

The Development of Digital Competence Model Among TVET Educators Towards Digitization: A Concept Paper

Mohd Hatta Md Hani^{1*}, Affero Ismail¹, Siti Soleha Razali¹, M. Nizan Abu Bakar², Nur Liyana Rosman¹, Nuqman Nasir¹, Zawawi Mohamad³

¹ UTHM-LABTECH Digital Innovation Centre (DICE), Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, Pt. Raja, Batu Pahat, Johor, 86400, MALAYSIA

² JPK Wilayah Selatan, Department Skills Development, Ministry of Human Resource, Johor Bahru, 80000, MALAYSIA

³ Non-Destructive Technology (NDT) Division, Advance Technology Training Centre (ADTEC) Jerantut, Ministry of Human Resource, Jerantut, Pahang, 27000, MALAYSIA

*Corresponding Author: hatta@uthm.edu.my
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Abstract

The ongoing trend towards digitization in education has introduced new challenges for educators, necessitating a range of competencies to meet contemporary demands. Technical and Vocational Education and Training (TVET) educators are no exception to these challenges. To ensure the production of high-quality students, educators must develop digital competencies that are critical for effective technology integration in education. In recent years, the Malaysian government has strongly emphasized the importance of TVET in preparing the workforce for the demands of the Fourth Industrial Revolution (IR4.0). However, studies have revealed that TVET educators in Malaysia often struggle to keep up with the rapidly evolving digital landscape, lacking the necessary competencies to integrate technology into their teaching practices effectively. To address this issue, developing a comprehensive model for digital competencies among TVET educators within the Malaysia Technical University Networks (MTUN) is crucial. Several International frameworks for digital competence exist, allowing educators to assess their skills, identify training needs, and receive targeted training. However, a specific digital competency model for TVET educators is currently lacking. From observation, interviews, and previous research, it was found that there is a need for a structured digital competence model for TVET educators to integrate digital technologies into teaching and learning effectively. This research aims to explore the current state of digital competencies among TVET educators in Malaysia, identify the key factors contributing to developing these competencies, and propose a framework for effectively implementing a digital competencies model. Utilizing the Exploratory Sequential Mixed Methods approach, the study was conducted in two phases: the first phase involved document analysis and structured interviews with ten experts in educational technology and digitization to identify the domains and elements of digital competence among TVET educators. Theme analysis was employed to extract themes from the data, and the Fuzzy Delphi Method (FDM) was used to reach consensus among experts. In the second phase, a survey was conducted with 85 TVET educators from the

Malaysian Technical Universities Network (MTUN). The survey data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to predict the relevant domains and elements. The findings revealed several domains, elements, and sub-elements of digital competence. Based on these findings, a digital competency model for TVET educators was developed. In conclusion, developing a digital competence model tailored specifically for TVET educators is crucial. This model will address the unique demands of vocational education, enhance teaching and learning outcomes, support effective digitization initiatives, and ensure the delivery of high-quality, industry-relevant education. Equipping TVET educators with the necessary digital skills and competencies will better prepare students for the challenges of the modern workforce and contribute to the overall advancement of the education system. This model is expected to play a vital role in developing competent and high-quality TVET educators in the future.

1. Introduction

In an age defined by rapid digital advancements and innovative breakthroughs, the call for digital transformation is evident across all sectors of society. This transformation is particularly significant for TVET institutions at the forefront of this shift. The convergence of technological progress, the emergence of new industries, and the evolving nature of work necessitate a robust response from TVET sectors. These institutions play a vital role in equipping learners with practical skills and knowledge that align with the demands of the labour market, addressing the skills gap created by digital revolutions. This revolution presents significant challenges, particularly in the realm of work. Technological advancements are creating new jobs at an unprecedented rate while making many others obsolete. Today's youth and adults, educated under traditional paradigms, often lack the digital and transversal skills required in modern professional environments. The knowledge and skills acquired in school quickly become outdated in rapidly evolving technological and industrial landscapes. The mismatch of skills, combined with a global increase in youth unemployment, underscores the urgency of recalibrating our TVET system to meet the demands of the digital age.

With the digital economy taking centre stage and rapid transformations in the world of work, there is a growing demand for skilling, upskilling, and reskilling in digital technologies. The International Labour Organization (ILO) has forecasted a significant increase in the need for technical skills. According to the ILO, the hours worked using technical skills will double from 31 billion in 2016 to 60 billion in 2030 in the United States and from 41 to 60 billion in Western Europe. This indicates that new entrants to the labour market will require training in digital technologies for initial employment (Ernst et al., 2018). Regarding upskilling, the McKinsey Global Survey has revealed that up to 87% of 1,216 surveyed employers worldwide have identified skills gaps, either currently or within the next five years. Data analytics and Information and Communication Technology (ICT) are the top two areas where skills gaps are prevalent (McKinsey & Company, 2020). This implies that those currently employed will need to master more advanced digital skills to adapt to increasingly digitalized work environments, aligning with the findings of the European Training Foundation (Brolpito, 2018). The World Economic Forum estimates that by 2025, half of employees worldwide may need to change jobs and acquire new skills due to the obsolescence of their current roles with the application of new technologies (Schwab & Zahidi, 2020). Li (2022) also identified 'technology use, monitoring, and control' and 'technology design and programming' as among the top 10 skills for reskilling and upskilling the future-ready workforce in 2025, which were not listed as such in 2015 and 2020. This underscores the importance of emerging digital skills in the process of reskilling.

The explosion of digital technology and the advancement of ICT has tremendously impacted the shifting educational landscape. Because of technological advancements, educators are no longer the sole source of information. Students now have unlimited access to knowledge and educational content via digital resources in cyberspace. It has resulted in an alteration in the role of educators and the teaching and learning environment. According to Majumdar (2011), this new learning environment demands that educators adopt new instructional methods based on ICT and multimedia environments that are dynamic, flexible, and open. With the advancement of technology, the traditional learning environment has become inadequate. The pandemic has taught us an essential point of view. Adopting a virtual platform with resilient, comprehensive, accessible digital content helps institutions continue functioning and be productive. Carretero et al. (2017) and the Swiss Confederation (2019) concur that a country's endeavours to prepare a system for digital transformation necessitate the development of digital competence among citizens and professional groups.

In order to progress, there is a need to reskill and upskill the digital competence skills of TVET educators. A TVET educator is defined by ILO and the United Nations Educational, Scientific, and Cultural Organization

(UNESCO) as an individual whose function is to transmit information or knowledge to students or trainees in TVET institutions (UNESCO & ILO, 2018). In Malaysia, TVET educators are included in the Malaysian Technical University Network (MTUN) for higher learning institutions. MTUN is made up of four universities: Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Malaysia Perlis (UniMAP), and Universiti Malaysia Pahang (UMP).

According to Grollmann and Rauner (2007), TVET educators play a vital role in ensuring that the country can develop a qualified workforce capable of bringing economic prosperity to the government. Schroder (2013) agrees, stating that TVET educators are the most essential factor in the success of quality in the TVET system. Thus, efforts toward the holistic development of TVET, particularly the professional competency of TVET educators, are critical in the attempt to produce human capital who will become competent workers to achieve the country's aim of being a developed and high-income country. Competent TVET educators are professionals in their field, skilled and knowledgeable in information and communication technology (ICT) and technological processes. They practically impart generic skills to students, innovate in teaching, and have a career development mission (Ismail, 2018). In the context of these efforts, TVET educators' skill capacity, competency, and professionalism must be continually improved to keep themselves competitive and in line with industry needs. It corresponds to the third core of the TVET 4.0 Framework from 2018 to 2025 (Kementerian Pendidikan Malaysia, 2018), emphasizing the importance of TVET educators enhancing their competency profile for future learning challenges. Several International frameworks for digital competence exist, allowing educators to assess their skills, identify training needs, and receive targeted training. However, a specific digital competency model for TVET educators is currently lacking. Developing a digital competence model for TVET educators has significant implications and contributions across theory, practice, and policy in TVET and digital education.

This research offers critical theoretical contributions by advancing educational theories, specifically in the context of digital competence in education for TVET educators. It expands existing theories by integrating the unique requirements of vocational education, emphasizing practical skills and industry relevance. Additionally, the research provides a structured and validated framework for understanding and assessing digital competence among TVET educators. This framework can be a valuable resource for future studies exploring various dimensions of digital competence and their impact on educational outcomes. By combining insights from educational technology, vocational training, and digitalization, the study fosters interdisciplinary dialogue and contributes to a comprehensive understanding of digital competence in education.

Furthermore, this research presents a practical tool for TVET educators to self-assess and enhance their digital skills. Improving digital competence can lead to more effective technology integration in teaching, enhancing the overall quality of education. The model can be used to customize professional development programs to the specific needs of TVET educators, ensuring greater relevance and impact for improved student learning outcomes. Educational institutions can also use the model to pinpoint areas for resource allocation to support digital competence development, including investment in digital tools, training programs, or infrastructure improvements.

Finally, the research findings can inform policies that foster digital competence among TVET educators. This may involve creating incentives for continuous professional development and integrating digital competence standards into national education policies. The model can also serve as a basis for standardizing digital competence requirements across TVET institutions, ensuring a consistent level of digital proficiency among educators. Moreover, it can facilitate the effective implementation of digitization initiatives in TVET institutions by ensuring educators are well-prepared to use digital tools and technologies.

2. Problem Background

2.1 Existing Gap or Challenge in the Current Digital Competence Landscape Among TVET Educators

The current state of digital competence among TVET educators is marked by significant gaps and challenges that hinder the effective integration of digital technologies in teaching practices. According to a study by Afferò Ismail et al. (2022), many TVET educators lack sufficient digital skills, limiting their ability to use technology in teaching effectively. These skills gaps often result from a lack of formal training in digital tools and methodologies, leaving educators unprepared to incorporate technology into their curriculum. Despite the availability of digital tools, there is often a gap in their effective integration into teaching practices. Educators may struggle to apply digital technologies pedagogically, leading to suboptimal learning experiences for students. This challenge is exacerbated by a lack of support and resources to assist educators in this integration (Tanya Christ et al., 2018). There is a notable absence of structured, comprehensive frameworks that define and support digital competence development among TVET educators.

While several international frameworks exist, they are often not tailored to the specific needs and contexts of TVET education. This lack of a customized framework makes it difficult for educators to assess their digital competence, identify areas for improvement, and access targeted professional development (D. S. A. Jafar et al., 2020). There is significant variability in digital competence levels among TVET educators, often influenced by age, experience, and access to technology. This inconsistency can lead to disparities in the quality of education provided to students, depending on the digital proficiency of their instructors (J. et al. et al., 2021). The fast-paced nature of technological change poses a continual challenge for educators to stay current with new tools and platforms. Without ongoing professional development and a commitment to continuous learning, educators may find it challenging to keep up with these advancements, leading to outdated teaching practices (Siyamoy Ghory et al., 2021). By addressing these challenges through a structured and supportive approach, TVET educators can enhance their digital competence, improving teaching practices and student learning outcomes.

2.2 Changes in Skills Needs in the Future World of Work

According to a study performed by WEF experts in 2022 titled "Jobs Will Be Very Different in 10 Years. Here's How to Prepare", they anticipate that ninety per cent (90%) of employment in the world will demand digital skills within the next ten years (Jobs Will Be Very Different in 10 Years. Here's How to Get Ready, 2022). In today's digital economy and society, technologies such as AI (Artificial Intelligence) and robotics rapidly transform various sectors and the future job landscape. The development of AI is driving changes at a pace 10 times faster and 300 times larger than previous industrial revolutions, with nearly 3,000 times the impact (Dobbs et al., 2016). AI technologies are displacing outdated jobs (Petropoulos, 2018).

According to a study involving over 200,000 workers across 29 countries, including 27 from the OECD plus Singapore and Russia, it is estimated that the proportion of jobs to be replaced ranges from approximately 20–25% in Nordic countries and East Asia to over 40% in Eastern Europe by the early 2030s (PwC, 2018a). PwC (2018b) projected that in the next two decades, AI and other labour-saving technologies would displace 26% of current jobs in services, construction, industry, and agriculture in China, with the UK estimate at 20%. The scale of job replacement is even higher in the US, with Frey and Osborne (2017) calculating that 47% of jobs in the US were at high risk of automation in the next two decades.

Conversely, digital technologies also give rise to new job sectors, such as robotics, AI-driven analytics, machine learning, and virtual personal assistance (Kieran, C., 2020). Projections indicate that these technologies will create 297 million new jobs in China between 2017 and 2037 (PwC, 2018b), and 20% of new jobs in the UK during the same period (PwC, 2018c). In light of the digital economy's increasing prominence and the rapid evolution of the labour landscape, there is a growing demand for training, upskilling, and reskilling in digital technologies. The ILO has projected a general rise in technical skills (Ernst et al., 2018). According to the ILO, the hours worked using technological skills are expected to increase from 31 billion in 2016 to 60 billion in 2030 in the US and from 41 to 60 billion in Western Europe (Ernst et al., 2018). This indicates that individuals entering the job market will require training in relevant technologies for initial employment. Concerning upskilling, the McKinsey Global Survey revealed that up to 87% of 1,216 surveyed employers worldwide identified skills gaps either currently or within the next five years, with data analytics and Information and Communication Technology (ICT) being the top two areas with skills gaps (McKinsey & Company, 2020).

It is increasingly crucial for employees to master advanced digital skills to thrive in digitalized working environments. This aligns with the findings of the European Training Foundation (Brolpito, 2018). According to the World Economic Forum, by 2025, an estimated half of the global workforce may need to transition to new roles and acquire new skills due to the obsolescence of their current jobs caused by emerging technologies (Schwab & Zahidi, 2020). Li (2022) identified that skills such as 'technology use, monitoring, and control' and 'technology design and programming' will be among the top 10 skills needed for reskilling and upskilling the workforce in 2025, highlighting the increasing importance of emerging digital skills in the reskilling process.

The demand for transferable skills is on the rise, alongside technological expertise, reflecting the evolving landscape of future jobs. UNESCO (2022) emphasizes the need for digital and technological skills, collaboration, civic competencies, creativity, social and emotional skills, and a sense of global solidarity. The European Commission (2018) similarly advocates for AI capacity building to encompass specific skills and key competencies in science, technology, liberal arts, and citizenship. These cross-cutting skills have always been vital in the job market, as demonstrated by Li's (2022) findings that skills such as 'complex problem solving' and 'critical thinking' consistently rank among the top 10 necessary job skills. Moreover, these skills will be increasingly crucial due to integrating digital technologies in emerging work areas (Ernst et al., 2018).

2.3 The Impact of The Fourth Industrial Revolution (IR 4.0), The Fourth Educational Revolution (Education 4.0) and Post-COVID-19

The influence of IR 4.0, Education 4.0, and the post-COVID-19 era has brought about significant changes in the global economy (Lase, 2019). In today's rapidly changing educational landscape, integrating digital technologies

is essential for enhancing the quality and effectiveness of teaching and learning. TVET imparts practical skills and hands-on training relevant to various industries, requiring educators to use prevalent digital tools and technologies proficiently. As industries continue to digitize, the quality of TVET education needs to keep up. A digital competence model ensures educators can teach students the digital skills required to succeed in the contemporary workforce.

A tailored digital competence model ensures educators are proficient in industry-specific technologies, making their teaching more pertinent and influential. The unique context of TVET presents specific challenges and demands, necessitating a tailored digital competence model for TVET educators. The swift technological advancements in industries mean that TVET educators must continuously update their digital skills to prepare students for the current and future job market. A specific digital competence model helps bridge the gap between the existing skills of educators and the evolving demands of the industries they serve. On top of that, having a tailored Digital Competence Model for TVET educators will equip educators with the necessary digital skills that allow them to incorporate innovative teaching methods, such as blended learning, virtual simulations, and interactive multimedia content. This can lead to more engaging and effective student learning experiences (Derek et al., 2023).

A structured digital competence model provides a consistent framework for evaluating and developing the digital skills of TVET educators. This standardization ensures that all educators meet a certain level of proficiency, leading to more uniform implementation of digital technologies across institutions. By identifying specific digital competencies needed for TVET, professional development programs can be more targeted and effective. Educators receive training directly relevant to their teaching context, leading to better technology integration in their instructional practices. A competence model tailored for TVET supports digital technologies' sustainable and long-term integration in education. It helps educators adapt to technological changes and continuously improve their skills, ensuring that digitization initiatives are not just one-off efforts but part of an ongoing improvement process. TVET institutions adopting a robust digital competence model can enhance their reputation by producing well-prepared graduates for the digital economy. This can attract more students and industry partnerships, further elevating the institution's standing.

Finally, the need for a digital competence model tailored specifically for TVET educators is paramount. Such a model addresses the unique demands of vocational education, enhances teaching and learning outcomes, supports effective digitization initiatives, and ensures the delivery of high-quality, industry-relevant education. By equipping TVET educators with the necessary digital skills and competencies, we can better prepare students for the challenges of the modern workforce and contribute to the overall advancement of the education system.

2.4 Conforming the Need for Gen Z

Today's educators, particularly those in higher education, are dealing with students from Generation Z (Gen Z). Whether higher education institutions (HEIs) are prepared to welcome Gen Z students on campus they are upon us. According to Seemiller (2017), the current campus environment was designed for the previous generation and cannot fully suit Gen Z students' demands, interests, and learning preferences. Gen Z students differ from prior generations in learning preferences, motivational factors, learning styles, academic skill sets, social behaviours, and societal concerns (Smith, 2017). This notion is corroborated by a study conducted on a group of students at a private higher education institution in Malaysia, which reveals that Gen Z in Malaysia is a visual learner who likes active technological learning activities (Azman, 2021).

According to a survey conducted by a group of academics from INTI International University College, as many as 60.9 per cent of Gen Z in this country prefer to engage with their lecturers through social media platforms rather than face-to-face. According to the research, Gen Z students focus more on visual and sequential learning and recognize diverse and unique strategies for everyone (60.9 Peratus Gen Z Lebih Suka Interaksi Di Media Sosial - Kajian, 2021).

It is undoubtedly a significant challenge for TVET institutions, as teaching and learning are increasingly centred on hands-on learning. Chien et al. (2020) state that educators must develop and strengthen current knowledge to conduct learning that will improve students' academic skills and achievements. It can be accomplished through ongoing training, upskilling, reskilling, and expert advice. Then, teaching approaches must be synergized to be viable and adaptable to current demands. Changes and learning strategy strategies in teaching aids, according to Mahat et al. (2020), are crucial steps in effective information delivery.

2.5 Transforming TVET Education Towards Digital TVET

In the 2023 Digital TVET Framework policy paper (Ismail et al., 2023), digital TVET is defined as the process of individual development through digitally implemented teaching, learning, governance, and monitoring. The evaluation includes aspects of knowledge, skills, and attitudes to achieve competence in skills, communication, problem-solving, creativity, collaboration, character, and culture. The Digital TVET ecosystem, illustrated in Figure 1, comprises institutions, industry, students, government, non-government organizations, and the

community. It emphasizes information and data literacy, communication and collaboration, digital material development, security, and problem-solving. This is supported by adequate information infrastructure and culture. According to the "Ministry of Education (KPM) Malaysia Digital Education Policy" report (KPM, 2021), digital competency among TVET educators is considered crucial for digital TVET. It aims to enhance educators' digital technology expertise, improve the quality of digital content, strengthen educators' competency, and promote digital technology among educational leaders.

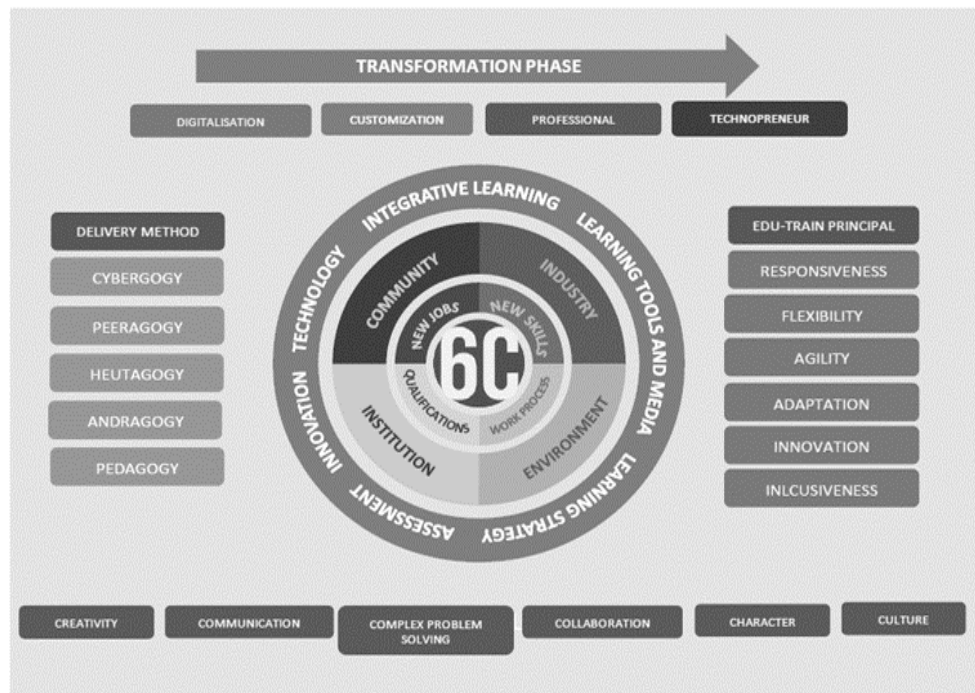


Fig. 1 Digital TVET ecosystem (Source: Ismail et al., 2023)

As the economy becomes more digital, the demand for a workforce proficient in digital skills increases. TVET educators must be equipped to teach these skills to ensure that students can thrive in a digital world. Inadequate digital competence among TVET educators can have far-reaching negative consequences on student learning outcomes, workforce readiness, and the overall quality of TVET programs. Addressing this issue is crucial to meeting the evolving digital economy and industry demands.

Without adequate digital skills, educators may struggle to incorporate interactive and engaging digital tools into their teaching. This can lead to traditional, lecture-based methods that fail to capture the interest and motivation of students accustomed to digital interaction. Ineffective technology integration can lead to suboptimal instructional strategies that fail to cater to diverse learning styles. This can result in poorer academic performance and lower retention of skills and knowledge.

Industries are rapidly becoming digital, which means that employees need to have strong digital skills. Suppose educators in TVET cannot teach these skills because of their own lack of digital proficiency. In that case, students will graduate without the skills employers are looking for, affecting their ability to find a job. Graduates who lack digital skills may struggle to compete in the job market, impacting their career opportunities and reflecting poorly on the TVET institutions. This could lead to a decrease in enrollment and funding for these institutions. When educational tools are not used effectively, students miss out on opportunities to develop these essential skills, which are highly valued in the workforce.

2.6 The Importance of Digital Competence Towards Digital Transformation

According to Ferrari (2012), digital competence refers to the abilities and literacies the public requires to learn and participate in a digitally informed society. Ilomäki et al. (2016) and Khan et al. (2021) agreed to define digital competence as a set of expertise, skills, and attitudes required when using ICT and digital media to complete tasks, solve problems, communicate, manage information, create, collaborate, share content, and develop knowledge effectively, efficiently, correctly, achieve objectives, be creative, ethical, flexible, and reflective for work, study, and community.

Since the turn of the millennium, digital competence has become increasingly relevant in developing countries' policy documents, activities, and initiatives. Digital competence has become crucial worldwide,

particularly in Europe, because practically all employment demands it (Commission, 2016). Several studies, beginning in 2018, have been conducted in developed European countries to produce a digital competence framework expressly for educators, including "The European Framework for the Digital Competence of Educators (DigCompEdu)."

The framework intends to support member countries' efforts to develop digital competence among their citizens and to boost educational innovation. This framework supports regional countries' efforts to build equal digital competence among educators by referencing the digital competence framework in the same sense of logic and language. This initiative is the consequence of a growing recognition among many European member countries that educators require a set of digital capabilities particular to their profession to capitalize on the potential of digital technology to improve and reinvent education.

The broader trends of digitization in education and the increasing reliance on digital technologies in TVET programs are reshaping the roles and responsibilities of TVET educators. These changes underscore educators' need to develop robust digital competencies to effectively leverage digital tools in their teaching. By doing so, they can enhance the quality of education, better prepare students for the digital economy, and ensure their programs remain relevant in an increasingly digital world.

2.7 Challenges and Issues Among TVET Educators About Adaptation of Digitalization

Developing digital competence among TVET educators is essential to meet the demands of modern education and industry. However, several challenges and barriers hinder this development. These can be broadly categorized into individual, institutional, and systemic challenges. In his study, Majumdar (2011) identified a technology gap between students and educators of at least one generation. It is because the students were born and grew up in a highly advanced technological period. As a result, they are more adaptable to today's technological world than teachers who grew up while technology was still in its earliest days. According to Allen et al. (2010), today's kids are technologically and informationally literate. They are more adaptive and at ease with technology.

Past empirical studies have revealed that there are challenges surrounding educators' abilities to adapt to current advancements in technology (Valtonen, 2011), (McLoughlin, 2011), (Miller, 2012), (Ledger, 2020); and (Cordova, 2021). Many TVET educators may have limited prior exposure to digital technologies, leading to a fundamental skills gap that can make adopting new tools and practices difficult. Research studies have also reported on TVET educational concerns and problems adapting to new technological changes that need improving performance (Obwoye, 2016). Some educators may resist changing established teaching practices and adopting new technologies due to comfort with traditional methods or skepticisms about the benefits of digital tools. As a result of the many arguments presented on the issue and relevance of digital competence, it was discovered that the question of how prepared Malaysian educators, particularly those in the field of TVET, are to adapt their knowledge to confront future educational challenges also arises. Previous research by Cattaneo et al. (2022), Thangaiah et al. (2020), and Kanwar et al. (2019) concluded that the digital gap among educators will have an impact on the implementation of the future education revolution, mainly digital. Educators often have heavy workloads, leaving limited time for professional development and acquiring new digital skills. It is also supported by a study conducted by (Artacho, 2020), which found that educators' lack of competency around digitization in teaching and learning causes challenges in implementing digital integration in their classrooms. In fact, (Rusdin, 2018), (Li et al., 2019), and (Aditya, 2021) all noted that when educators' readiness, particularly in terms of knowledge, skills, and attitudes, is inadequate, it becomes an impediment to the implementation of teaching and learning techniques. As a result of technological advancements, there is a need to increase specialization, expertise, and knowledge in specific technologies. It necessitates educators upgrading their existing qualifications and competencies, which are reported to fall short of the desired competencies (Grollmann & Rauner, 2007).

Many institutions do not provide adequate training programs tailored to the needs of TVET educators. Training opportunities may be sporadic, poorly organized, or not aligned with the specific vocational education requirements (J. Fernández-Batanero et al., 2020). The institution needs to develop and offer continuous, high-quality professional development programs focused on digital literacy and the practical application of digital tools in vocational education. Institutions may lack the necessary infrastructure to effectively use digital technologies in teaching, such as up-to-date hardware, software, and technical support. Enhancing support structures within institutions, including technical support, access to modern digital tools, and collaborative environments that encourage sharing best practices, will tackle these issues. Educators may lack motivation to develop digital competencies if institutions do not offer incentives such as career advancement opportunities, recognition, or financial rewards for engaging in professional development. Without a cohesive digital strategy, institutions may struggle to provide a clear direction and support for integrating digital tools into teaching practices. Thus, crafting digital competency models for TVET educators can significantly enhance digital TVET.

2.8 Efforts and Commitments by The Malaysian Government to Empowering TVET

Meanwhile, numerous measures are being planned and executed by the Malaysian government through the ministries and agencies associated with TVET to empower TVET at all levels. Various measures were described in the 12th RMK to continue to empower TVET (2021), and a financial allocation of RM6.7 billion (2023) has been earmarked for projects to boost the TVET program.

The trend of increasing budget allocation for TVET demonstrates the government's commitment to TVET. It is consistent with current and previous policies, such as the Malaysian Education Development Plan - Higher Education (PPPM-PT) 2015-2025, which is a continuation of the review of the National Higher Education Strategic Plan (PSPTN) 2007-2020, as well as the coordination of the PPPM (Preschool to Post Secondary Education) 2013-2025 (Ministry of Education, 2015). The PPPM-PT is a strategic plan that serves as a compass for the path of education in this country in the face of numerous new problems while also upgrading and elevating the country's higher education system (Yahya, 2022). It is also in line with the creation of the National TVET Council (MTVET) in December 2020 to reform Malaysia's TVET ecosystem. Meanwhile, the Malaysian Technical Universities Network - MTUN (UTHM, UNIMAP, UTeM, UMP) and TVET Institutions under the Malaysian Ministry of Education, namely Polytechnics, Community Colleges, and Vocational Colleges, has expressed its unity of direction through the development of strategic planning for the TVET 4.0 Framework Book. The textbook serves as a guide and reference for the institution and all its citizens as they prepare to tackle the challenges of the Fourth Industrial Revolution (4IR) over seven years, beginning in 2018 and ending in 2025.

This framework establishes six (6) primary cores that support many strategies and initiatives to drive changes in TVET education that produce skilled human capital and are crucial in thinking and humanitarian efforts (Kementerian Pendidikan Malaysia, 2018). In addition, to support PPPM-PT, the Malaysian Higher Education Action Plan 2022-2025 and the KPT Digitalization Strategic Plan 2021-2025 have been developed at the KPT level. Various digitization projects are planned to follow the priorities of KPT management and operations to overcome present ICT challenges and drive towards the perfection of the KPT delivery system based on ICT and the empowerment of digital technology. The truth of these efforts is that it is envisaged that every KPT educator, particularly TVET educators, will be able to identify and comprehend the direction that is being targeted, particularly in the digital technology transition set. As a result, total commitment and consistent efforts to improve educator competency, particularly those connected to digital competence, are critical to ensuring that the digitization process is realized for all benefits. According to Nor et al. (2018), the quality of an educational system that has been planned and developed has no relevance until the quality of the educator is improved first, particularly in terms of commitment and competence.

Designing a digital competence model that is sustainable and adaptable is essential for equipping TVET educators with the skills needed to leverage digital technologies effectively. By focusing on comprehensive training, supportive infrastructure, continuous assessment, and inclusive policies, the model can evolve with the changing digital landscape and meet the long-term needs of educators. This approach will enhance the quality of TVET programs, better prepare students for the digital economy, and ensure that education systems remain resilient and forward-thinking.

3. Problem Statement and Objectives

In recent years, the Malaysian government has strongly emphasized the importance of Technical and Vocational Education and Training (TVET) in preparing the workforce for the demands of the Fourth Industrial Revolution (IR4.0) (Rosly et al., 2019). However, studies have revealed that TVET educators in Malaysia often struggle to keep up with the rapidly evolving digital landscape, lacking the necessary competencies to integrate technology into their teaching practices effectively (Rus et al., 2020; Hamid et al., 2023; Dusadee & Piriyasurawong, 2020; Yeap et al., 2021; Aslamiah et al., 2020; Yunos et al., 2016). Developing a comprehensive model for enhancing digital competencies among TVET educators within the Malaysia Technical University Networks (MTUN) is crucial to address this issue. There is a clear need to gain a comprehensive understanding of the digital competencies required by TVET educators to effectively integrate technology into their teaching practices and meet the evolving needs of their students (Lam & Hassan, 2018).

A digital competency model for TVET educators has not been developed yet. Previous empirical studies have revealed a digital gap among educators, which impacts the implementation of digital education (Cattaneo et al., 2022; Thangaiah et al., 2020). Kanwar et al. (2019) also acknowledge this issue, stating that the lack of competency of educators unfamiliar with digitization in teaching and learning causes difficulties in implementing digital integration in their education. Kaviza (2020) noted that when educators' preparation, particularly in terms of knowledge, skills, and attitudes, is inadequate, it impedes the implementation of effective teaching and learning approaches.

The primary goal of this research is to develop and publish a reference model for identifying the domains and elements of digital competence required of TVET educators. The following are the study's more precise objectives:

- Exploring the domains of digital competence among TVET educators in the context of TVET digitization.
- Exploring the elements of digital competency among TVET educators towards TVET digitization.
- Determine and evaluate the development of a digital competency model among TVET educators in preparation for TVET digitization.
- Develop a digital competency model for TVET educators to prepare for TVET digitization.

4. Research Methodology

4.1 Research Concept Framework

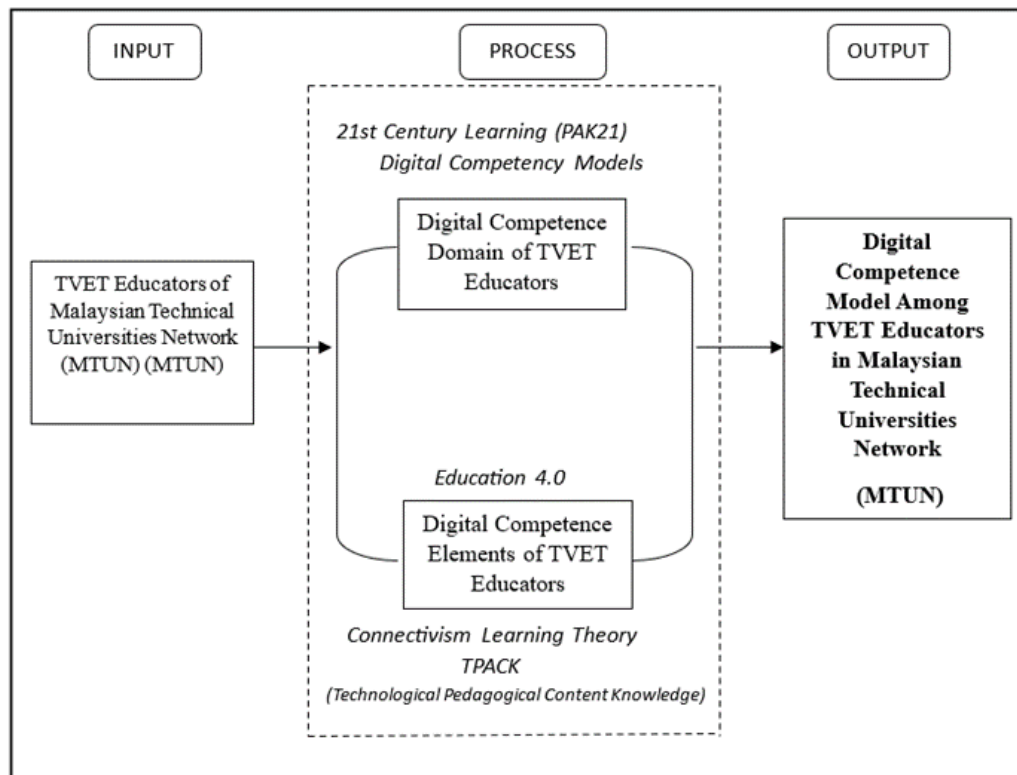


Fig. 2 Research concept framework for the development of digital competence model among TVET educators

Developing a digital competence model for TVET educators requires a robust theoretical foundation based on existing frameworks, models, and theories from the relevant literature. This foundation helps to ensure that the model is comprehensive, evidence-based, and aligned with best practices in digital education. The research's conceptual framework provides the research's general concept or idea. Figure 2 depicts the conceptual framework for this research. The study is divided into two parts: the domain and the elements that comprise the digital competency model among TVET educators. The domain comprises primary components and elements, sub-domains necessary in the digital competency model for TVET educators.

Given that there is no specific digital competency model among TVET educators, references are made to several previous models related to digital competency, such as The European Digital Competence Framework for Citizens (DigComp), The Digital Competence Framework for Educators (DigCompEdu), and The International Society for Technology in Education (ISTE) Standards for Students (ISTE). Furthermore, to enhance the domains and elements explored by adopting the learning characteristics of the twenty-first century. According to Prayogi (2020), mastery of twenty-first-century learning skills abilities is critical for the future competence of educators. Next, this study considers elements of Learning 4.0 since, according to Sarango-Lapo (2021), digital competence is essential to the success of Learning 4.0.

Because this study aims to focus on digital competency among TVET educators, learning theories that encourage the use of technology should be used as a reference in exploring domains and elements indirectly.

This study relates to the connectivism learning theory (Seimens, 2005), which stresses learning with relationships and online user interactions. Furthermore, connectivism influences distant learning theory, which promotes individual learning and interaction between students, information items, and student-teachers.

The Technological Pedagogical and Content Knowledge Framework (TPACK) is mentioned to develop TVET educators who are influential in incorporating technology into teaching. A TPACK framework is essential for successful technology-assisted instruction (Mishra & Koehler, 2006). This framework assists educators in identifying crucial factors that will help them develop their professionalism to become effective educators or future educators (Mishra & Koehler, 2007).

When conducting research on developing a digital competence model for TVET educators, several limitations and constraints must be acknowledged to provide a comprehensive and transparent understanding of the study's scope and potential areas for improvement. These limitations can influence the outcomes and generalizability of the findings. As for this research, some limitations and constraints include time constraints, resource limitations, and potential biases in data collection and analysis.

4.2 Research Design

Research design is the process of planning and structuring research to gain answers to all research questions or as steps or procedures taken to attain all research aims. It is an essential element of every scientific investigation because if it is not suitable, it will result in insufficient findings and may have a detrimental impact on subsequent researchers who refer to the research results. As a result, the researcher should arrange his study using a research design consistent with the study's objectives.

The proposed research design for this concept paper focuses on the theoretical and conceptual development of a digital competence model tailored for TVET educators. By systematically reviewing existing literature, developing a solid theoretical framework, designing a comprehensive conceptual model, and outlining strategic implementation and evaluation plans, this research aims to provide a foundational blueprint for enhancing digital competence in TVET education. This approach ensures that the model is grounded in evidence-based practices and is adaptable to the dynamic landscape of digital technologies in education.

This research adopts a mixed methods approach that blends qualitative and quantitative approaches. This approach is a method for collecting, analyzing, combining, or integrating quantitative and qualitative data at various stages of the research process in a single study (Creswell & Clark, 2011; Tashakkori & Teddlie, 2003).

According to Creswell (2012), this mixed method can be utilized when one method is insufficient to answer the research question, requiring more material to be provided as the primary database. As a result, it becomes a reason for choosing this method, which requires qualitative discoveries followed by quantitative methodologies to establish the research framework.

The first part of this study employs an exploratory sequential mixed approach that prioritizes the collection and interpretation of qualitative data. From the exploratory discoveries, the researcher moved on to the second phase, depicted in Figure 3 (Creswell & Clark, 2011).

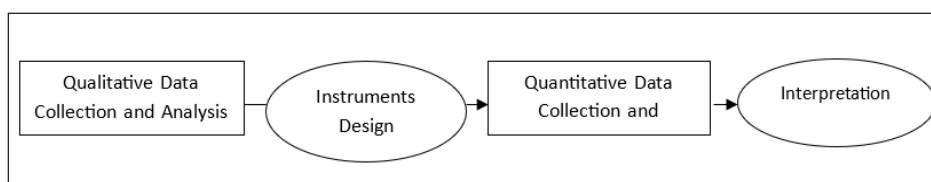


Fig. 3 Exploratory sequential mix-method design (Source: Creswell & Clark, 2011)

4.3 Research Procedure

A mixed-methods approach will be employed to support the development of the digital competence model for TVET educators. This approach will combine qualitative and quantitative data collection methods to gather comprehensive insights into the digital skills, knowledge, and practices of TVET educators. This research adopts a sequential exploratory mixed method because the variables in the context of digital competency among TVET educators are still unknown. It is also used to discover significant unknown variables and then quantitatively explore them (Creswell & Clark, 2011). On top of that, this sequential exploratory mixed design is being adopted due to:

- The researcher's lack of knowledge about which domain is crucial to the investigation and
- The researcher can perform the study in two phases, as Creswell and Clarke (2011) indicated.
- This is required to provide better organized and efficient data collection.

The research procedure is designed to tailor the study in two stages, as shown in Figure 4. Separating these two phases makes it easier for the researcher to perform a study that combines qualitative and quantitative phases. Due to that, study issues must be explored using qualitative approaches first, followed by quantitative research employing a larger sample size. In this study, quantitative research was chosen since it is ideal for gathering data to answer the research questions that have been developed. It is because the survey method, according to Idris (2010), is very useful in collecting data about phenomena that cannot be observed roughly, whereas Sabitha (2005) stated that the survey method is used to obtain information from many respondents, i.e., hundreds or thousands of respondents. Thus, the approach adopted by the study is acceptable in answering each research question that has been established. This study will employ several domains, which are the domains of variables and factors that will be used to answer the research questions that have been developed.

This emphasis creates a framework in which qualitative methods generate quantitative measures and measurement models (Creswell, 1999; Creswell et al., 2004). Consequently, the justification for using mixed approaches to find specific domain themes and elements of digital competence among TVET educators that are still to be discovered is exceptionally applicable. The results were then extrapolated to a broader sample to determine the significance of the elements. At the same time, the Malaysian Technical Universities Network is developing a digital competency paradigm for TVET educators. Figure 4 depicts the description of each task.

Phase	Activities	Procedure	Product
FIRST PHASE (QUALITATIVE)	Literature Review	i. TVET Educator Professionalism Factors	Interview protocol (for front-facing interviews)
		ii. The Impact of the Education Digital Revolution	
		iii. Related theories of education	
		iv. Previous studies on digital competency	
	Qualitative Data Collection	i. Development of interview protocols	Audio recordings and transcripts of interviews
		ii. Pilot study (3 experts)	
		iii. Face-to-face semi-structural interview (Head of Virtual Learning, Competency Training Management and Academician, N=12)	
	Qualitative Data Analysis	i. Coding via Theme Analysis (Pencil & Paper)	i. Analysis Theme ii. Expert check form iii. Fuzzy Delphi Method Analysis (Triangular Fuzzy Number & Defuzzification)
		ii. Development of themes	
iii. Confirmation of themes (Expert Agreement, N=12)			
SECOND PHASE (QUANTITATIVE)	Design Instruments	i. Based on themes obtained from qualitative data.	Questionnaire instrument
		ii. List items for each theme	
		iii. Expert verification (3 experts)	
	Quantitative Data Collection	i. Pilot study (30 MTUN academics)	i. Questionnaire instrument ii. Analysis Winsteps approach Rasch Model
		ii. Survey studies	
		iii. The sample is an academic expert at MTUN, N = 85)	
	Quantitative Data Analysis	i. PLS-SEM analysis using SmartPLS.	Measurement model
		ii. Analysis of measurement models	
Interpreting	i. The formulation of each domain and elements	i. Description of each domain-domain that contains multiple elements. ii. Digital Competency Model Among TVET Educators	
	ii. Proof of validity of the domains		

Fig 4 Research procedure framework for the development of digital competence model among TVET educators

Various qualitative data collection methods will be employed to gain an in-depth understanding of the experiences, challenges, and needs of TVET educators regarding digital competence. Semi-structured interviews will be conducted with a diverse group of TVET educators representing various levels of digital proficiency from different regions and disciplines. These interviews will utilize open-ended questions to explore educators' perceptions of their digital skills, the integration of technology into their teaching practices, and the support they need to enhance their digital competence. The interviews will be recorded and transcribed for detailed analysis, resulting in rich, detailed narratives that provide insights into the specific digital competence needs and experiences of TVET educators. In addition to interviews, focus group sessions will facilitate discussions among TVET educators, identifying common themes, challenges, and opportunities related to digital competence. These sessions will encourage interactive discussions using guided questions to explore the effectiveness of current digital training programs, the impact of digital technologies on teaching and learning, and suggestions for improving digital competence. The focus group discussions will be recorded and analyzed for recurring themes and insights, providing collective insights and perspectives highlighting common issues and potential solutions for enhancing digital competence among TVET educators. To examine the implementation of digital technologies and practices in specific TVET institutions, case studies will be conducted. Case study sites will be selected to represent a range of contexts, including different types of TVET institutions and geographic regions. Data collection for these case studies will involve observations, interviews with educators and administrators, institutional documents, and analysis of digital resources. The focus will be on understanding how digital competence is being developed and utilized within these institutions, resulting in detailed case studies that provide contextualized examples of successful practices and challenges in developing digital competence. Lastly, document analysis will review existing policies, frameworks, and training materials on digital competence in TVET education. Relevant documents will be collected and analyzed from TVET institutions, government agencies, and professional organizations. This analysis will identify key themes, strategies, and gaps in existing digital competence initiatives. The findings from the document analysis will be used to inform the development of the digital competence model, providing a comprehensive understanding of the current landscape of digital competence development in TVET education, including strengths and areas for improvement.

As for the qualitative data collection, surveys and questionnaires will be utilized to gather broad, generalizable data on the digital skills, knowledge, and practices of TVET educators. A structured survey instrument will be developed based on the theoretical framework and key competencies identified in the literature review. This survey will include a mix of closed-ended questions, such as Likert scale and multiple-choice questions, to quantify educators' self-assessed digital competence, usage of digital tools, and perceived training needs. The survey will be distributed to a large, representative sample of TVET educators across different regions and disciplines, providing quantitative data that offers a statistical overview of the digital competence levels and needs of TVET educators. To complement this data, targeted questionnaires will be designed to explore specific domains of digital competence in greater detail, such as digital pedagogy, cybersecurity, and digital content creation. These questionnaires will use quantitative and qualitative questions to capture numerical data and educators' perspectives. They will be administered to a subset of survey respondents interested in providing more detailed information. The outcome will be detailed quantitative and qualitative data that supplements the broader survey findings and provides deeper insights into specific areas of digital competence.

Both qualitative and quantitative methods will be employed for data analysis. Qualitative Analysis will involve using thematic analysis to identify key themes and patterns in the interview, focus group, and case study data. Coding techniques will be employed to categorize the data and draw connections between themes. Triangulation will be used to validate findings, comparing insights from different qualitative data sources to ensure consistency and reliability. Quantitative Analysis will involve using statistical analysis software to analyze survey and questionnaire data, employing descriptive statistics, factor analysis, and regression analysis techniques. This will help identify significant relationships and trends in the data that inform the development of the digital competence model. The reliability and validity of the quantitative data will be ensured through rigorous testing and validation procedures.

This research will utilize a mixed-methods approach, integrating qualitative and quantitative data collection methods to gain comprehensive insights into the digital competence needs of TVET educators. By combining in-depth qualitative and broad quantitative data, we aim to gain a well-rounded understanding of the current state of digital competence in TVET education and inform the development of a tailored digital competence model. This approach ensures that the model is firmly rooted in empirical evidence and responsive to the real-world needs and challenges of TVET educators.

5. Discussion

The research on developing a digital competence model for TVET educators yielded key findings and insights from a comprehensive literature review, data collection, and analysis processes. These findings highlight the main themes, patterns, and trends that informed the development of the digital competence model. Analyzing existing digital competence frameworks such as DigCompEdu, ISTE Standards, TPACK, and the SAMR model revealed essential competencies educators need. These include Technical Proficiency, Pedagogical Integration, Digital Literacy, and Ethical and Safe Use. The review identified a lack of frameworks specifically tailored to TVET educators. This gap underscores the need for a model that addresses the unique requirements and challenges TVET educators face in integrating digital technologies. Analysis of existing policies and frameworks revealed gaps in addressing the specific digital competence needs of TVET educators.

There was a lack of comprehensive strategies and targeted training programs at the institutional and national levels. TVET educators reported limited access to digital tools, inadequate training, and insufficient institutional support. There was a clear need for professional development tailored to their specific teaching contexts. Educators strongly desire ongoing support and resources to enhance their digital skills. They emphasized the importance of practical, hands-on training and continuous professional development. These key findings and insights inform the development of the digital competence model for TVET educators. The model addresses the unique challenges and needs identified in the research, providing a comprehensive framework to enhance digital competence in TVET education. By focusing on continuous professional development, strong institutional support, and adaptable strategies, the model aims to improve the quality of teaching and learning outcomes in TVET institutions, aligning with the demands of the digital economy and industry.

The proposed digital competence model is highly relevant to the goals and objectives of TVET institutions and programs. By addressing the digital skills gap among educators, the model enhances the quality and effectiveness of teaching and learning in digital environments. It ensures that TVET educators have the digital competencies to prepare students for the workforce, promote lifelong learning, and support inclusive and equitable education. This alignment with TVET goals ultimately contributes to producing a digitally competent and adaptable workforce, ready to meet the challenges of the evolving digital economy.

The current research on developing a digital competency model among TVET educators significantly benefits many stakeholders. First and foremost is the TVET educators themselves. As a result of the model created, professional development and training components for TVET educators in Malaysia will be aided. It can be used as a standard to help ensure that TVET educators constantly remain up-to-date and informed of new technology. Following that, this approach will aid in establishing a comprehensive upskilling and reskilling plan for developing and assessing digital competence among TVET educators. It, in turn, can help ensure that educators in TVET have the necessary abilities and expertise to efficiently incorporate digital technology into their teaching while also contributing to improving the quality of the TVET program. According to the TVET 4.0 Framework Guidelines (2018-2025), TVET educators must update their competency profiles to prepare for future learning challenges.

The digital competency model among TVET educators will deliver benefits and interests to the community, particularly prospective students, to encourage them to enter the TVET programs. According to the Auditor General's Report in 2021, TVET has failed to meet the targets outlined in the 11th Malaysia Plan (RMKe 11) (Sinar Harian, 2021). The report claims that only 474,672 (53 per cent) graduates were successfully produced from 2016 to 2020, compared to the target of 900,000 additional job possibilities established for 2020. According to the statistics, this is due to the overall intake of TVET students from 2016 to 2020, which showed a declining trend of between 1.0 per cent and 24.6 per cent compared to the previous year, from 139,699 students in 2016 to only 99,589 students in 2020. In the 12th Malaysia Plan (RMKe 12), the government has taken the initiative to revolutionize digitization in the TVET education sector through the digital TVET project to address the issue. It can provide more offers to potential students with broader geographical limits through the digital-based TVET 4.0 Education System while also increasing the production of TVET graduates to satisfy the needs of the industries. To sustain the effort, TVET educators must be accomplished with digital competence. Thus, the study will ensure that the Malaysian government's aims and ambitions for empowering TVET are achieved.

Besides that, it provides benefits and interests to TVET students. Students can go through an engaging and enjoyable learning experience because of TVET educators' ability to implement digital learning. Through varied learning activities and creative cooperation in digital form, students will be more active in learning sessions. Following that, each student can learn at their own pace while also helping them understand each other's strengths and weaknesses. Students can also increase their digital competence by sharpening their abilities by creating digital material, allowing them to compete in the workforce once their studies are completed.

Next, it provides advantages and benefits to TVET institutions. It indirectly allows TVET institutions to investigate numerous digital advances through their educators and students. Multiple media and platforms can conduct the teaching and learning process more flexibly. Because of the existence of applications and platforms

built to enable learning outcomes to be reached even in harsh and restricted times, the availability of digital TVET programs can allow the community to follow TVET education.

On top of that, it provides the government with advantages and benefits. This research is significant because it supports numerous government programs that empower TVET. As a result, more people will have access to high-quality TVET education and training. Therefore, more people will be able to be trained in digital TVET skills to meet job market demands. Next, it can assist the government in ensuring that our country's skilled workforce increases constantly. Indeed, by boosting the people's abilities, particularly in industry, the youth will determine the country's future success.

Finally, it will add value and intrigue to the industry. To produce industry-based graduates, aspects of digital skills will be able to be implemented in teaching and learning to train students for workforce needs through the coordination of digital competency across TVET instructors. It can bridge the digital divide among students and provide new added value in response to industry demands. It also makes it easier for companies to find competent people for jobs that need digital skills. Furthermore, the industry can partner with TVET institutions on digital TVET innovation, research, and development projects. While the country's economy remains competitive, the country's industrial sector can move forward with digital transformation.

6. Conclusion

Technology's rapid advancement has revolutionized our lives and work, creating a growing demand for a digitally skilled workforce. Digital competence has garnered significant attention in education due to its impact on 21st-century learning. Embracing TVET digitization is crucial for the future, necessitating educational institutions to adopt digital strategies to enhance knowledge and skills.

TVET educators must elevate their digital competence to drive the success of educational institutions. Therefore, a digital competency paradigm for TVET educators must be developed. Digital competence has become one of the most essential skills for educators to meet the needs of the present generation. Developed countries have already established models for developing digital competence among citizens and educators, such as the European Digital Competence Framework for Citizens - DigComp, the Digital Competence Framework for Educators - DigCompEdu, and the International Society for Technology in Education (ISTE) Standards for Students.

Neglecting to establish a reference model for digital competence among TVET educators can lead to a dearth of awareness, skills, knowledge, guidelines, structured training, and expertise in digital competence. TVET institutions should provide more opportunities for students to enhance their knowledge and skills in alignment with the TVET 4.0 Framework. Creating a digital competency model for TVET educators can ensure that educators possess the necessary digital skills and knowledge.

Ultimately, the objective is to realize the vision of "Quality Education" outlined in the United Nations' "The 2030 Agenda for Sustainable Development Goals (SDGs)" by focusing on inclusive and equitable quality education and promoting lifelong learning opportunities for all.

Future research, practice, and policy initiatives should focus on refining, validating, and scaling the digital competence model for TVET educators. By conducting rigorous research, developing targeted professional development programs, and enacting supportive policies, stakeholders can enhance the digital skills of TVET educators. This, in turn, will improve the quality of teaching and learning, better-preparing students for the digital economy's demands. The digital competence model can become a cornerstone of effective TVET education in the digital age through continuous improvement and collaboration.

Conflict of Interest

The authors declare no conflict of interest regarding the paper's publication.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design:** Mohd Hatta Md Hani, Affero Ismail; **problem background:** Mohd Hatta Md Hani, Siti Soleha Razali, M Nizan Abu Bakar; **problem statement and objectives:** Mohd Hatta Md Hani, Nuqman Nasir; **research methodology:** Mohd Hatta Md Hani, Nur Liyana Rusman; **discussion and conclusion:** Mohd Hatta Md Hani, Zawawi Mohamed **draft manuscript preparation:** Mohd Hatta Md Hani, Siti Soleha Razali, Nur Liyana Rusman. All authors reviewed the results and approved the final version of the manuscript.*

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