Mapping Digital Competence Across Five Digcomp Dimensions among Vocational College Students in Johor, Malaysia

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ABSTRACT

Digital competence has become increasingly important in Technical and Vocational Education and Training (TVET) as technological advancements reshape educational practices and workforce requirements. Despite growing expectations for digitally competent graduates, concerns remain regarding the extent to which vocational students possess the competencies necessary to navigate digital workforce environments effectively. This study assessed the digital competence levels of vocational college students in Johor, Malaysia, based on five dimensions of the European Digital Competence Framework (DigComp). A quantitative survey design was used involving 181 students from a vocational college in Johor. Data were collected using a questionnaire adapted from the DigComp Self-Assessment Tool (DigCompSAT) and analysed using descriptive statistics. The findings showed an overall mean score of 3.97 (SD=0.45) on a five-point response scale. Among the five dimensions, problem-solving recorded the highest mean score (M = 4.11, SD = 0.55), followed by digital content creation (M = 4.00, SD = 0.56), safety (M = 3.97, SD = 0.65), and information and data literacy (M = 3.96, SD = 0.48). Communication and collaboration recorded the lowest mean score (M = 3.79, SD = 0.62). The relatively lower score for communication and collaboration highlights an area requiring particular attention, especially in students' reported use of cloud-based information-sharing tools. These findings provide a descriptive profile of digital competence among the participating vocational students and identify areas for targeted educational support. The study highlights the importance of integrating structured digital learning activities into TVET curriculum to strengthen students' digital competencies and support their preparation for technology-driven learning and working environments.

Keywords: Digital Competence, DigComp, TVET, Vocational Education, Digital Skills

INTRODUCTION

The development of digital technology has transformed the way people work, learn, communicate, and access information. Digital technology has become an important part of daily life and continues to influence various sectors, including education and employment. These transformations have created a growing demand for graduates who can use digital technology effectively and responsibly. As industries continue to adopt digital technologies, graduates are expected to develop not only technical skills but also the knowledge and attitudes to work and communicate in digital environments (Lee et al., 2018; UNESCO-UNEVOC, 2024). Therefore, digital competence has become a crucial competency for students preparing to enter the workforce.

Digital competence refers to the combination of knowledge, skills, and attitudes needed to use digital technologies confidently, critically, and responsibly in learning, work, and everyday life (Vuorikari et al., 2022). It encompasses more than technical proficiency to operate digital devices or applications. Individuals also need to search for and evaluate information, communicate and collaborate through digital platforms, create digital content, protect personal information, and solve problems using digital technology (Joint Research Center, 2013; The Council of the European Union, 2018). These competencies are increasingly important as digital technologies become more widely used in learning environments and workplaces. In Technical and Vocational Education and Training (TVET), digital competence plays an significant role in preparing students to meet the

changing demands of industries. TVET focuses on developing practical knowledge and skills that are relevant to specific occupations. However, the increasing use of digital technologies in industries requires TVET graduates to possess additional competencies beyond their technical specializations. Students are expected to use digital tools to access information, complete tasks, communicate with others, and solve work-related problems. According to Ismail and Hassan (2019), technological changes associated with the Fourth Industrial Revolution have influenced the competencies required in technical and vocational fields. Therefore, digital competence should be considered an important component of TVET education to ensure that graduates can adapt to changing workplace requirements.

In Malaysia, the importance of digital competence has been recognised through national education policies and qualification frameworks. The Ministry of Education introduced the Digital Education Policy to strengthen digital education and develop a digitally competent generation (Kementerian Pendidikan Malaysia, 2023). In addition, the Malaysian Qualifications Agency (MQA) incorporated digital skills as one of the learning outcome components under the functional work skills cluster in the Malaysian Qualifications Framework (MQF 2.0). This reflects the importance of preparing graduates with the digital skills required in education and employment. These developments highlight the responsibility of educational institutions, including vocational colleges, to support students in developing digital competence throughout their studies. Despite the growing importance of digital competence, previous studies have raised concerns about the digital abilities of students, particularly those in technical and vocational education. Although young people are often assumed to be familiar with digital technology given that they are digital natives, frequent use of digital devices does not necessarily indicate a high level of digital competence. Findeisen and Wild (2022) highlighted that young learners may still lack important digital competencies despite their familiarity with technology. Similarly, studies by Ismail and Hassan (2019) and Iwa Kuntadi et al. (2022) reported moderate levels of digital competence among students in technical and vocational education contexts. These findings suggest that students may be familiar with digital technology but may not have fully developed the competencies needed to use it effectively for learning and employment.

Digital competence consists of several dimensions that require different types of knowledge and skills. The European Digital Competence Framework, commonly known as DigComp, provides a comprehensive framework for understanding and assessing digital competence. The framework identifies five main dimensions, namely information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving (Vuorikari et al., 2022). These dimensions cover various activities related to the effective and responsible use of digital technology. For example, information and data literacy involves searching for, evaluating, and managing digital information, while communication and collaboration focus on interacting and sharing information through digital platforms. Digital content creation involves developing and modifying digital materials, whereas safety relates to protecting personal information, devices, and digital well-being. Problem-solving involves identifying and addressing problems in digital environments. Assessing these dimensions provides a broader understanding of students' digital competence and helps identify areas that require further development.

Despite existing literature on student digital competence in various academic settings, research explicitly centered on vocational college students is still limited (Barboutidis & Stiakakis, 2023). In Malaysia, existing studies have reported concerns about digital competence among students in higher education and other TVET institutions (Ismail & Hassan, 2019; Iwa Kuntadi et al., 2022). However, these findings may not fully reflect the digital competence of students enrolled in vocational colleges, where learning activities place considerable emphasis on practical and occupation-related skills. Furthermore, examining overall digital competence alone may not provide sufficient information about students' strengths and weaknesses in specific competency areas. A more detailed assessment across the five DigComp dimensions is therefore useful for understanding the digital competence profile of vocational college students and identifying areas that may require additional educational support.

Therefore, this study aims to evaluate the level of digital competence among students at a vocational college in Johor, Malaysia, based on the five dimensions of the DigComp framework. Specifically, the study examines students' overall digital competence, identifies their competence levels across the five dimensions, and explores the competencies with relatively higher and lower scores. By providing a detailed profile of students' digital

competence, the study offers useful information for educators and vocational education institutions to identify areas for improvement. The findings may also support the development of appropriate teaching strategies and learning activities to strengthen digital competence among vocational college students and enhance their readiness for the expectations of an increasingly digitized workforce.

LITERATURE REVIEW

Digital competence is often associated with terms such as digital literacy, digital skills, and information and communication technology (ICT) skills. Although these terms are closely related, they may represent different aspects of technology use. Digital skills focus on performing tasks using technology, whereas digital competence integrates the knowledge and attitudes required to contextualize and apply those skills effectively. Ilomäki et al. (2011) explained that digital competence is a developing concept that covers several areas related to technology use. This suggests that digital competence should not be assessed only through students' technical abilities but should also consider how they understand, evaluate, and apply digital technologies. In education, digital competence supports students in becoming more independent and responsible learners. Students need to identify reliable information, organize digital materials, communicate appropriately through digital platforms, and protect their personal information when participating in online activities. These competencies are relevant not only to academic learning but also to everyday activities and future employment. The Council of the European Union (2018) recognized digital competence as one of the key competencies for lifelong learning, emphasizing its importance for learning, work, and participation in society.

Nevertheless, students may develop different levels of competence across digital activities. For example, students who frequently use social media or online communication applications may not necessarily have the same level of competence in evaluating information, creating digital content, or solving technical problems. Findeisen and Wild (2022) examined digital competence among 480 trainees in commercial vocational education in Germany and identified different competence profiles among the participants. Their findings indicate that students entering vocational training do not have the same level of digital competence. Therefore, assessing digital competence across different dimensions is important for understanding students' capabilities and identifying areas that may require further development.

Digital Competence in Technical and Vocational Education and Training

Digital competence is relevant across different vocational fields, even when the use of technology varies according to occupational requirements. For example, students may need to search for technical information, prepare digital documents, communicate through online platforms, manage digital records, and solve problems involving digital tools. These activities require competencies that extend beyond the operation of specific equipment. Ismail and Hassan (2019) discussed the importance of technical competencies in digital technology in relation to the Fourth Industrial Revolution, highlighting the need to strengthen technology-related capabilities in technical education. Existing literature highlights that the digital competence of TVET students continues to remain as an area of concern. Kuntadi et al. (2022) conducted a comparative study involving 259 students from universities in Indonesia and Malaysia to examine their digital readiness for industrial demands. The study assessed five digital competence domains and found that students from both countries demonstrated an intermediate level of digital competence. The results also showed differences across the competence domains, with information competence recording the highest scores and problem-solving the lowest. This indicates that students may have stronger competencies in certain digital activities while requiring further development in others.

Similarly, Findeisen and Wild (2022) studied the digital competence of students entering commercial vocational training programmes in Germany. The study identified three competence profiles, representing students with low, medium, and high levels of self-reported digital competence. The findings suggest that students enter vocational education with different digital learning experiences and competencies. These differences highlight the importance of understanding students' existing digital abilities before planning learning activities intended to improve their digital competence. Barboutidis and Stiakakis (2023) also investigated digital competence among students at vocational training institutes using the DigComp framework. Their study examined factors

associated with different areas of digital competence and highlighted the importance of considering the individual dimensions of the framework. The study supports the view that digital competence is multidimensional and that a single overall score may not fully explain students' digital abilities. In Malaysia, the development of digital competence is also supported through national education initiatives. The Digital Education Policy introduced by the Ministry of Education aims to strengthen digital education and develop digitally competent learners (Kementerian Pendidikan Malaysia, 2023). In addition, digital skills are included in the Malaysian Qualifications Framework as part of the functional work skills expected of graduates (Malaysian Qualifications Agency, 2017). These initiatives highlight the importance of ensuring that students in vocational education are equipped with appropriate digital competencies.

Although prior studies have investigated digital competence in universities and vocational training centers, further empirical research is needed to understand the competence levels of students in Malaysian vocational colleges. Students in these institutions undertake vocational programmes that combine theoretical and practical learning, and their digital experiences may differ from those of university students. Therefore, examining their digital competence across specific dimensions can provide useful information for identifying areas of strength and areas that require additional support.

The DigComp Framework and Its Five Dimensions

The European Digital Competence Framework, commonly known as DigComp, was developed to provide a common understanding of the competencies required for individuals to use digital technologies effectively. The framework was first introduced in 2013 and has been updated to reflect developments in digital technologies and their use in society. DigComp 2.2 provides a comprehensive description of digital competence, including examples of the knowledge, skills, and attitudes required in different digital environments (Vuorikari et al., 2022). The DigComp framework consists of five main competence areas, namely information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving as shown in Figure 1. These areas cover different aspects of digital technology use and provide a structured approach to understanding individual digital competence. The framework is relevant to education because it allows researchers and educators to examine students' competencies across several areas rather than focusing only on technical skills.

The first dimension, information and data literacy, refers to the ability to search for, access, evaluate, and manage digital information and content. Individuals with this competence can identify their information needs, select appropriate search strategies, evaluate the reliability of online information, and organise digital materials. This dimension is important in education because students regularly use online sources to obtain information for learning activities. Proficiency in evaluating and managing information enhances students' capacity to utilize digital learning resources effectively. The second dimension, communication and collaboration, involves using digital technologies to communicate, share information, interact with others, and participate in collaborative activities. It also includes understanding appropriate behaviour when communicating online and managing digital identity. In educational settings, students may use email, messaging applications, video conferencing tools, and cloud-based platforms to exchange information and complete group assignments. These activities require students to select suitable communication tools and understand how to interact responsibly in digital environments.

The third dimension, digital content creation, refers to the ability to create, edit, and integrate digital content in different formats. It also includes understanding copyright, licensing, and basic programming concepts. Students may demonstrate this competence by preparing digital presentations, editing images and videos, producing documents, or developing other digital learning materials. In vocational education, digital content creation can support students in documenting practical tasks, presenting project outcomes, and developing materials relevant to their vocational fields. The fourth dimension, safety, focuses on the responsible and secure use of digital technologies. It includes protecting digital devices, personal data, and privacy, as well as maintaining health and well-being when using digital technology. This dimension also considers the environmental impact of digital technology use. Students need to understand online risks, protect sensitive information, and practise safe behaviour when using digital platforms. Developing these competencies is important because students increasingly use online applications and digital services for learning and personal activities.

The fifth dimension, problem-solving, refers to the ability to identify and solve technical problems, select appropriate digital tools, use technology creatively, and recognise the need to improve personal digital competencies. For instance, students may need to troubleshoot software problems, select suitable applications for particular tasks, or learn how to use unfamiliar digital tools. This dimension is particularly relevant to vocational education, where students are often required to apply practical knowledge and solve problems in different learning and work situations (Vuorikari et al., 2022).

The five DigComp dimensions provide a comprehensive basis for assessing digital competence. However, the framework itself does not require all individuals to demonstrate the same level of competence in every dimension. Students may have different strengths and weaknesses depending on their learning experiences and opportunities to use digital technologies. For this reason, examining each dimension separately can provide a clearer understanding of students' digital competence than relying only on an overall score. In addition to providing a conceptual framework, DigComp has supported the development of digital competence assessment tools. One example is DigCompSAT, a self-reflection tool designed to assess individuals' perceived knowledge, skills, and attitudes across the five DigComp areas. Such tools can be used to identify perceived competence levels and areas for improvement. However, self-assessment results reflect respondents' perceptions of their abilities and should not be treated as direct evidence of practical performance.

Based on this framework, the present study examines digital competence among vocational college students in Johor, Malaysia. By assessing all five dimensions, the study aims to provide a detailed understanding of students' self-reported digital competencies and identify areas that may require further attention in vocational education. This approach can support educators in planning appropriate learning activities and improving the integration of digital competencies into TVET programmes.



Figure 1. The five competence areas of the European Digital Competence Framework (DigComp). Source: European Commission Joint Research Centre

METHODOLOGY

This study employed a quantitative approach using a survey research design to assess the digital competence of vocational college students in Johor, Malaysia. The survey design was considered appropriate for collecting information about students' self-reported digital competence using a structured questionnaire. The study focused on five competence areas of the European Digital Competence Framework (DigComp), namely information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving (Vuorikari et al., 2022). Descriptive statistics were used to assess students' overall digital competence and examine their competence levels across these five areas.

The study was conducted at a vocational college in Johor, Malaysia, with a population of 660 students enrolled in the Malaysian Vocational Certificate (Sijil Vokasional Malaysia, SVM) and Malaysian Vocational Diploma (Diploma Vokasional Malaysia, DVM) programmes. The target population comprised 438 SVM students (66.36%) and 222 DVM students (33.64%). Although the sample size table proposed by Krejcie and Morgan (1970) recommended a sample of 242 students, the survey was administered via Google Forms to the entire cohort of 660 students, relying on voluntary participation rather than random selection. A total of 181 completed questionnaires were received, representing a response rate of 27.4%. Although the number of responses was lower than the recommended sample size, all completed questionnaires were included in the analysis. The voluntary nature of participation and the lower response rate may affect the representativeness of the sample. Therefore, the findings represent the digital competence of the participating students and should be interpreted within the context of the selected institution.

Data were collected using a structured questionnaire adapted from the DigComp Self-Assessment Tool (DigCompSAT), developed to support the assessment of digital competence across the five areas of the DigComp framework (Clifford et al., 2020). The questionnaire was designed to obtain information about students' background characteristics, access to ICT resources, ICT training experiences, and perceived digital competence. It consisted of seven sections, labelled A to G. Section A collected demographic information, including gender, educational level, and programme of study. Section B contained six items related to personal factors, including access to ICT resources and ICT training. Sections C to G contained 30 items measuring digital competence, with six items representing each of the five DigComp dimensions. To contextualize the instrument for Malaysian vocational college students, 30 items were extracted from the DigCompSAT item bank and categorized according to the five DigComp competence domains. The questionnaire was administered to participants in the Malay language.

The first dimension, information and data literacy, assessed students' ability to search for, evaluate, store, and manage digital information. The second dimension, communication and collaboration, focused on students' use of digital technologies to communicate, share information, and interact with others. The third dimension, digital content creation, assessed students' ability to develop, edit, and manage digital content. The fourth dimension, safety, examined students' awareness and practices related to digital security, privacy, and protection of digital information. The fifth dimension, problem-solving, assessed students' ability to identify and address technical problems and use digital tools to complete different tasks. The questionnaire employed a five-point response scale, with scores ranging from 1 (strongly disagree) to 5 (strongly agree). The response options were strongly disagree, disagree, somewhat disagree, agree, and strongly agree. As the middle response represented somewhat disagree rather than a neutral position, the results were interpreted based on the actual response categories.

The 30 items were mapped against the 21 competencies of the DigComp framework (Vuorikari et al., 2022) to examine their alignment and coverage. The mapping focused on identifying the extent to which the adapted questionnaire represented the competencies within the five DigComp areas. Each item was examined based on its relevance to the competency descriptions provided in the framework. Table 1 displays the mapping of selected questionnaire items, demonstrating comprehensive coverage across all five DigComp competence dimensions.

Table 1: Instrument Mapping and Competency Coverage

Item	Questionnaire item (English translation)	DigComp competency
Area1: Information and Data Literacy		
C1	I know that different search engines may provide different information.	1.1 Browsing, searching and filtering
C3	I can organise and store digital content systematically.	1.3 Managing data, information and digital content
C4	I can identify the purpose of online information, such as informing, persuading, entertaining or promoting.	1.2 Evaluating data, information and digital content
C5	I evaluate information by comparing several sources to ensure its accuracy.	1.2 Evaluating data, information and digital content
Area 2: Communication and Collaboration		
D1	I select appropriate communication tools according to different situations.	2.1 Interacting through digital technologies

D2	I share information through cloud storage services such as Google Drive and OneDrive.	2.2 Sharing through digital technologies
D3	I use online services, such as booking clinic appointments, paying fees and applying for jobs.	2.3 Engaging in citizenship through digital technologies
D4	I practise appropriate behaviour when interacting in digital environments.	2.5 Netiquette
Area 3: Digital Content Creation		
E2	I am skilled in developing digital content using applications such as CapCut, InShot, YouTube and KineMaster.	3.1 Developing digital content
E5	I seek permission from copyright owners before copying or distributing their digital content.	3.3 Copyright and licences
Area 4: Safety		
F1	I know that sensitive information, such as personal details, should not be shared on social media.	4.2 Protecting personal data and privacy
F2	I can activate, use and update security features on my digital devices, such as antivirus software and operating systems.	4.1 Protecting devices
Area 5: Problem-Solving		
G3	I use online learning resources, such as video tutorials and online courses, to improve my digital skills.	5.4 Identifying digital competence gaps
G4	I can find solutions on the internet when facing technical problems.	5.1 Solving technical problems

Validity and Reliability of the Instrument

The research instrument was evaluated through face validity, content validity, and a pilot study before the main data collection. Face and content validity were reviewed by three experts. Two experts assessed the content of the questionnaire, while one expert evaluated its face validity. These evaluations were conducted to determine whether the questionnaire items were appropriate for the research objectives and could be understood by the target respondents. A pilot study was conducted involving 27 students from a technical and vocational education institution in Melaka, Malaysia. The pilot study aimed to assess the internal consistency of the questionnaire using Cronbach's alpha. The results showed reliability coefficients ranging from 0.728 to 0.818 across the five digital competence dimensions. The reported overall Cronbach's alpha for the 30 items covering digital competence was 0.911 as shown in Table 2. These findings demonstrated acceptable to high internal consistency across the survey scales, confirming the instrument's reliability. Consequently, the instrument was used in the main data collection involving vocational college students in Johor.

Table 2: Reliability of the Survey Items

Dimension	Number of items	Cronbach's alpha
Information and Data Literacy	6	0.818
Communication and Collaboration	6	0.728
Digital Content Creation	6	0.739
Safety	6	0.762
Problem-Solving	6	0.784
Overall instrument	36	0.911

Data Collection and Analysis

Before data collection, an official support letter describing the purpose of the research was prepared through the institution and submitted to the participating institution. Respondents were informed about the objectives of the study and the questionnaire. They were also informed that their identities and responses would be treated confidentially. Data were collected using a questionnaire distributed through Google Forms. A total of 181 completed responses were obtained and included in the analysis. The collected data were screened for possible errors and missing values before statistical analysis. The data were analysed using the Statistical Package for the Social Sciences (SPSS), version 27. Descriptive statistics, including mean scores and standard deviations, were used to determine students' digital competence levels. The analysis examined the overall digital competence

score and the scores for each of the five DigComp dimensions. Individual questionnaire items were also examined to identify specific competencies with relatively higher and lower mean scores.

FINDINGS

A total of 181 vocational college students participated in this study. All respondents were enrolled in the Malaysian Vocational Certificate (SVM) or Malaysian Vocational Diploma (DVM) programmes at a vocational college in Johor, Malaysia. Most respondents were female (84.0%), while male students accounted for 16.0%. In terms of educational level, 69.1% were enrolled in the SVM programme, compared with 30.9% in the DVM programme. Regarding their field of study, respondents were also categorised into catering and non-catering programmes. These demographic characteristics provide an overview of the students included in the analysis.

Overall Level of Digital Competence

The overall digital competence of the respondents was examined using 30 questionnaire items covering the five dimensions of the DigComp framework. Descriptive statistics, including mean scores and standard deviations, were used to assess students' self-reported digital competence across these dimensions. As presented in Table 3, the respondents obtained an overall mean score of 3.97 (SD = 0.449) on a five-point response scale. Among the five dimensions, problem-solving recorded the highest mean score (M = 4.11, SD = 0.549), followed by digital content creation (M = 4.00, SD = 0.557), safety (M = 3.97, SD = 0.650), and information and data literacy (M = 3.96, SD = 0.475). Communication and collaboration recorded the lowest mean score (M = 3.79, SD = 0.620). These findings indicate that respondents generally agreed with the statements describing their digital competence, although the level of agreement varied across the five dimensions.

Table 3: Digital competence levels across five DigComp dimensions

Digital competence dimension	**Mean (M)**	**SD**
Information and Data Literacy	3.96	0.475
Communication and Collaboration	3.79	0.620
Digital Content Creation	4.00	0.556
Safety	3.97	0.650
Problem-Solving	4.11	0.548
Overall digital competence	**3.97**	**0.449**

Among the five DigComp dimensions, problem-solving recorded the highest mean score (M = 4.11, SD = 0.549), followed by digital content creation (M = 4.00, SD = 0.557), safety (M = 3.97, SD = 0.650), and information and data literacy (M = 3.96, SD = 0.475). Communication and collaboration recorded the lowest mean score (M = 3.79, SD = 0.620). These findings show that students generally agreed with the statements measuring their digital competence across all five dimensions. However, the variation in mean scores suggests that students perceived their competence differently across digital activities, with relatively greater agreement in problem-solving and lower agreement in communication and collaboration.

Digital Competence Across the Five DigComp Dimensions

The five DigComp dimensions were further examined at the item level to identify specific digital activities with relatively higher and lower mean scores. This analysis provides a more detailed understanding of students' self-reported digital competence beyond the overall dimension scores.

Information and data literacy recorded a mean score of 3.96 (SD = 0.475). The six items in this dimension assessed students' knowledge and practices related to searching for information, evaluating online sources, and organising digital content. The highest mean score was recorded for checking the reliability of online information sources (M = 4.14, SD = 0.630), followed by comparing information from different sources to ensure accuracy (M = 4.02, SD = 0.605) and identifying the purpose of online information (M = 4.01, SD = 0.587). In comparison, organising and storing digital content systematically recorded the lowest mean score (M = 3.78, SD = 0.652). These findings suggest that respondents expressed relatively stronger agreement with statements related to evaluating online information than with the statement concerning systematic digital content management.

Communication and collaboration recorded the lowest mean score among the five DigComp dimensions (M = 3.79, SD = 0.620). This dimension examined students' reported use of digital technologies for communication, information sharing, online services, and collaboration. Selecting appropriate digital communication tools according to different situations recorded the highest mean score (M = 4.34, SD = 0.598), followed by practising appropriate behaviour when interacting in digital environments (M = 4.08, SD = 0.734). In contrast, sharing information through cloud storage services, such as Google Drive and OneDrive, recorded the lowest mean score (M = 3.12, SD = 1.180). This was also the lowest-scoring item among all 30 digital competence statements. Using online services for activities such as making payments, booking appointments, and applying for jobs recorded a comparatively lower mean score (M = 3.65, SD = 1.104). The findings suggest that students reported greater familiarity with choosing digital communication tools than with using some digital platforms for information sharing and online services.

Digital content creation recorded a mean score of 4.00 (SD = 0.557). The items examined students' familiarity with digital content formats, their perceived ability to create digital materials, and their awareness of ethical and copyright-related practices. Recognising different digital content formats, including audio, images, text, videos, and applications, recorded the highest mean score (M = 4.21, SD = 0.658). This was followed by expressing opinions carefully through digital media (M = 4.14, SD = 0.744) and developing digital content using applications (M = 4.05, SD = 0.902). The lowest mean score was recorded for seeking permission from copyright owners before copying or distributing digital content (M = 3.70, SD = 0.984). These findings indicate that respondents expressed relatively stronger agreement with statements about recognising and creating digital content than with the statement concerning copyright-permission practices.

The safety dimension recorded a mean score of 3.97 (SD = 0.650). This dimension focused on students' awareness and reported practices related to digital security, privacy, and the protection of personal information. The highest mean score was recorded for understanding that sensitive personal information should not be shared on social media (M = 4.59, SD = 0.586). This was also the highest-scoring item across the entire questionnaire. Awareness that strong passwords can protect digital devices and online accounts recorded the next highest mean score (M = 4.27, SD = 0.774). In comparison, restoring data using backup files recorded the lowest mean score within this dimension (M = 3.53, SD = 1.143). The findings suggest that students expressed stronger agreement with statements concerning personal information protection than with the statement about performing data recovery. This difference highlights the importance of distinguishing awareness of digital safety from confidence in carrying out specific technical tasks.

Problem-solving recorded the highest mean score among the five DigComp dimensions (M = 4.11, SD = 0.549). The items in this dimension assessed students' familiarity with digital devices, awareness of technological developments, use of online learning resources, and approaches to technical problems. Understanding the main functions of commonly used digital devices, such as computers, tablets, and smartphones, recorded the highest mean score (M = 4.24, SD = 0.696). This was followed by using online learning resources, including video tutorials and online courses, to improve digital skills (M = 4.21, SD = 0.730). Helping others improve their digital skills recorded the lowest mean score within this dimension (M = 3.87, SD = 0.921). Although problem-solving had the highest overall dimension mean, its items mainly addressed familiarity with digital technologies, independent learning, and selected approaches to technical problems. Therefore, the findings should not be interpreted as evidence of students' overall ability to solve complex digital problems in practical situations.

To identify specific areas of strength and weakness, the individual questionnaire items were examined based on their mean scores. Table 4 presents selected items with relatively higher and lower mean scores across the five DigComp dimensions.

Table 4: Selected Digital Competence Items with Relatively Higher and Lower Mean Scores

Digital competence item	Mean	SD
Protecting sensitive personal information on social media (F1)	4.59	0.586
Selecting appropriate digital communication tools (D1)	4.34	0.598
Understanding the functions of commonly used digital devices (G1)	4.24	0.696
Recognising different digital content formats (E1)	4.21	0.658
Seeking copyright permission before copying or distributing content (E5)	3.70	0.984
Using online services for everyday activities (D3)	3.65	1.104
Restoring data using backup files (F4)	3.53	1.143
Sharing information through cloud storage services (D2)	3.12	1.180

The results show that students reported their highest level of competence in protecting sensitive personal information on social media. In contrast, sharing information through cloud storage services recorded the lowest score. Other areas with relatively low scores included restoring data from backup files and using online services for everyday activities. Overall, the findings show that the participating vocational college students reported moderate levels of digital competence across all five DigComp dimensions. However, the item-level results reveal differences in their reported knowledge, skills, and practices. In particular, the findings highlight lower scores in selected digital sharing, online service, and data recovery activities compared with awareness of personal information protection and the use of familiar digital device.

DISCUSSION

Overall Digital Competence Among Vocational College Students

The findings of this study showed that vocational college students generally expressed agreement with statements describing their digital knowledge, skills, and practices. The overall mean score of 3.97 on a five-point scale suggests that respondents had relatively positive perceptions of their digital competence. However, the responses varied across specific digital activities, indicating that agreement with general digital competence statements does not necessarily reflect the same level of familiarity or experience in every area. These findings highlight the importance of examining digital competence beyond an overall mean score.

The findings can be considered alongside previous studies examining digital competence in technical and vocational education. Kuntadi et al. (2022) reported an intermediate level of digital competence among university students in Malaysia and Indonesia, suggesting that students may still face challenges in meeting the digital demands of industry. Similarly, Ismail and Hassan (2019) highlighted the importance of developing digital technology competencies in technical education to support the requirements of the Fourth Industrial Revolution. Although these studies used different populations and assessment approaches, they support the broader argument that digital competence development remains an important consideration in technical and vocational education.

The findings also support the argument that young people should not automatically be considered digitally competent simply because they are familiar with digital devices. The results also relate to the findings of Findeisen and Wild (2022), who identified different digital competence profiles among students entering vocational training. Their study suggests that students may differ in their digital knowledge and experience even when they are at similar stages of education. In the present study, respondents expressed relatively strong agreement with statements concerning familiar digital devices and the protection of personal information, but comparatively lower agreement with statements about cloud-based information sharing and data recovery. This pattern suggests that familiarity with certain digital technologies may not extend equally to other digital activities.

From the perspective of vocational education, these findings are important because digital competence supports students in completing learning tasks and preparing for employment. Students may need to use digital platforms to access technical information, prepare reports, communicate with others, and manage work-related information. Therefore, vocational education institutions should consider digital competence development as part of students' learning experiences, instead of relying on the assumption that digital skills will develop organically via technology exposure.

Differences in Digital Competence Across the Five DigComp Dimensions

While all five DigComp dimensions were generally positive self-reported digital competence, the findings showed variations in their mean scores. Problem-solving recorded the highest mean score, while communication and collaboration recorded the lowest. This pattern suggests that students perceived themselves as more capable in certain digital activities than others. However, these differences should be interpreted descriptively because the study did not conduct inferential tests to establish whether the mean differences between dimensions were statistically significant. The relatively higher score for problem-solving may be related to students' familiarity with commonly used digital devices and online learning resources. Students reported relatively positive responses regarding their understanding of digital devices and their use of online tutorials to improve digital skills. These activities may be familiar to vocational students because practical learning often involves identifying problems, exploring possible solutions, and completing tasks using available resources. Nevertheless, this explanation remains a possible interpretation because the study did not directly investigate the reasons behind the higher problem-solving score.

The results can also be considered alongside the findings of Kuntadi et al. (2022), who reported differences in digital competence across several areas among university students in Malaysia and Indonesia. However, their study identified problem-solving as the lowest competence area, whereas problem-solving recorded the highest mean score in this study. This difference suggests that digital competence profiles may vary across educational contexts and student populations. Differences in the instruments, learning experiences, and characteristics of respondents may also contribute to variations in the findings. Therefore, comparisons across studies should be made carefully.

The findings are also consistent with the multidimensional nature of the DigComp framework. Vuorikari et al. (2022) explained that digital competence includes several areas of knowledge, skills, and attitudes that are relevant to different digital activities. As a result, competence in one area does not necessarily indicate the same level of competence in another. The findings of this study support the usefulness of examining the five dimensions separately because an overall competence score may not fully describe students' strengths and weaknesses.

Challenges in Digital Communication, Collaboration, and Information Management

A primary finding of this study indicates that this study was the lower level of self-reported competence in communication and collaboration compared with the other DigComp dimensions. Although students reported that they could select suitable communication tools for different situations, they reported much lower agreement with using cloud storage services to share information. This was the lowest-scoring item among all the digital competence items assessed. This finding suggests that students' familiarity with digital communication tools may not extend to all forms of digital collaboration and information sharing. For example, students may be comfortable using messaging applications or social media but may have less experience using cloud-based platforms to share documents and learning materials. However, this study did not examine the reasons for this difference. It is therefore not possible to determine whether the lower score was related to limited access, lack of training, fewer opportunities to use cloud services, or other factors.

The DigComp framework identifies communication and collaboration as important competencies for interacting with others and sharing information through digital technologies (Vuorikari et al., 2022). These competencies are particularly relevant in educational environments where students are expected to complete group assignments, exchange learning resources, and work collaboratively. In vocational education, digital collaboration may also support practical projects that require students to communicate, share documents, and

coordinate tasks with others. Another finding that deserves attention is the positive self-reported digital competence of information and data literacy. While students demonstrated high competence in assessing the credibility of online information, they recorded lower scores in systematically organizing digital content. This suggests that students may have different levels of confidence when evaluating and managing information. Both competencies are important because students need not only to identify reliable information but also to store and organise it for future use.

These findings highlight the need for learning activities that provide students with opportunities to practise digital communication, collaboration, and information management. For example, collaborative assignments using shared online documents and cloud storage platforms could provide students with practical experience in managing and exchanging digital information. Such activities may help students develop a broader range of digital competencies relevant to both learning and workplace environments.

Digital Content Creation, Safety, and Problem-Solving

The findings for digital content creation showed that students expressed relatively strong agreement with statements concerning their familiarity with digital content formats and their ability to develop digital materials. Students reported relatively higher scores for recognising different digital content formats but lower scores for seeking permission before copying or distributing copyrighted materials. This suggests that students were relatively familiar with different types of digital content but reported less consistent practices regarding copyright and intellectual property. Digital content creation involves more than producing digital materials. According to Vuorikari et al. (2022), it also includes understanding copyright, licensing, and the responsible use of digital content. Therefore, vocational students need to develop both technical and ethical competencies when creating and sharing digital materials. This is especially relevant in vocational programmes where students may produce presentations, images, videos, portfolios, and other digital materials as part of their coursework. In the safety dimension, students reported their highest individual item score for understanding that sensitive personal information should not be shared on social media. However, the item related to restoring data using backup files recorded a low score. This difference suggests that students reported greater awareness of personal information protection than confidence in carrying out certain technical safety procedures.

The findings indicate that digital safety should not be understood only as awareness of online risks. It also involves practical competencies, such as protecting devices, managing personal data, and recovering information when problems occur. Vuorikari et al. (2022) included these competencies within the safety dimension of DigComp. Therefore, educational activities that involve practical data protection and recovery tasks may be useful in developing students' digital safety competencies. Problem-solving recorded the highest mean score among the five dimensions. Students reported relatively higher scores for understanding the functions of common digital devices and using online learning resources to improve their skills. These findings suggest that students perceived themselves as reasonably familiar with some digital tools and resources that support independent learning. However, the comparatively lower score for helping others improve their digital skills indicates variation across the activities included in this dimension. It suggests that students may have less confidence or experience in supporting others with technology-related tasks. This is an area that could be explored further because problem-solving in digital environments may involve not only solving individual technical problems but also sharing knowledge and supporting collaborative learning.

Implications for Digital Competence Development in TVET

This study contributes valuable evidence toward understanding how vocational college students develop digital competence. Although respondents generally expressed positive perceptions of their digital competence across the five DigComp dimensions, the differences in individual item scores suggest that some digital activities may require greater attention. This emphasizes the importance of integrating structured educational activities designed to remediate specific skill deficits.

First, vocational educators could integrate digital competence development into existing teaching and learning activities. Rather than treating digital competence as a separate set of skills, teachers could design assignments that require students to search for reliable information, organise digital materials, produce digital content, and

communicate through appropriate online platforms. These activities could provide opportunities for students to develop digital competence while completing tasks related to their vocational programmes.

Second, greater attention could be given to digital communication and collaboration. The relatively low score for sharing information through cloud storage services suggests that students may benefit from more opportunities to use collaborative digital tools. Teachers could introduce group projects that require students to share documents, manage digital files, and complete tasks through online collaboration platforms. These learning experiences may help students become more familiar with digital practices used in education and workplaces.

Third, digital safety instruction should incorporate more experiential, hands-on activities. Although participants demonstrated relatively strong awareness regarding personal data protection, their comparatively lower competence in restoring data from backups highlights an urgent need to reinforce specific technical security skills. Practical exercises involving data backup, file retrieval, password management, and digital privacy would enable students to operationalize their theoretical safety knowledge.

Finally, this study demonstrates the practical value of the DigComp framework for assessing students' self-perceived digital competence across key domains. The framework provides educators with a systematic approach to identifying skill deficits that require instructional development. Within the Malaysian TVET sector, this model can effectively inform curriculum planning and facilitate the design of learning tasks aligned with contemporary digital workforce requirements.

Overall, the study provides a descriptive profile of digital competence among students from one vocational college in Johor. The findings should not be generalised to all vocational college students in Malaysia because the study involved a single institution and relied on self-reported data. However, the results identify specific areas that may benefit from further educational attention. Future studies involving students from different vocational colleges and direct assessments of digital skills would help provide a more comprehensive understanding of digital competence in Malaysian TVET education.

CONCLUSION

This study assessed the digital competence levels of vocational college students in Johor, Malaysia, based on the five dimensions of the DigComp framework. The findings revealed that students generally expressed positive perceptions of their digital competence across all five DigComp dimensions. Among these dimensions, problem-solving recorded the highest mean score, while communication and collaboration recorded the lowest. The findings also showed that students reported relatively higher awareness of protecting personal information but lower engagement in certain digital activities, particularly sharing information through cloud storage services and restoring data using backup files. It also highlights the importance of assessing digital competence across different dimensions rather than relying only on an overall competence score. Although students may be familiar with digital technologies, their competencies may differ depending on the types of digital activities involved. The study provides a descriptive profile of digital competence among the participating vocational college students and identifies areas that may require additional educational support.

From an educational perspective, the findings suggest that vocational colleges should provide more opportunities for students to develop digital competence through practical and collaborative learning activities. Greater attention could be given to digital communication, information management, and technical safety skills. Integrating these competencies into existing vocational courses may help students apply digital technologies more effectively in learning and work-related situations. However, this study has several limitations. The respondents were selected from a single vocational college in Johor, which limits the generalisability of the findings to other vocational institutions. In addition, digital competence was measured using a self-assessment questionnaire, and the findings may not fully reflect students' actual performance when completing digital tasks. Future research could involve students from different vocational colleges and combine self-assessment with practical digital competence assessments to provide a more comprehensive understanding of students' abilities.

Ultimately, fostering digital competence is essential to equip vocational graduates for the dynamic requirements of both academic and professional environments. These findings serve as an informative guide for vocational institutions seeking to diagnose digital skill deficiencies and formulate strategic interventions that enhance students' digital capabilities.

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