

# Bridging The Digital Divide: A Comparative Study of Digital Competencies Among TVET Teachers in TVET Institutions in Asian Countries

Affero Ismail<sup>1\*</sup>, Ana, A.<sup>2</sup>, Muktiarni, M.<sup>2</sup>, Junita Sulaiman<sup>1</sup>, Sulaganya Punyayodhin<sup>3</sup>, Asghar Feizi<sup>3</sup>

<sup>1</sup> *Fakulti Pendidikan Teknikal dan Vokasional, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA*

<sup>2</sup> *Universitas Pendidikan INDONESIA, Kota Bandung, Jawa Barat 40154, INDONESIA*

<sup>3</sup> *Research Planning and Curriculum Development, Technical and Vocational Training Organization of Iran, IRAN*

<sup>4</sup> *Rajamangala University of Technology Thanyaburi, THAILAND*

<sup>5</sup> *Technical and Vocational University, No. 4, East Brazil Street, Vanak Square, Tehran, IRAN*

\*Corresponding Author: [affero@uthm.edu.my](mailto:affero@uthm.edu.my)  
DOI: <https://doi.org/10.30880/jtet.2025.17.03.006>

## Article Info

Received: 21<sup>st</sup> January 2025  
Accepted: 15<sup>th</sup> August 2025  
Available online: 2<sup>nd</sup> October 2025

## Keywords

Digital competencies, TVET, vocational education, DigComp 2.0 framework, TVET teachers

## Abstract

Digital competencies are very crucial in ensuring the successful of digital economy transformation and sustainability of the nation. To educate the new generation to become IT savvy, the teachers and instructors should have adequate knowledge and skills related to digital competencies. The study examines the digital competencies among teachers and instructors in selected TVET institutions in five countries namely Malaysia, Indonesia, Maldives, Thailand, and Iran. The research utilised descriptive statistics and ANOVA test to evaluate five important domains specified in the DigComp 2.0 framework. The five domains are Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving. The results indicate that there are generally high levels of competence with minor differences among institutes. There are no significant differences across institutes according to the ANOVA test with  $p=0.31$ . TVET institution in Indonesia consistently had the greatest scores, whereas TVET institutes in Thailand and Maldives consistently achieved lower scores across all components. Disparities may be ascribed to variables such as educational policy and infrastructure. The research highlights the need of customised digital literacy programmes, enhanced infrastructure, and cooperation among stakeholders to narrow the digital gap and provide graduates with the essential skills for the digital workplace.

## 1. Introduction

Ensuring equitable opportunities and access to technology in TVET institutions is vital in bridging the digital divide. The rapid development of digital technology has revolutionised our lifestyles, occupations, and educational pursuits (Purwaningrum et al., 2022). Consequently, there is a growing focus on cultivating digital skills to succeed in the digital age. TVET institutions are at urge in providing people with the essential skills and information

needed to thrive in the digital environment (Peisachovich et al., 2021). Nevertheless, there are discrepancies in the digital proficiencies of students in rural and urban areas.

The study will assess and evaluate the digital competencies of TVET teachers and instructors in selected TVET institutions across five Asia countries, as well as to determine the differences between those institutions, hence providing effective approaches for narrowing the gap in digital skills. In order to close the gap in skills and solve the disparity in access to digital resources, it is essential to build a shared comprehension of the fundamental digital abilities required by people, especially when it comes to resolving issues related to job searching (Maji & Laha, 2021). To address the digital gap in TVET institutions, it is crucial to determine the fundamental digital skills necessary for students to succeed in the digital era. Digital competencies encompass a broad spectrum of abilities, which include, but are not restricted to, fundamental digital literacy, expertise in utilising productivity software, coding and programming proficiencies, data analysis capabilities, awareness of cybersecurity, and the aptitude to utilise digital tools for efficient communication and collaboration (Ricci, 2023). By comprehending the precise digital proficiencies that hold the utmost importance for persons in TVET institutions, educators and policymakers may customise their curriculum and programmes to address the requirements of pupils more effectively (Yun, 2023). Furthermore, this understanding will also guide the creation of focused training and assistance programmes designed to tackle the discrepancies in digital skills across various geographical areas.

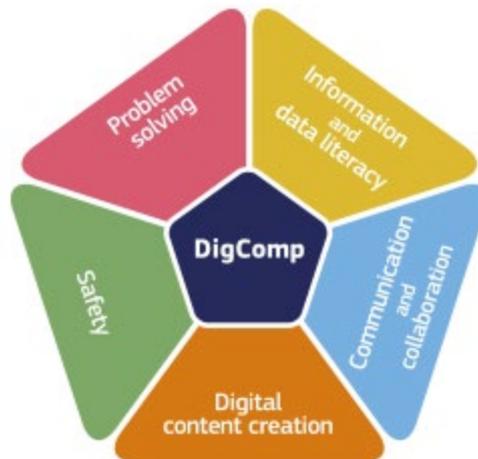
The digital competences should extend beyond fundamental computer literacy and involve a diverse set of abilities, such as technical proficiency, digital communication, information literacy, critical thinking, problem-solving, and online collaboration (Zhang et al., 2021). The study will include an evaluation of the students' digital capabilities, the degree to which they use the internet for educational purposes, and any disparities in digital access between students residing in urban and rural locations (Hidayat et al., 2023). When conducting a thorough background study on the digital competencies in TVET institutions in the selected countries, it became clear that there are notable differences in the availability of digital resources and the level of digital literacy among students.

## 2. Background of Research

To effectively bridge the digital divide among TVET teachers and instructors, it is essential to not only improve access to digital resources and infrastructure, but also to provide comprehensive and tailored digital literacy training programs that address the specific needs and priorities of each country (Sicilia et al., 2018). In some countries, there was a strong focus on technological proficiency and information literacy while others prioritized traditional vocational skills alongside digital competencies (Yeap et al., 2021). It is important to understand the level of digital competencies among teachers, identifying strategies for improvement, and facilitating knowledge exchange. On the other hand, it is important to acknowledge that access to digital resources and infrastructure is one of the important aspects of the digital divide. While urban areas may have better access to technology, it does not guarantee a higher level of digital competencies among students. In fact, some studies have shown that students in rural areas often demonstrate greater creativity and problem-solving skills when it comes to using limited digital resources (Jafar et al., 2022). Additionally, prioritizing traditional vocational skills alongside digital competencies can be beneficial, as it ensures a well-rounded education that prepares students for a variety of career paths.

Furthermore, the importance placed on digital capabilities may differ depending on the distinct requirements and goals of each nation (Le et al., 2022). For example, a nation that prioritises traditional vocational skills may be meeting the needs of its domestic labour market, where these abilities are much appreciated. When addressing the digital gap, it is important to not only prioritise the standardisation of digital skills across nations, but also to consider the distinct capabilities and requirements of each area. To effectively address the digital divide, it is crucial to enhance access to digital resources and infrastructure. Additionally, it is important to offer comprehensive and customised digital literacy training programmes that cater to the specific needs and priorities of each country (Akram et al., 2021). While it is essential to acknowledge and rectify disparities in access to digital resources, it is also vital to acknowledge and appreciate the varied proficiencies and expertise that students from various geographical areas possess. Instead of aiming for a standardised collection of digital skills, it is more effective to focus on establishing inclusive learning settings that recognise and enhance the current abilities of students, independent of their location or access to digital resources (Watulak & Collier, 2020). In order to do this, vocational education centres may use inclusive and culturally sensitive teaching methods that foster critical thinking, problem-solving, and teamwork (Sicilia et al., 2018). This method not only promotes digital skills, but also improves overall skill growth and readies students for the varied requirements of the job market. Furthermore, it is essential to foster cooperation among all parties involved to address the digital gap and improve digital prospects for students. This entails establishing collaborations among vocational education centres, government agencies, private firms, and community organisations to enable efficient allocation and focused delivery of resources and assistance tailored to the unique requirements of individual students and regions (Li, 2020). To effectively address the digital gap in vocational education centres across various nations, it is essential to adopt a contextual strategy that takes into account the distinct requirements and goals of each specific location.

To tackle the challenges these differences, create, this study uses the DigComp 2.0 framework, a model created by the European Commission to highlight the key digital skills needed in today's world. The framework breaks down digital competence into five main areas: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem Solving. These areas offer a thorough guide for assessing and improving digital skills, especially within TVET institutions. By using the DigComp 2.0 framework, this research looks at the digital skills of TVET teachers and instructors in Malaysia, Indonesia, Maldives, Thailand, and Iran. The goal is to find out where these educators excel and where there are gaps in their digital abilities, and to suggest ways to close those gaps. This framework provides a clear and organized way to analyze digital skills, making sure that all important areas of digital literacy are covered.



**Fig. 1** DigComp 2.0 framework. Source: Redecker, 2017

In regard to the quality of TVET delivery, it is crucial to not only grant access to digital resources and infrastructure, but also to prioritise customised and comprehensive digital literacy training programmes that cater to the specific requirements and preferences of each country (Zaika, 2019). Furthermore, the cooperation and coordination among all parties involved is essential for achieving success in narrowing the gap between those who have access to digital technology and those who do not. This entails establishing collaborations among vocational education centres, government agencies, private firms, and community organisations to guarantee efficient allocation and focus of resources and assistance towards the distinct requirements of each centre and its students (Abubakari et al., 2020).

This study on digital skills among TVET (Technical and Vocational Education and Training) teachers was carried out in five different countries to get a well-rounded view of how digital literacy varies in different educational and cultural settings within Asia. Each of these countries brings something unique to the table, whether it's in terms of their technological development, the resources they have, or the educational policies they follow. By including a mix of countries like this, the study aims to paint a more complete picture of digital competencies among TVET educators, helping to identify both common challenges and specific needs for each country.

These countries were chosen because they are all part of the UNEVOC Network, which is coordinated by UNESCO to improve vocational education worldwide. Being part of this network shows that these countries are committed to advancing vocational education, making them perfect candidates for a study on digital skills. Plus, these countries differ a lot in terms of their economic development and access to digital resources, which is important because it means the study's findings can be relevant across a variety of different educational environments.

### 3. Methodology

This study used a comparative method to evaluate digital capabilities in vocational education across selected Asia countries namely Malaysia, Indonesia, Maldives, Thailand, and Iran. The location of the study is based on the UNEVOC Network assessment, which these countries are members of the network. This study is purposely conducted in these centres as they represent the TVET centres in their countries, based on the UNEVOC database. The institutions chosen in this study are the established and recognized TVET institutions. The study adopts the DigComp 2.0 framework, which was developed by the European Commission, to assess the digital competencies among TVET teachers and instructors. The component of digital competencies delineates five fundamental domains of digital competence: information literacy, communication and collaboration, content production,

safety, and security, and problem-solving. The questionnaire was validated through face and content validity. The online survey has been disseminated to teachers, instructors, and administrators at the selected TVET institutions using purposive sampling. The purpose of the survey is to collect information on their perspectives about their perception of the five DigComp categories. This study also served as a needs analysis for the further development of capacity building among TVET educators. A total of 270 responses were successfully returned and analyzed.

### 3.1 Sampling Method: Purposive Sampling

The study focused on TVET teachers and instructors from selected vocational schools and institutions in each of the five countries. These institutions were chosen because they are well-known and play a key role in their country's education system, and they are also active members of the UNEVOC Network. This approach ensured that the study included influential institutions that have a big impact on the digital skills of educators.

To decide on the sample size, the researchers used a method called purposive sampling. This means they specifically selected participants who are TVET educators, ensuring that the sample accurately reflects the target group. The number of participants varied slightly from country to country, depending on the type of institutions and teachers were available in each institution. This approach helps make sure that the sample is representative of the overall TVET teaching population in each country, allowing the study to make meaningful comparisons and draw insights across different contexts. In short, by including these five countries, the study provides a rich, diverse perspective on digital skills among TVET educators. It helps to identify both common patterns and unique challenges, offering valuable insights that can guide efforts to improve digital literacy in vocational education around the world.

### 3.2 Location

The vocational education centers in this study are part of the UNEVOC Network, which is coordinated by UNESCO-UNEVOC to enhance and promote TVET globally. The institutions in Malaysia, Indonesia, Maldives, Thailand, and Iran were chosen because they offer a range of educational environments within Asia, reflecting different levels of technology, educational policies, and cultural contexts. These institutions play a key role in preparing students with the hands-on skills and knowledge they need for various careers, making them perfect places to study digital competencies. By focusing on these specific locations, the study aims to get a clear picture of how well TVET educators are equipped with digital skills in different settings, which is crucial for figuring out how to close the digital skills gap. This approach ensures that the study's findings are directly relevant to the current state of vocational education in these countries, and that the recommendations can be practically applied to help improve digital skills among TVET educators.

After collecting the data, the study used descriptive and inferential statistics (ANOVA) for analysis. Descriptive analysis would need using measures such as frequencies and percentages to illustrate the overall degree of digital proficiency in each of the five DigComp categories across the institutions involved. The technique section would certainly recognise the limitations associated with the selected strategy. These limitations may include constraints related to the data source itself, such as the data is not fully encompassing the whole spectrum of TVET practices in each nation. In addition, it should be noted that the DigComp framework, while helpful, may not comprehensively include all aspects of digital proficiency that are relevant to certain occupational domains. The generalizability of the results to other vocational education settings within the five nations may be limited owing to the possibility of a small sample size of respondents in the research.

## 4. Results and Findings

The study has assessed the level of digital competency among TVET teachers and instructors in selected institutions across five Asian countries. The institution from each of the country are coded as Malaysia (My), Indonesia (Id), Maldives (Mv), Thailand (Th) and Iran (Ir). The results are analyzed based on the following five elements.

### a. Information And Data Literacy Competency

The element of information and data literacy is analysed using descriptive analysis. Table 1 shows the mean score from UNEVOC centres in five countries: Malaysia, Indonesia, Maldives, Thailand and Iran.

**Table 1** Competency element of information and data literacy

NO	ITEM	My N=50	Id N=54	Mv N=46	Th N=57	Ir N=63
A1	I can understand the basic principles of using ICT in the workplace	4.22	4.22	4.22	4.22	4.22
A2	I can scan, search and filter information	4.14	4.46	4.17	3.86	4.21
A3	I can identify available digital interactive tools	4.08	4.26	3.74	3.67	4.21
A4	I can understand the basics of computing, coding and systems thinking	3.48	4.04	3.52	3.58	3.71
A5	I have an in-depth understanding of how social media enables different forms of communities and democracy	3.7	4.11	3.74	3.49	3.95
A6	I have a wide range of digital communities, networks and social media	3.66	3.93	3.52	3.53	3.73
A7	I have a good understanding of when technology can support a process (and when it cannot).	3.84	4.24	3.7	3.6	4.14
A8	I am familiar with a wide range of digital communities, networks and social media	3.74	4.09	3.65	3.44	3.79
A9	I am very proactive in finding and collecting information from the internet	3.86	4.28	3.91	3.6	4.03
A10	I thrive on the continuous requirement to stay up to date with new technology	3.78	4.26	3.83	3.61	4.13
TOTAL		38.5	41.89	38	36.6	40.12
MEAN		3.85	4.21	3.79	3.62	4.03
STANDARD DEVIATION		0.23	0.15	0.24	0.23	0.20

The study of Table 1.1 reveals that the total mean value exceeds 3, indicating a relatively high level. Indonesia has the highest average value ( $m = 4.21$ ), followed by Iran ( $m = 4.03$ ), Malaysia ( $m = 3.85$ ), Maldives ( $m = 3.79$ ), and Thailand ( $m = 3.62$ ). The variation may be attributed to the respondents' proficiency in discerning, finding, obtaining, storing, consolidating, and evaluating digital information, as well as determining its significance and intended use. The standard deviation values ranged between 0.15 and 0.24, suggesting a moderate consistency of responses across countries. Indonesia ( $SD = 0.15$ ) displayed the most uniform competency levels, indicating that teachers there shared relatively similar strengths in information and data literacy. In contrast, Maldives ( $SD = 0.24$ ) showed greater variability, reflecting a wider gap between teachers with stronger and weaker digital information skills. This implies that while the overall mean scores were generally high, the distribution of skills among teachers was not equally balanced across all contexts. Overall, the average scores across all institutions show a reasonably high level of proficiency, which suggests a solid basis in abilities related to information and data literacy. Nevertheless, there are notable disparities across institutions, with Indonesia and Iran demonstrating the greatest level of competence, followed by Malaysia, Maldives, and Thailand. These disparities may arise from a multitude of variables, including educational policy, cultural dispositions towards technology, and availability of resources. Countries that have strong educational infrastructure and aggressive attempts to promote digital literacy often achieve higher levels of performance. The skill areas of recognising, finding, analysing, and evaluating the significance of digital information demonstrate consistent proficiency in all nations, indicating a basic grasp of data management concepts. These results emphasise the need for ongoing investment in digital literacy education and training programmes within vocational education centres. Policymakers should give top priority to efforts focused on improving digital literacy. International cooperation may play a crucial role in facilitating the sharing of information and exchanging best practices to enhance digital competence worldwide. In summary, the research highlights the need of promoting digital literacy to ensure people are adequately equipped for the challenges of the digital age and to enable equal access to digital possibilities globally.

## b. Information Communication and Collaboration Competency

Table 2 displays the mean score for the element of communication and collaboration.

**Table 2** *Communication and collaboration element*

NO	ITEM	My N=50	Id N=54	Mv N=46	Th N=57	Ir N=63
B1	I carefully consider where and how digital content is saved and stored	3.92	4.28	3.65	3.75	3.97
B2	I have a thorough understanding of the effects of communicating through different types of media	3.84	4.17	3.96	3.77	3.92
B3	I always evaluate the recipients and carefully tailor the communication accordingly	3.72	4.17	3.91	3.84	3.92
B4	I have an in-depth understanding of how social media enables different forms of communities and democracy	3.82	4.06	3.3	3.53	3.79
B5	I am familiar with a wide range of digital communities, networks and social media	3.78	4.11	3.57	3.47	3.95
B6	I enjoy expressing thoughts and opinions through relevant social media	3.54	3.54	3.35	3.51	3.71
B7	I have a good understanding of how others can contribute (positively or negatively) to my digital identity	3.82	3.91	3.61	3.53	3.78
B8	I have developed good strategies for handling the improper behaviour of others	3.62	3.72	3.35	3.56	3.56
B9	I always carefully consider what the most appropriate tone is when communicating with others	3.84	4.24	3.65	3.77	4.16
B10	I am good at choosing the most suitable type of media (e.g. text, photo, video, animation etc.) to achieve the desired result	3.84	4	3.57	3.7	4.14
TOTAL		37.74	40.2	35.92	36.43	38.9
MEAN		3.77	4.02	3.6	3.64	3.9
STANDARD DEVIATION		0.12	0.24	0.22	0.14	0.19

The analysis of the Communication and Collaboration proficiency among respondents offers significant observations about their digital aptitude. Overall, the average scores show a reasonably high level of competence in all institutions, with mean value of 3 and above. Nevertheless, there are noticeable variations in the degrees of proficiency across the institutions. Indonesia has the highest mean value of 4.02, followed closely by Iran with a mean value of 3.90. Malaysia, Thailand, and Maldives have somewhat lower mean scores of 3.77, 3.64, and 3.60, respectively. The SD values for communication and collaboration ranged from 0.12 to 0.24. Malaysia recorded the lowest SD (0.12), signifying highly consistent responses among teachers in this domain. Conversely, Indonesia (SD = 0.24) demonstrated greater variability, suggesting that while some educators possessed strong collaboration competencies, others lagged. This variability highlights disparities in communication-related digital practices across respondents, even within the same country, and may be influenced by institutional differences in exposure to collaborative technologies. The differences in these outcomes are likely due to the varying proficiencies of participants in successfully communicating, working, and interacting with others in virtual teams and networks. These inequalities may be influenced by factors such as cultural norms, educational methods, and access to technology. The competence categories include the aptitude to use appropriate medium, tone, and behaviour skills in communication, as well as the capacity to identify and engage in collaborative endeavours. The results emphasise the significance of cultivating proficient communication and cooperation abilities inside the institutions, since these skills are crucial for achieving success in the current linked digital environment. It is important for policymakers and educators to give priority to efforts that focus on improving these abilities. This will help people to be better prepared for the requirements of the contemporary job and encourage more

involvement in global networks and communities. In addition, promoting cultural understanding and sensitivity may enhance cooperation in many circumstances.

### c. Content Production Competency

Table 3 shows the mean score for the element of Content Production.

**Table 3** Content production element

NO	ITEM	My	Id	Mv	Th	Ir
		N=50	N=54	N=46	N=57	N=63
C1	I can develop content in different formats (video, visual, animation, etc.) using various tools of digital technologies.	3.58	3.72	3.43	3.25	3.76
C2	I can choose the most suitable type of media (e.g., text, photo, video, animation etc.) to achieve the desired result.	3.72	4.06	3.52	3.42	3.86
C3	I can choose the most appropriate format to store data	3.68	4.09	3.65	3.4	3.9
C4	I can produce digital content by making changes to ready-made content.	3.54	3.67	3.43	3.11	3.71
C5	I can change ready-to-use templates in programming and correct existing errors (for example, when creating a website).	3.4	3.33	3	3.04	3.13
C6	I am skilled at using applications to create relevant multimedia	3.4	3.56	3.22	3.16	3.52
C7	I can make efficient use of databases to store large amounts of data	3.36	3.57	3.04	3.11	3.6
C8	I can create content or enhance functionalities through advanced use of programming	3.2	3.43	2.87	3.05	3.13
C9	I have a good understanding of how applications and websites are developed and built	3.2	3.33	3	3.02	3.1
C10	I can easily edit advanced settings on digital devices, online services and applications	3.3	3.44	2.74	3.05	3.13
TOTAL		34.38	36.2	31.9	31.61	34.84
MEAN		3.44	3.62	3.2	3.16	3.48
STANDARD DEVIATION		0.19	0.27	0.30	0.15	0.33

The analysis of Content Production proficiency provides significant insights into their capacity to produce, configure, and modify digital information. In general, the average scores reflect a rather good level of competence, with average mean value of 3 and above. Nevertheless, there are discernible disparities in the degrees of proficiency across institutions. Indonesia has established itself as the frontrunner in Content Production competence, with the highest mean score of 3.62. Iran closely trails after with a mean value of 3.48. Malaysia and Thailand have similar average scores of 3.44 and 3.16, respectively, while Maldives has a little lower average score of 3.20. Content production recorded the widest range of variability, with SD values between 0.15 and 0.33. Iran (SD = 0.33) had the highest spread, indicating significant differences in teachers' ability to produce and manage digital content. Some respondents demonstrated strong competence, while others showed considerably weaker proficiency. On the other hand, Thailand (SD = 0.15) exhibited the lowest variability, though with generally lower mean scores. These findings suggest that digital content creation remains a challenging area, particularly in countries where infrastructure and professional development opportunities may differ widely. The disparities are likely due to variances in the respondents' ability to participate in the development of digital material, solve digital issues, and efficiently use technology. Disparities in these areas may be influenced by factors such as the availability of resources, educational methods, and technological infrastructure. The analysis evaluates competencies in generating, configuring, and editing digital information, as well as the ability to solve digital issues and innovate utilising technology. The results emphasise the significance of cultivating creativity, problem-solving abilities, and digital literacy in vocational education centres to equip students for the requirements of the contemporary labour market. Policymakers and educators should give priority to efforts focused on improving Content Production competence, which will provide students with the essential skills and knowledge needed to succeed in the digital era. In addition, fostering cooperation and information exchange across nations helps expedite the implementation of optimal methods and the development of digital skills worldwide.

#### d. Safety and Security Competency

Table 4 displays the mean score for the element of safety and security.

**Table 4** *Safety and security element*

NO	ITEM	My N=50	Id N=54	Mv N=46	Th N=57	Ir N=63
D1	I know the principles of an ergonomic computer station and a healthy working posture.	3.58	3.94	3.39	3.3	4.19
D2	I practice good strategies for creating and remembering passwords.	3.68	3.91	3.48	3.37	4.08
D3	I evaluate various options to save and store digital content.	3.7	3.91	3.48	3.37	4
D4	I always backup my work on various digital devices.	3.9	3.85	3.83	3.53	3.79
D5	I have proactive attitude towards verifying information from the internet.	3.76	3.93	3.65	3.51	3.9
D6	I carefully consider what personal information to share (and not to share) through any online platform.	3.94	4.22	3.78	3.72	3.94
D7	I am aware of copyright, licensing and other regulations when using or publishing digital material.	3.84	4.13	3.96	3.88	3.84
D8	I know different methods for identifying phishing and malware (malicious programs).	3.46	3.37	3.39	3.19	3.4
D9	I can encrypt, password-protect or otherwise secure access to data when it is sent or stored.	3.38	3.48	3.04	3.3	3.46
D10	I am in the habit of familiarising myself with the terms and conditions for using various services on the internet.	3.6	3.67	3.17	3.32	3.73
TOTAL		36.84	38.41	35.17	34.49	38.33
MEAN		3.68	3.84	3.52	3.45	3.83
STANDARD DEVIATION		0.18	0.27	0.29	0.21	0.25

The analysis of Safety and Security competency sheds light on their proficiency in utilizing digital technology while adhering to personal health, data protection, and legal framework requirements. Overall, the mean scores indicate a moderately high competency level, with all countries surpassing a mean value of 3. However, there are notable variations in proficiency levels among the institutions. Indonesia emerges as the leader in Safety and Security competency, recording the highest mean value ( $m = 3.84$ ), closely followed by Iran ( $m = 3.83$ ). Malaysia and Thailand exhibit comparable mean scores of 3.68 and 3.45, respectively, while Maldives demonstrates a slightly lower mean score of 3.52. The standard deviation values for safety and security ranged between 0.18 and 0.29. Malaysia ( $SD = 0.18$ ) showed relatively consistent competency levels among respondents, suggesting uniform awareness and practices in safe digital engagement. In contrast, Maldives ( $SD = 0.29$ ) demonstrated greater variability, indicating uneven distribution of safety-related knowledge and practices among teachers. This inconsistency highlights the importance of strengthening digital safety training in certain countries to ensure all educators maintain adequate data protection and cybersecurity awareness. These differences likely stem from variations in respondents' ability to implement good practices in using digital technology safely and securely, as well as their awareness of personal health and data protection measures. Factors such as access to resources, educational policies, and legal frameworks may contribute to these disparities. Competency areas assessed include the ability to protect devices, content, personal data, and privacy in digital environments, as well as awareness of the environmental impact of digital technologies. The findings underscore the importance of fostering a culture of safety and security within vocational education centers, equipping individuals with the skills and knowledge necessary to navigate digital environments responsibly. Policymakers and educators should prioritize initiatives aimed at enhancing Safety and Security competency, promoting awareness of data protection and privacy measures, and ensuring compliance with legal requirements. Additionally, fostering collaboration and knowledge-sharing among countries can facilitate the adoption of best practices and the advancement of digital competencies on a global scale.

### e. Problem Solving Competency

The mean score for the element of problem solving is summarised in Table 5.

**Table 5** Problem solving element

NO	ITEM	My N=50	Id N=54	Mv N=46	Th N=57	Ir N=63
E1	I can perform step-by-step analysis towards achieving desired digital solutions.	3.64	3.72	3.39	3.21	3.48
E2	I update myself with recent digital technology and problem-solving skills.	3.62	3.96	3.57	3.18	3.68
E3	I have a good understanding of suitable technology to support technical requirements.	3.6	3.83	3.65	3.26	3.54
E4	I can apply relevant tools to create digital solutions.	3.46	3.65	3.35	3.09	3.44
E5	I can apply programming skills to develop functionalities in various applications.	3.28	3.33	2.96	2.98	3
E6	I can install and update relevant tools for application development.	3.58	3.8	3.3	3.14	3.51
E7	I have an overall understanding of the components of a computer and how it is connected to other devices.	3.62	3.74	3.52	3.18	3.92
E8	I like to experiment with new digital devices and applications.	3.64	3.7	3.7	3.21	3.95
E9	I can customize settings on various digital devices and applications to solve problems.	3.48	3.67	3.48	3.07	3.7
E10	I understand the design process of digital solutions.	3.48	3.54	3.43	3.05	3.44
TOTAL		35.4	36.94	34.35	31.37	35.66
MEAN		3.54	3.69	3.44	3.14	3.57
STANDARD DEVIATION		0.12	0.17	0.21	0.09	0.27

The analysis of Problem-Solving proficiency provides valuable insights into their capacity to use technical skills in the process of analysing, planning, and creating digital solutions to tackle diverse difficulties. In general, the average scores suggest a rather good level of competence, with all institutions exceeding a mean value of 3. Nevertheless, there are notable disparities in the degrees of proficiency across institutions. Indonesia has emerged as the frontrunner in Problem Solving capability, with the highest mean score of 3.69. Iran closely follows with a mean value of 3.57. Malaysia and Maldives have similar average ratings of 3.54 and 3.44, respectively, whereas Thailand has a slightly lower average score of 3.14. The disparities are likely due to variances in the respondents' ability to use technical abilities, creativity, and critical thinking to solve digital challenges, as well as their access to appropriate tools and technology. The SD values for problem-solving competencies varied from 0.09 to 0.27.

Thailand recorded the lowest SD (0.09), reflecting very consistent responses, though their mean scores remained comparatively lower, suggesting uniform but weaker proficiency. Iran (SD = 0.27), however, displayed greater variability, pointing to disparities in problem-solving skills across respondents. This indicates that while some educators in Iran are well-versed in digital problem-solving, others struggle significantly, emphasizing the uneven diffusion of these advanced competencies within the same educational context. Disparities in this context may be influenced by factors such as educational procedures, technological infrastructure, and resource availability. The analysis evaluates competencies in identifying requirements and challenges, solving conceptual problems and problem scenarios in digital settings, and innovating processes and products utilising digital technologies. The results emphasise the significance of cultivating problem-solving abilities in vocational education centres, since these skills are crucial for achieving success in the era of digital technology. Policymakers and educators should give top priority to efforts focused on improving Problem Solving proficiency, equipping students with the required skills and knowledge to successfully navigate and excel in an ever more intricate digital environment. In addition, fostering cooperation and knowledge-sharing across nations may allow the interchange of exemplary methods and the development of digital skills on a worldwide level.

Based on the ANOVA test, the p-value is 0.31 with  $df=4$ , which is greater than the threshold of 0.05. This indicates that there is no significant difference in competencies among the countries. Therefore, the level of competencies among institutions is relatively similar. This uniformity is attributed to the access to resources and the type of training they have undergone. Given these scenarios, we can conclude that the capabilities of the TVET teachers and instructors in the selected institutions are comparable.

**Table 6 ANOVA output analysis**

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Value	P-Value
Between Groups	12.91	4	3.23	1.04	0.31
Within Groups	329.1	265	1.24		
Total	342.01	269			

## 5. Discussion

In today's rapidly advancing digital world, the need for individuals to possess digital competency has become increasingly important. During the COVID-19 emergency, most students' educational experience shifted to web-based platforms, highlighting the disparities in digital resources and competence among students. The analysis of the five TVET institutions in Malaysia, Indonesia, Maldives, Thailand, and Iran revealed moderately high competency levels in all five digital literacy elements: Information and Data Literacy, Communication and Collaboration, Content Production, Safety and Security, and Problem-Solving. However, significant variations were found among the countries, with Indonesia consistently scoring the highest and Thailand or Maldives scoring the lowest across all elements.

In addition to the digital competency needs of students, it is equally crucial for Technical and Vocational Education and Training teachers to possess a high level of digital competencies (Ismail *et al.*, 2017). The evolving landscape of technology has significantly impacted the way skills are taught and learned, and TVET instructors need to be adequately equipped to effectively integrate digital tools and technologies into their teaching methods. The integration of digital competencies among TVET teachers is essential for preparing students with the technological skills required in today's workforce. Moreover, digital competencies among instructors can bridge the digital divide and ensure equitable access to quality education. Emphasizing the development and enhancement of digital competencies in TVET educators is critical for the continued advancement of vocational and technical education in the digital era.

To address the necessity for digital competencies among TVET teachers, it is imperative to implement targeted professional development programs that focus on enhancing digital skills, digital pedagogy, and the effective use of digital resources in the classroom. Furthermore, fostering a culture of continuous learning and professional growth in digital competencies can empower TVET instructors to adapt to the evolving technological landscape and effectively prepare students for future employment opportunities. The seamless integration of digital competencies into the pedagogical practices of TVET teachers will undoubtedly contribute to the overall enhancement of vocational and technical education, ultimately benefiting both the educators and the students (Tsvetkova & Kiryukhin, 2019).

The fact that there were no significant differences suggests that the digital skills of TVET educators in these countries are quite similar. This is an interesting finding because it shows a level of consistency in digital skills across the region, despite differences in things like educational policies, resources, and cultures. It also means that regional efforts to improve digital literacy in TVET institutions could work well across these countries without needing to be heavily customized for each one (Gayyur, 2021).

Disparities in digital competencies among countries can be attributed to various factors, including educational policies, infrastructure development, and cultural influences. Countries with robust digital infrastructure and proactive educational initiatives tend to exhibit higher levels of digital proficiency in vocational education centers. However, addressing the digital divide and enhancing digital literacy programs are imperative to ensure equitable access to digital opportunities for all (Nurhidayat *et al.*, 2022). While it is important to recognize and celebrate the diverse skills and knowledge that students from different regions bring to the table, it's also crucial to acknowledge the rapidly evolving demands of the global workforce. In today's highly digitalized world, proficiency in digital skills is becoming increasingly essential across various industries and professions. Emphasizing traditional vocational skills at the expense of digital competencies may limit the competitiveness and adaptability of graduates in the job market (Skills development for the digital economy, 2023). To bridge this gap, it is essential for vocational education centers to prioritize the integration of digital competencies into their curricula (Tzafilkou *et al.*, 2022).

This can be achieved through collaborations with industry partners, professional development programs for teachers, investment in digital infrastructure, and the incorporation of practical, hands-on learning experiences that align with real-world digital demands (Luan *et al.*, 2020). Institutions should provide adequate and quality support for the student (Ismail, Hassan and Masek, 2015). Furthermore, while inclusive learning environments are valuable, it is essential to acknowledge that a foundational level of digital competencies is increasingly becoming a prerequisite for success in the modern workplace (Spante *et al.*, 2018; Haleem *et al.*, 2022). As technology continues to permeate all aspects of professional life, digital literacy has become a fundamental skill

that cannot be overlooked (Walter, 2024). Neglecting the development of digital competencies in vocational education may result in graduates being ill-prepared to meet the evolving needs of the job market, potentially hindering their career prospects (Nurhidayat et al., 2022). The quality of higher education is at stake if these issues are not addressed (Abiddin and Ismail, 2014). In conclusion, while it is important to value and build upon the existing skills of students, including traditional vocational skills, integrating comprehensive digital literacy training programs and prioritizing digital competencies in vocational education centers is essential to equip students with the skills needed to succeed in today's digital age.

## 6. Conclusion

In conclusion, the varying levels of digital competencies across institutions in Malaysia, Indonesia, Maldives, Thailand, and Iran underscore the imperative for a nuanced and tailored approach to bridging the digital divide. By implementing customized digital literacy programs, enhancing infrastructure and resources, promoting inclusive pedagogical approaches, and fostering stakeholder collaboration, vocational education centers can work towards ensuring equitable access to digital opportunities while valuing the diverse skills and knowledge of students in different regions. While the findings highlight moderately high overall competency levels, significant variations exist between nations. These disparities underline the influence of factors like educational policies and infrastructural limitations. This approach will not only address the existing disparities but also prepare graduates to meet the evolving demands of the global workforce, balancing digital and non-digital skills for a comprehensive vocational education. In summary, a comprehensive approach that encompasses customized digital literacy programs, infrastructure enhancement, inclusive pedagogical approaches, and stakeholder collaboration is essential for bridging the digital divide and promoting equitable access to digital competencies among TVET institutions. The results emphasize the urgent need for targeted digital literacy programs within vocational education centers. By tailoring these programs to address specific regional and national shortcomings, educators can equip graduates with the necessary competencies to thrive in the digital workplace. Bridging the digital divide requires a collaborative effort among policymakers, educators, and technology providers. By investing in improved infrastructure and fostering cross-stakeholder partnerships, countries can ensure all graduates possess the critical digital skills demanded by the evolving job market. This study serves as a springboard for further research investigating the efficacy of specific digital literacy interventions within vocational education settings. It underscores the importance of ongoing monitoring and adaptation to ensure graduates remain at the forefront of digital competency in an ever-changing technological landscape.

## Acknowledgement

The authors would like to acknowledge the support provided by the UNEVOC Network in contributing ideas and conducting research. This project is funded by the International Centre for Technical and Vocational Education and Training (UNESCO-UNEVOC) as part of the Co-Action Initiative Project.

## Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

## Author Contribution

*The authors are responsible for the study conception, research design, data collection, data analysis, result interpretation and manuscript drafting.*

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