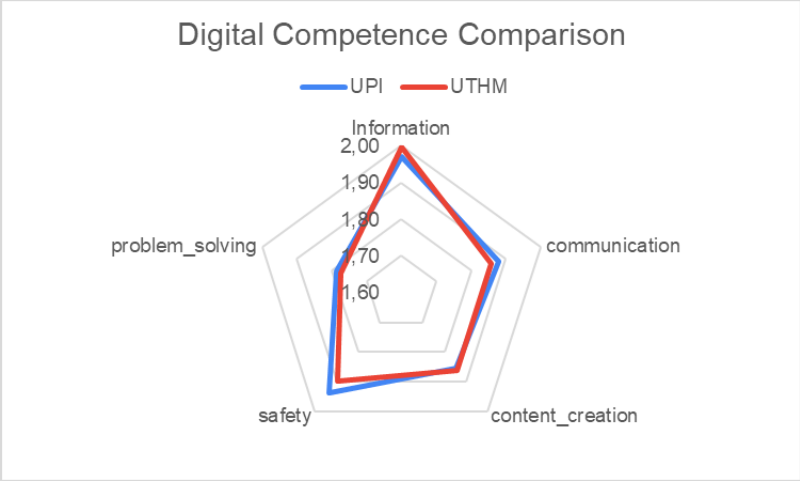

Fig. 7 - Digital Competence Comparison between UTHM and UPI

There are several possible reasons why digital skills gap happens among TVET students, one of them are the difference of accessibility to internet and the digital and physical tools that support it (Correa, 2010; de Haan, 2004), online experience, self-efficacy, and motivation (Correa et al., 2010). The first step to increase digital competence can be done by reflecting to what extent the skills have been possessed by the students, although the indicators are currently still being examined further (Iordache et al., 2017). Digital skills are closely related to creativity and critical thinking; therefore, students who continuously improve their digital skills would have a higher chance of keeping up with technological developments (van Laar et al., 2020). Based on several studies pertinent to digital skills, digital training and practice can also be beneficial in improving students' skills. This is in line with research conducted by (Riel et al., 2012), students will have digital skills if these students often practice and try new things related to technological developments.

4. Conclusion

Based on the data analysis, it can be concluded that UPI and UTHM students show similar proficiency level, both in overall digital skills and in each domain which is in intermediate level. It shows that the students have not yet reach their full potential yet to be fully prepared in facing digital demand of the industry in Industrial Revolution 4.0. Both UPI and UTHM can learn from each other based on which domain they perform best, and which area should be the concern to be improved. It also can be helpful to standardize the indicators for the skill set across the border and geographically bound.

The responsibility of preparing students' readiness lies heavily in the university's role. However, it should be noted that universities also need to collaborate with the industry in developing benchmark and standards to measure and set what skill set should be taught and prepared at school. Internship in the industry can be the simulation how well students perform in a professional setting.

It should be noted that the study is looking at the general digital skills that can be found in every industry, which is not specifically related to a certain field. Some areas of expertise may need additional skills in the digital environment which can be further developed in future research.

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References

Abd Rashid, Z., Kadiman, S., Zulkifli, Z., Selamat, J., Hisyam, M., & Hashim, M. (2016). Review of web-based learning in TVET: history, advantages, and disadvantages. *International J. of Vocational Edu. and Training Research*, *2*(2), 7.

Bhurtel, A. (2015). Technical and vocational education and training in workforce development. *Journal of Training and Development*, *1*, 77–84.

BPS. (2019). Data dan Informasi kemiskinan kabupaten/kota tahun 2018 [Data and poverty information 2018]. *Jakarta: Badan Pusat Statistik*.

BPS. (2021). *Data dan Informasi kemiskinan kabupaten/kota tahun 2020* [Data and poverty information 2018]. *Jakarta: Badan Pusat Statistik*.

Brennen, J. S., & Kreiss, D. (2016). Digitalization. *The International Encyclopaedia of Communication Theory and Philosophy*, 1–11.

Brolpito, A. (2018). Digital Skills and Competence, and Digital and Online Learning. *European Training Foundation*.

Carretero, S., Vuorikari, R., & Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*.

Correa, T. (2010). The participation divides among "online experts": Experience, skills and psychological factors as predictors of college students' web content creation. *Journal of Computer-Mediated Communication*, *16*(1), 71–92.

Correa, T., Hinsley, A. W., & de Zuniga, H. G. (2010). Who interacts on the Web? The intersection of users' personality and social media use. *Computers in Human Behavior*, *26*(2), 247–253.

de Haan, J. (2004). A multifaceted dynamic model of the digital divide. *It & Society*, *1*(7), 66–88.

Department of Statistics Malaysia. (2015). Malaysia Monthly Manufacturing Statistics. *Change*.

Ferrari, A. (2012). Digital Competence in Practice. European Commission Joint Research Centre. *Institute for Prospective Technological Studies. Spain: Seville. Retrieved from: Http://Ftp. Jrc. Es/EURdoc/JRC68116. Pdf (Accessed on 18.08. 2020)*.

Ferrari, A. (2013). *DIGCOMP: a framework for developing and understanding digital competence in Europe, EUR 26035*. JRC Scientific and Policy Reports, Luxembourg: Joint Research Centre.

Fors, A. C. (2010). The beauty of the beast: the matter of meaning in digitalization. *AI & Society*, *25*(1), 27–33.

Frank, T., & Castek, J. (2017). From digital literacies to digital problem solving: Expanding technology-rich learning opportunities for adults. *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education*.

Gebhart, M., Giessler, P., & Abeck, S. (2016). Challenges of the digital transformation in software engineering. *ICSEA 2016*, 149.

Gligora Marković, M., Debeljak, S., & Kadoić, N. (2019). Preparing students for the era of the General Data Protection Regulation (GDPR). *TEM Journal*, *8*(1), 150–156.

Hadi, M. Y. A., Hassan, R., Razzaq, A. R. A., & Mustafa, M. Z. (2015). Application of thinking skills in career: A Survey on Technical and Vocational Education Training (TVET) qualification semi-professional job duties. *Procedia-Social and Behavioral Sciences*, *211*, 1163–1170.

Huang, R. H., Liu, D. J., Zhu, L. X., Chen, H. Y., Yang, J. F., Tlili, A., Fang, H. G., & Wang, S. F. (2020). Personal data and privacy protection in online learning: Guidance for students, teachers and parents. *Beijing: Smart Learning Institute of Beijing Normal University*.

Ilomäki, L. (2011). Does gender have a role in ICT among Finnish teachers and students? *Scandinavian Journal of Educational Research*, *55*(3), 325–340.

Iordache, C., Mariën, I., & Baelden, D. (2017). Developing digital skills and competences: A quick-scan analysis of 13 digital literacy models. *Italian Journal of Sociology of Education*, *9*(1).

Jamaludin, K. A., Alias, N., DeWitt, D., Kenayathulla, H. B., & Razzaq, A. R. A. (2019). Employability skills valued by employers in Malaysia. *JuKu: Jurnal Kurikulum & Pengajaran Asia Pasifik*, *7*(2), 30–37.

Khan, N., Khan, S., Tan, B. C., & Loon, C. H. (2021). Driving digital competency model towards IR 4.0 in Malaysia. *Journal of Physics: Conference Series*, *1793*(1), 012049.

Kiong, T. T., Saien, S., Rizal, F., Yee, M. H., Mohamad, M. M., Othman, W., Azman, M. N. A., & Azid, N. (2020). Design and technology teacher in TVET: A view on thinking style and inventive problem-solving skill. *Journal of Technical Education and Training*, *12*(1).

Koroivulaono, T. B., & Seth, K. (2013). *Designing Technical Vocation and Educational Training (TVET) Courses for the first time at the University of the South Pacific*.

Kotsik, B., Tokareva, N., Boutin, F., & Chinien, C. (2009). ICT application in TVET. In *International handbook of education for the changing world of work* (pp. 1879–1894). Springer.

Lasi, H., Fettke, P., Kemper, H.-G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, *6*(4), 239–242. https://doi.org/10.1007/s12599-014-0334-4

Maisiri, W., Darwish, H., & van Dyk, L. (2019). An investigation of industry 4.0 skills requirements. *South African Journal of Industrial Engineering*, *30*(3), 90–105.

Majumdar, S. (2011). Teacher education in TVET: Developing a new paradigm. *International Journal of Training Research*, *9*(1–2), 49–59.

Malaysian Qualifications Agency (MQA). (2017). *Malaysian qualifications framework (MQF) version 2.0 draft: stakeholders' consultation*.

Ministry of Higher Education Malaysia. (2015). *Graduate Tracer Study 2014*. Retrieved 22nd April 2022 from https://ge.mohe.gov.my/SearchGraduateEmployability.aspx

Ministry of Higher Education Malaysia. (2016). *Graduate Tracer Study 2015*. Retrieved 22nd April 2022 from https://ge.mohe.gov.my/SearchGraduateEmployability.aspx

Ministry of Higher Education Malaysia. (2018). *Graduate Tracer Study 2017*. Retrieved 22nd April 2022 from https://ge.mohe.gov.my/SearchGraduateEmployability.aspx

Monterubbianesi, R., Tosco, V., Vitiello, F., Orilisi, G., Fraccastoro, F., Putignano, A., & Orsini, G. (2022). Augmented, Virtual and Mixed Reality in Dentistry: A Narrative Review on the Existing Platforms and Future Challenges. *Applied Sciences*, *12*(2), 877.

OECD. (2018). *Good jobs for all in a changing world of work: the OECD jobs strategy*. OECD. www.oecd.org/employment/good-jobs-for-all-in-a-changing-world-of-work-9789264308817-en.htm

OECD. (2022). *Education briefly 2022: OECD Indicators*. OECD. https://doi.org/10.1787/69096873-en

Parida, V. (2018). *Digitalization* (pp. 23–38).

Quann, S., & Ponder, T. (2015). *Integrating Digital Literacy and Problem Solving into Instruction*. LINCS Regional Professional Development Center for Adult Education.

Riel, J., Christian, S., & Hinson, B. (2012). Charting digital literacy: A framework for information technology and digital skills education in the community college. *Available at SSRN 2781161*.

Sari, I., Sinaga, P., & Hernani. (2021). The impact of industrial revolution 4.0 on basic chemistry learning. *AIP Conference Proceedings*, *2331*(1), 040024.

Schumacher, A., Nemeth, T., & Sihn, W. (2019). Road mapping towards industrial digitalization based on an Industry 4.0 maturity model for manufacturing enterprises. *Procedia Cirp*, *79*, 409–414.

Singh, V., Kumar, A., & Singh, T. (2018). Impact of TQM on organisational performance: The case of Indian manufacturing and service industry. *Operations Research Perspectives*, *5*, 199–217.

Stolterman, E., & Fors, A. C. (2004). Information technology and the good life. In *Information systems research* (pp. 687–692). Springer.

Van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *Sage Open*, *10*(1), 2158244019900176.

Vuorikari Rina, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens-With new examples of knowledge, skills and attitudes*. Joint Research Centre (Seville site).