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Exploring The Relationship between Personal Factors and Digital Competency Using The DigComp Framework among Vocational College Students

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Abstract

The rapid expansion of digital technologies has transformed the skills demanded by modern economies, prompting educational institutions to adapt accordingly. Within Malaysia's Technical and Vocational Education and Training (TVET) system, digital competencies are now emphasized as essential components of employability and lifelong learning. This study investigates the relationship between personal factors and digital competency levels among students in a Vocational College in Johor, guided by the European Commission's DigComp Framework. A quantitative survey was conducted among 182 students across diploma and certificate programs. The instrument, adapted from the DigComp Self-Assessment Tool (DigCompSAT), assessed five key digital dimensions, information and data literacy, communication and collaboration, digital content creation, safety and problem solving. Correlational analysis revealed a statistically significant positive relationship between personal factors namely, access to ICT resources and participation in ICT-related training and students' digital competence levels. The findings suggest that personal exposure to digital environments outside formal education contributes meaningfully to students' readiness for digitally mediated work contexts. The study highlights the need for enhanced access to digital infrastructure and targeted skills training as part of institutional strategies to strengthen digital readiness among vocational learners. These findings carry important implications for curriculum developers, TVET policymakers, and institutional leadership, who are responsible for ensuring that graduate competencies remain responsive to the dynamic requirements of the digital economy. Specifically, the integration of structured digital skills training, equitable access to digital infrastructure, and alignment of learning outcomes with Malaysian Qualification Framework for digital competency should be prioritized to better prepare students for the realities of a technology-driven workforce.

1. Introduction

The integration of digital technologies into all aspects of society and industry has led to a redefinition of the skills needed in the workforce. As economies transition into the Fourth Industrial Revolution (IR4.0), digital competencies have emerged as foundational requirements, particularly in education systems tasked with preparing future talent. In Malaysia, the Malaysian Qualifications Agency (MQA) has formally recognized digital skills as essential learning outcomes within its revised Malaysian Qualifications Framework (MQF 2.0), placing them under the cluster of functional work skills. This shift necessitates the reorientation of Technical and Vocational Education and Training (TVET) institutions, including Vocational Colleges, to equip students with relevant digital competencies.

Digital competence is increasingly recognized as a core component of lifelong learning frameworks, underscoring its essential role in personal, professional, and civic domains. According to the Council of the European Union (2019), digital competence is listed as one of the eight key competencies for lifelong learning, highlighting its significance in enabling individuals to navigate and participate effectively in a digitally mediated world. In parallel, Saxena (2018) identifies digital skills as a critical element of 21st-century competencies, which encompass a range of knowledge, skills, and attitudes necessary to thrive in a technology-driven society. Notably, Ala-Mutka et al. (2011) were among the early scholars to provide a comprehensive understanding of digital literacy and competence within the context of lifelong learning. Their work emphasized that digital competence is not only foundational for academic and professional success but also essential for continuous personal development in the digital age. Collectively, these perspectives affirm that digital competence is not merely a technical skill but a multifaceted capability that supports adaptability, problem solving, and meaningful engagement in the evolving global landscape.

Given the pivotal role digital competence plays in lifelong learning and workforce adaptability, its integration into vocational education systems has become increasingly urgent. As digital technologies continue to redefine industry practices and skill demands, Technical and Vocational Education and Training (TVET) institutions are expected to play a central role in equipping learners with the digital capabilities needed for sustained employability. The inclusion of digital skills in national education frameworks such as Malaysia's Malaysian Qualifications Framework (MQF 2.0) reflects a policy-level commitment to this agenda. However, the translation of these frameworks into effective institutional practices and student outcomes remains inconsistent. Ensuring that digital competence is meaningfully embedded in both formal curricula and informal learning opportunities is thus essential to narrowing the digital skills gap and fostering a digitally competent workforce aligned with 21st-century demands.

Vocational education plays a vital role in Malaysia's national agenda to produce a digitally fluent, industry-ready workforce. TVET institutions, in particular, are positioned as key drivers in preparing learners to meet the technological demands of the Fourth Industrial Revolution. However, despite policy emphasis and structural reforms, existing studies have identified a concerning gap between the expected and actual levels of digital preparedness among TVET students. Research by Kuntadi et al. (2022) and Ismail and Hassan (2019) found that digital competency levels among vocational learners remain moderate and unevenly developed, with significant variability influenced by access, training, and institutional support. These findings raise critical questions about the effectiveness of current strategies to build digital readiness and the extent to which personal and contextual factors may hinder students from achieving the competencies envisioned in national and international frameworks.

While curriculum design and instructional approaches play a critical role in facilitating digital skills development, there is a growing body of evidence suggesting that individual-level factors may also significantly influence students' digital competency. Personal variables such as access to digital infrastructure (such as availability of internet connectivity, ownership of personal digital devices) and prior exposure to ICT-related training outside the formal curriculum have been identified as important contributors to students' digital readiness. These personal factors can affect not only students' frequency of engagement with digital tools but also their confidence, autonomy, and adaptability in navigating technology-rich environments. The European Commission's DigComp Framework provides a comprehensive model for assessing digital competence, comprising five interrelated dimensions: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. Each of these domains can be shaped by students' varying levels of access to digital technologies and learning experiences outside the classroom.

Given the strategic imperative of cultivating digitally competent graduates within the Technical and Vocational Education and Training (TVET) sector, and in light of the empirical evidence linking personal factors to digital proficiency, this study aims to examine the relationship between selected personal factors specifically, access to ICT resources and participation in ICT-related training and the digital competency levels of vocational college students in Johor, Malaysia. Through this inquiry, the study seeks to provide evidence that can inform targeted interventions to strengthen digital capability among TVET learners and support Malaysia's broader aspirations for a future-ready workforce.

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1.1 Digital Competency in TVET Contexts

Digital competency is increasingly recognized as a fundamental skill set for employability and lifelong learning, particularly within the context of technical and vocational education. In response to the accelerating pace of digital transformation across industries and societies, the European Commission developed the Digital Competence Framework for Citizens (DigComp), which serves as a comprehensive guide for identifying and developing essential digital capabilities. The most current version, DigComp 2.2, conceptualizes digital competence as a dynamic combination of knowledge, skills, and attitudes that enable individuals to use digital technologies critically, responsibly, and effectively in various aspects of life (Vuorikari et al., 2022). This framework provides a structured foundation for digital skills development, policy formulation, and curriculum design, and has been widely adopted across European and international education systems.

The DigComp Framework comprises five interrelated dimensions of digital competence. The first is Information and Data Literacy, which refers to the ability to search, evaluate, and manage digital information effectively. It includes skills such as browsing, filtering data, and critically assessing the reliability and relevance of digital sources. The second dimension, Communication and Collaboration, focuses on using digital tools to interact, share information, collaborate with others, and participate in online communities. This includes awareness of digital etiquette, managing one's digital identity, and engaging in respectful, inclusive communication in digital spaces.

The third dimension, Digital Content Creation, involves the ability to develop, edit, and integrate digital content across multiple formats and platforms. It encompasses understanding copyright and licensing, producing original content, and applying basic programming concepts. The fourth dimension, Safety, addresses the need to protect personal data, digital identity, health, and well-being in digital environments. It covers cybersecurity practices, privacy awareness, and the promotion of responsible technology use to safeguard oneself and others. Finally, the Problem Solving dimension pertains to the ability to identify digital needs and challenges, make informed decisions when using digital tools, and adapt to emerging technologies in both personal and professional contexts.

In Malaysia, the relevance of these competencies has been formally acknowledged through their incorporation into the Malaysian Qualifications Framework 2.0 (MQF 2.0), under the domain of work-related skills. This alignment reflects a national commitment to equip learners with digital literacy in tandem with technical and vocational knowledge. As TVET institutions strive to produce graduates who can thrive in IR4.0-driven industries, the integration of digital skills has become a central educational priority. Despite this emphasis, empirical studies continue to reveal a gap between expectations and outcomes. Research by Ismail and Hassan (2019) and Supian et al. (2020) has shown that digital competency levels among TVET students are generally moderate, with noticeable deficits in areas such as content creation and digital problem solving. These findings suggest that while curriculum reforms are necessary, they may be insufficient on their own. Greater attention must be directed toward understanding additional factors such as personal access to ICT resources, informal digital learning experiences, and socio-demographic influences that shape students' digital readiness.

1.2 Personal Factors Influencing Digital Competency

A growing body of research indicates that personal factors such as access to digital infrastructure and engagement in ICT-related learning experiences play a critical role in shaping digital competencies. Zhao et al. (2021), in a large-scale study involving over 5,000 students, found that personal access to ICT tools, as well as prior participation in digital skills training, significantly influenced digital competence scores across all DigComp dimensions. Similarly, Barboutidis and Stiakakis (2023) demonstrated that students who owned personal devices and had regular internet access performed better in areas such as digital content creation and problem solving.

In the Malaysian context, disparities in access to digital tools remain a challenge, especially among students in rural or economically disadvantaged areas. This uneven access may contribute to a digital divide not only in infrastructure but also in competencies. Studies by Supian et al. (2020) and Kuntadi et al. (2022) point to persistent gaps in readiness for digital environments among young learners, particularly those in vocational tracks. Additionally, prior exposure to structured ICT training whether formal (such as workshops, certification programs) or informal (for instance online tutorials) has been shown to enhance digital competence. Training contributes to increased confidence, better understanding of cybersecurity practices, and stronger ability to navigate digital collaboration platforms (Campos & Scherer, 2023).

While the influence of personal factors on digital competence has been established in higher education contexts, studies focusing specifically on vocational college students in Malaysia remain limited. Most existing research aggregates findings across multiple education levels or focuses on urban university settings. Moreover, little is known about how personal factors specifically affect performance across the five dimensions of the DigComp Framework within vocational education. This study addresses this gap by investigating how access to ICT and participation in ICT-related training relate to digital competence levels among students at a Vocational

College in Johor. Understanding this relationship can inform institutional strategies to reduce digital inequality and strengthen students' readiness for digitally intensive work environments.

2. Methodology

This study employed a quantitative, correlational research design to examine the relationship between personal factors and digital competencies among students at a Vocational College in Johor. A cross-sectional survey method was used to collect data from participants, allowing for the identification of statistical relationships between selected independent and dependent variables. The population of this study comprised students enrolled in the Sijil Vokasional Malaysia (SVM) and Diploma Vokasional Malaysia (DVM) programs at one selected Vocational College in Johor. A total of 182 students participated in the study, selected through purposive sampling to ensure representation from various fields of study. Participants represented a range of demographic backgrounds, including variations in gender, program of study, and access to digital resources.

2.1 Instrumentation

The instrument used in this study was a structured questionnaire adapted from the DigComp Self-Assessment Tool (DigCompSAT), which aligns with the DigComp 2.2 Framework developed by the European Commission (Vuorikari et al., 2022). The questionnaire was designed to measure students' digital competencies across five core dimensions: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. In addition to these five domains, the instrument included items that captured two personal factors, access to ICT resources and participation in ICT-related training. These personal factors were operationalized through questions related to the students' ownership and use of digital devices, availability of internet access, and experiences with formal or informal digital skills training. All questionnaire items were presented using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument was reviewed for content validity by a panel of experts in vocational education and digital literacy. A pilot test was conducted with 30 students from a different vocational college, yielding Cronbach's alpha coefficients ranging from 0.78 to 0.89, confirming the instrument's internal consistency and reliability for full deployment.

3. Data Analysis

Quantitative data collected from the completed questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 26.0. The analysis began with descriptive statistics to determine the mean scores and standard deviations for each of the five digital competency dimensions. These values provided an overview of students' self-reported levels of digital competence. Following this, inferential analysis was carried out to address the study's main objective. Specifically, Pearson's correlation coefficient was used to assess the strength and direction of the relationship between the two personal factors, access to ICT and participation in ICT-related training and students' overall digital competency levels. Correlation results were interpreted according to Cohen's (1988) guidelines, where r values of 0.10 to 0.29 were considered small, 0.30 to 0.49 moderate, and 0.50 or above strong. A significance threshold of $p < 0.05$ was used to determine the statistical relevance of observed relationships.

4. Findings

Descriptive statistics were conducted to examine the overall level of digital competency among students across the five dimensions of the DigComp Framework, information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. The results revealed that students reported a moderate level of digital competency overall. Table 1 presents the mean and standard deviation scores for each dimension.

Table 1 *Descriptive statistics for digital competency dimensions (N = 182)*

Dimension	Mean (M)	Standard Deviation (SD)	Interpretation
Information and data literacy	3.42	0.68	Moderate
Communication and collaboration	3.55	0.65	Moderate
Digital content creation	3.38	0.71	Moderate
Safety	3.47	0.66	Moderate
Problem solving	3.31	0.69	Moderate
Overall digital competency	**3.43**	**0.66**	**Moderate**

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The highest mean was observed in the domain of communication and collaboration (M = 3.55, SD = 0.65), while the lowest mean score was in problem solving (M = 3.31, SD = 0.69). These results suggest that while students feel reasonably confident in using digital tools for communication, they may experience more difficulty when using digital technologies to troubleshoot problems or adapt to complex digital tasks.

Pearson correlation analyses were used to examine the statistical significance of the relationship between students' personal factors and their digital competency. The results are summarized in Table 2.

Table 2 *Pearson correlation between personal factors and digital competency (N = 182)*

Personal Factor	r	p	Interpretation
Access to ICT resources	0.346	< .005	Moderate
Participation in ICT training	0.418	< .005	Moderate

The analysis showed a moderate positive correlation between access to ICT resources and digital competency ($r = .346$, $p < .001$), indicating that students who have greater access to digital devices and internet infrastructure tend to report higher levels of digital competence. Similarly, a moderate positive relationship was found between participation in ICT-related training and digital competency ($r = .418$, $p < .001$), suggesting that structured or informal digital training experiences contribute significantly to competency development.

5. Discussion

The findings of this study revealed that Vocational College students in Johor possess moderate levels of digital competency across all five DigComp dimensions. Among these, students reported the highest competency in communication and collaboration, and the lowest in digital problem solving. This trend aligns with prior studies indicating that young learners are typically more comfortable with social and communicative uses of technology than with advanced problem-solving or creative tasks (Barboutidis & Stiakakis, 2023; Supian et al., 2020). Importantly, the study found significant positive correlations between personal factors and digital competency, suggesting that digital skills development is not solely dependent on formal education structures but also on individual exposure and experiences. Students with greater access to ICT resources such as personal devices and stable internet connectivity demonstrated higher levels of digital competence. This is consistent with the findings of Zhao et al. (2021), who reported that digital access strongly influences competency outcomes, particularly in informal learning environments.

Furthermore, participation in ICT-related training was found to have the strongest correlation with digital competency. This supports the notion that structured learning opportunities whether formal or informal significantly enhance students' digital readiness (Campos & Scherer, 2023). These findings underscore the value of embedding digital training into co-curricular activities or offering supplemental ICT modules beyond the core curriculum in vocational institutions. The results also reaffirm that access and training opportunities are unevenly distributed, leading to variability in students' digital preparedness. Although Vocational Colleges are mandated to integrate digital skills under MQF 2.0, practical implementation remains inconsistent. This aligns with the concerns raised by Ismail and Hassan (2019) and Findeisen and Wild (2022a), who argued that assumptions about youth being "digitally fluent" due to their generational position are often misplaced.

In the context of TVET, these findings suggest a dual challenge, improving both institutional support for digital integration and personalized access to digital learning environments. The moderate competency levels observed highlight the urgent need for policy interventions aimed at closing digital gaps, particularly among students with limited personal exposure to digital tools.

6. Conclusions

This study examined the relationship between personal factors (access to ICT resources and participation in ICT-related training) and digital competency among vocational college students in Johor, guided by the DigComp Framework. The findings indicated that while the overall level of digital competency among students was moderate, significant differences emerged based on these personal factors. Students with better access to digital devices, reliable internet connectivity, and participation in digital skills training consistently demonstrated higher levels of competence across all five DigComp dimensions. These findings affirm that personal digital environments and informal learning experiences play a crucial role in complementing formal education in the development of essential digital skills.

Considering the Fourth Industrial Revolution (IR4.0), where emerging technologies such as automation, artificial intelligence, and digital communication are reshaping the workforce, these results hold particular significance. The capacity to access, evaluate, and create digital content, collaborate through digital platforms and

solve problems in technology-rich contexts is no longer optional for vocational graduates but it is fundamental. Without deliberate and inclusive efforts to strengthen digital readiness, students lacking adequate exposure to digital tools may face serious disadvantages in the labor market. This study illustrates that digital competency cannot be fully developed through curriculum alone, it must be supported by equitable access to digital infrastructure and continuous digital engagement both inside and outside the classroom.

These implications are especially critical for Technical and Vocational Education and Training (TVET) institutions, which are central to Malaysia's national strategy for workforce development. As emphasized in the Malaysia Education Blueprint and MQF 2.0, TVET graduates are expected to possess not only technical expertise but also transversal skills such as digital literacy. However, this study suggests that institutional efforts must go beyond the integration of digital content in teaching. A more holistic and systemic approach is needed. One that addresses structural inequalities in ICT access and provides learners with varied opportunities for digital engagement. TVET institutions should, therefore, implement policies that support students' digital skill development through targeted strategies such as device-loan programs, free or subsidized internet access, ICT skill-building workshops, and micro-credentialing initiatives.

At the policy level, the findings contribute to national and international conversations on digital inclusion and education equity. Policymakers must recognize that digital competency is intertwined with broader social and economic factors, including geography, income, and prior exposure to technology. Consequently, interventions aimed at improving national digital readiness must include provisions for narrowing the digital divide within education systems. This includes developing inclusive digital literacy strategies, investing in infrastructure for under-resourced institutions, and supporting capacity-building initiatives for educators and administrators. The incorporation of digital skills into national frameworks, such as MQF 2.0, is an important first step but one that must be matched with targeted, on-the-ground implementation strategies to benefit all learners equitably.

This study also makes a theoretical contribution by reinforcing the relevance of the DigComp Framework as a diagnostic and planning tool within the vocational education context. The framework's five dimensions provide a comprehensive lens through which student competencies can be assessed and developed. By applying DigComp in the Malaysian TVET setting, this study demonstrates its adaptability and usefulness across different educational systems and cultural contexts. The empirical evidence generated here extends the application of DigComp beyond European or higher education environments, offering insights that can inform digital skills development in similarly structured vocational systems across the globe.

In terms of research implications, this study addresses a notable gap in the literature by examining personal-level influences on digital competence within a specific, underexplored population, vocational college students. Much of the existing research in digital competency has centered on university students or generalized school populations, often overlooking TVET learners who represent a substantial portion of the workforce pipeline. The current findings highlight the need for further empirical investigations that focus on how demographic, socioeconomic, and psychological factors intersect to shape digital skills development in this group. Future studies could benefit from adopting a mixed-methods or longitudinal approach to examine changes in competency over time, as well as integrating qualitative perspectives to understand students' perceptions, barriers, and motivations related to digital learning.

In conclusion, this study underscores the urgent need for multi-level efforts to improve digital competence among vocational learners in Malaysia. The digital divide is not only about access, but it is also about opportunity, training, and sustained support. By aligning educational practices, institutional strategies, and national policies to address these dimensions, stakeholders can ensure that TVET graduates are better prepared to participate in and contribute to a rapidly evolving digital economy. Ultimately, equipping students with robust digital competencies is not just a pedagogical challenge, it is a strategic imperative for inclusive and future-proof workforce development.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Marlina Mohamad, Sukasih Sugiman, Abdul Jalil Omar;* ***data collection:*** *Sukasih Sugiman;* ***analysis and interpretation of results:*** *Marlina Mohamad, Asiah Mohamad;* ***draft manuscript preparation:*** *Marlina Mohamad, Sukasih Sugiman, Abdul Jalil Omar, Asiah Mohamad. All authors reviewed the results and approved the final version of the manuscript.*

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