

# Enhancing High Aptitude TVET Technological Assistance (HATTA) Framework of a Digital Competence Model for TVET Educator's Satisfaction by Using Linear Regression Approaches

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## Abstract

The integration of digital technologies in education has transformed conventional teaching methodologies, particularly within Technical and Vocational Education and Training (TVET) institutions, which play a crucial role in preparing students for the evolving workforce. As digital transformation accelerates, TVET educators must develop robust digital competencies to integrate technology into vocational training effectively. However, existing literature lacks a structured framework that addresses the challenges and opportunities associated with digital competency among TVET educators. This study aims to bridge this gap by developing the High Aptitude TVET Technology Assistance (HATTA) framework to enhance TVET educators' digital proficiency and improve educational satisfaction. The research investigates how digital competency is incorporated into practical training, how educators adapt to technological advancements, and how digital tools enhance hands-on skill development for students. A subjective assessment method was employed, focusing on user satisfaction within the Malaysia Technical University Network (MTUN). The study collected Mean Opinion Score (MOS) data through a user acceptability review, followed by linear regression analysis to determine the relationship between user acceptability and factors influencing educator satisfaction. Findings from this study provide critical insights for policymakers, educators, and technology developers in designing effective digital competency frameworks for TVET. The HATTA framework offers a structured approach to integrating digital tools into vocational education, ensuring sustainable digital transformation in TVET institutions.

## 1. Introduction

Technical and Vocational Education and Training, or TVET, is a comprehensive system that encompasses education, training, and skill development in fields such as employment, production, services, and lifelong learning, according to UNESCO (2015). In Malaysia, TVET began in 1964 with the establishment of two public institutions, Institut Kemahiran Belia dan Negara (IKBN) Dusun Tua and Institut Latihan Perindustrian (ILP) Kuala Lumpur, dedicated to providing skills training to young people. Today, approximately 500 public TVET institutes offer various programs at all levels of schooling (Musa et al, 2021). TVET programs are also available at the Public University (UA) level through the Malaysian Technical University Network (MTUN), which consists of four universities: Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Malaysia Perlis (UniMAP), and Universiti Malaysia Pahang (UMP)(MTUN,2015).

TVET enhances human capital development by providing professional training and expertise in relevant fields, emphasizing practical components, psychomotor skills, industry practices, and recognized employment standards, as Paryono (2017) and Musa (2021) suggested. TVET is a catalyst for sustainable economic development and supports building distinctive human capital in the industry, according to Ahmad et al. (2021). In Malaysia, TVET plays a significant role in providing jobs and decent income opportunities for the youth, as Ikhsan (2022) noted. Graduates of TVET programs can also receive progressive pay, as highlighted by Ahmad and Bon (2023). However, despite its benefits, there is still a common misconception that TVET is a secondary option, as discussed by Norlatep (2023), BERNAMA (2023), Baharu (2023), Ahmad & Ibrahim (2022), and Central (2022). As a result, empowering TVET has become the country's top priority.

A TVET educator teaches or trains students in TVET institutions to impart information or knowledge. The International Labor Organization (ILO) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) define this role. TVET educators are critical in ensuring a qualified workforce to bring economic prosperity to the country, according to Grollmann and Rauner (2007). Schroder (2013) agrees, stating that TVET educators are the most crucial element in achieving quality in the TVET system. Therefore, efforts to develop the TVET system holistically, especially the professional competency of TVET educators, are critical in creating human capital to become skilled workers and help the country become a developed and high-income nation.

Competent TVET educators are experts in their respective fields and equipped with advanced ICT and technological process skills. They impart valuable practical skills to their students, foster innovation in teaching, and uphold a mission of career development. To stay ahead of the curve and cater to industry requirements, TVET educators must constantly enhance their skill set, proficiency, and professionalism (Ismail et al.,2018). It aligns with the third core of the TVET 4.0 Framework, spanning from 2018 to 2025, which prioritizes bolstering the competency profile of TVET educators to effectively tackle future learning challenges (Kementerian Pendidikan Malaysia, 2018).

Digital technology and ICT have revolutionized education, providing students unparalleled access to knowledge and educational content through various online digital resources. Consequently, educators must adapt to this new reality by embracing dynamic, flexible, and open instructional methods based on ICT and multimedia environments (Md Hani et al., 2024). Traditional learning methods are no longer sufficient to meet the demands of this new learning environment (Majumdar, 2011). The COVID-19 pandemic has further underscored the importance of adopting virtual platforms with resilient, comprehensive, and accessible digital content to ensure institutions can remain productive. Experts agree that the way forward for digital transformation is for countries to prioritize the development of digital competence among citizens and professional groups, as highlighted by Carretero et al. (2017) and the Swiss Confederation (2019).

## 2. Literature Reviews

### 2.1 A Study Performed by the World Economic Forum (WEF)

Integrating digital technologies into education, particularly within TVET, is increasingly recognized as essential for preparing the future workforce. The World Economic Forum's 2022 study highlighted that 90% of global employment will require digital skills within the next decade, underscoring the urgency for digital competence in education (Jobs Will Be Very Different in 10 Years. Here is How to Get Ready, 2022). This phenomenon aligns with the International Labor Organization (ILO) and UNESCO's predictions that successful digitization efforts will depend on collaboration among academic institutions, educators, students, and industry (ILO, 2020). Such collaborations are seen as pivotal in fostering the growth of TVET by creating opportunities that align educational outcomes with industry needs (Mohamad et al., 2021). We can understand that adopting digital technologies in TVET is not just a trend but a necessity driven by the evolving demands of the global labour market.

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

The global economy has experienced profound shifts due to the influence of Industry 4.0, Education 4.0, and the post-COVID-19 landscape, necessitating a reevaluation of traditional education systems, particularly within TVET (Lase, 2019). These changes demand a strategic overhaul to equip future human capital with industry-specific skills, making the role of TVET educators more critical than ever. As the educational landscape evolves, TVET educators must develop diverse technological skills to prepare students for the future workforce, addressing the rapidly changing demands of the global market. Moreover, the rise of Generation Z (Gen Z) students presents additional challenges for higher education institutions (HEIs). Contemporary educators must adopt new technologies and reimagine their teaching strategies to align with Gen Z's unique learning preferences. The current educational infrastructure, designed for previous generations, may not fully meet the needs of these students, emphasizing the need for HEIs to assess their readiness to support and engage this new generation (Seemiller, 2017). The impact of IR 4.0, Education 4.0 and post-COVID-19 highlights the necessity for TVET institutions to actively embrace digital transformation actively, ensuring that educators and students are well-equipped to thrive in a rapidly evolving educational and economic environment.

### 2.3 Conforming the Need for Gen Z

The distinct learning preferences and technological inclinations of Generation Z (Gen Z) students present new challenges and opportunities for educational institutions, particularly in TVET (Smith, 2017). Research indicates that Gen Z learners, especially in Malaysia, are predominantly visual and prefer active, technology-driven learning experiences (Azman, 2021). A survey at INTI International University College further highlights that many Gen Z students in Malaysia favour interacting with lecturers through social media rather than traditional face-to-face methods. These findings underscore TVET institutions' need to adapt their teaching methods to align with Gen Z's preferences, emphasizing visual and sequential learning. The growing importance of hands-on learning in TVET adds another layer of complexity, requiring educators to enhance their technological skills and knowledge continuously. Experts suggest this can be achieved through ongoing professional development, including training, upskilling, and reskilling initiatives. To effectively meet the needs of Gen Z students, TVET institutions must embrace digital transformation, updating teaching aids and strategies to reflect current technological advancements (Chien et al., 2020). This approach not only aligns with the learning styles of modern students but also ensures that TVET education remains relevant and capable of producing graduates with the skills needed to succeed in today's rapidly evolving job market (Mahat et al., 2020).

### 2.4 Transforming TVET Education Towards Digital TVET

Adopting digital technologies in TVET is crucial for building a comprehensive ecosystem that integrates teaching, learning, governance, and skill development. The Digital TVET Framework, as defined by Ismail et al. (2023), outlines a process that encompasses traditional educational goals and embeds digital evaluation to achieve competence in knowledge, skills, and attitudes. This framework emphasizes the interconnectedness of institutions, industry, students, government, NGOs, and the community, focusing on crucial digital competencies such as information and data literacy, communication, collaboration, and problem-solving. The "Ministry of Education (KPM) Malaysia Digital Education Policy" (KPM, 2021) further underscores the importance of digital competency among TVET educators. According to this policy, digital competency is essential for educators to implement and thrive in a successful digital TVET environment. It enhances educators' expertise in digital technology, enriches the quality of digital content, empowers educators' overall competency, and promotes the use of digital technologies among educational leaders. Hence, technology adoption in TVET is not merely about integrating digital tools but also about fostering a supportive digital culture and information structure. These elements are vital for creating an environment where educators can develop the necessary skills to deliver effective digital education, ultimately ensuring the success of the digital TVET ecosystem.

### 2.5 The Importance of Digital Competence Towards Digital Transformation

Digital competence is a critical component in successfully adopting technology within TVET. A comprehensive range of skills, knowledge, and literacies is necessary to thrive in a technology-driven society. Digital competence involves effectively using information and communication technologies (ICT) and digital media to achieve various objectives. Experts, including Ferrari (2012), Ilomäki et al. (2016), Jofri et al. (2020), and Khan et al. (2021), widely recognized this concept. They emphasize the importance of problem-solving, communication, content creation, collaboration, and knowledge sharing. Moreover, digital competence includes creativity, ethics, flexibility, and reflectiveness, essential across different life aspects, including work, education, and community engagement. In recent years, the global emphasis on digital competence has grown, particularly in developing countries in Europe,

and is recognized as a necessary skill for almost all job types (Commission, 2016; Hamid et al., 2021). In response to this need, Europe has developed "*The European Framework for the Digital Competence of Educators (DigCompEdu)*," a tool designed to enhance the digital skills of educators and foster educational innovation. This framework helps standardize digital competency among educators across European member countries, ensuring they possess the distinct digital skills required to harness technology in education effectively. Hence, digital competence is foundational to the digital transformation of TVET. By equipping educators with the necessary digital skills, frameworks like DigCompEdu are vital in driving educational innovation and ensuring that TVET institutions can effectively integrate and utilize digital technologies to enhance learning outcomes.

## 2.6 Challenges and Issues Among TVET Educators About Adaptation of Digitalization

The rapid evolution of technology presents significant challenges for educators, particularly in the context of TVET (Grollmann & Rauner, 2007). Research consistently shows that many educators struggle to adapt to the latest technological trends due to a lack of specialized knowledge and expertise (Valtonen, 2011; McLoughlin, 2011; Miller, 2012; Ledger, 2020; Cordova, 2021). This skills gap is particularly pronounced in TVET, where educators often lag behind the technological advancements necessary to enhance educational performance (Obwoye, 2016). A critical issue identified by Majumdar (2011) is the technology gap between students, who have grown up with rapid technological advancements, and educators, who may not have had the same exposure to modern technology during their formative years. This disparity can create challenges in effectively integrating digital tools into the classroom, as students tend to be more technologically and informationally literate than their teachers (Allen et al., 2010). In Malaysia, the situation is particularly concerning for TVET educators, who may not be fully equipped to meet the digital demands of future educational challenges. Studies by Cattaneo et al. (2022), Thangaiah et al. (2020), and Kanwar et al. (2019) highlight the potential of the digital gap among educators to hinder the implementation of a primarily digital education revolution. Artacho et al. (2020) also emphasize that educators' insufficient proficiency in digitization complicates the integration of digital tools in teaching and learning.

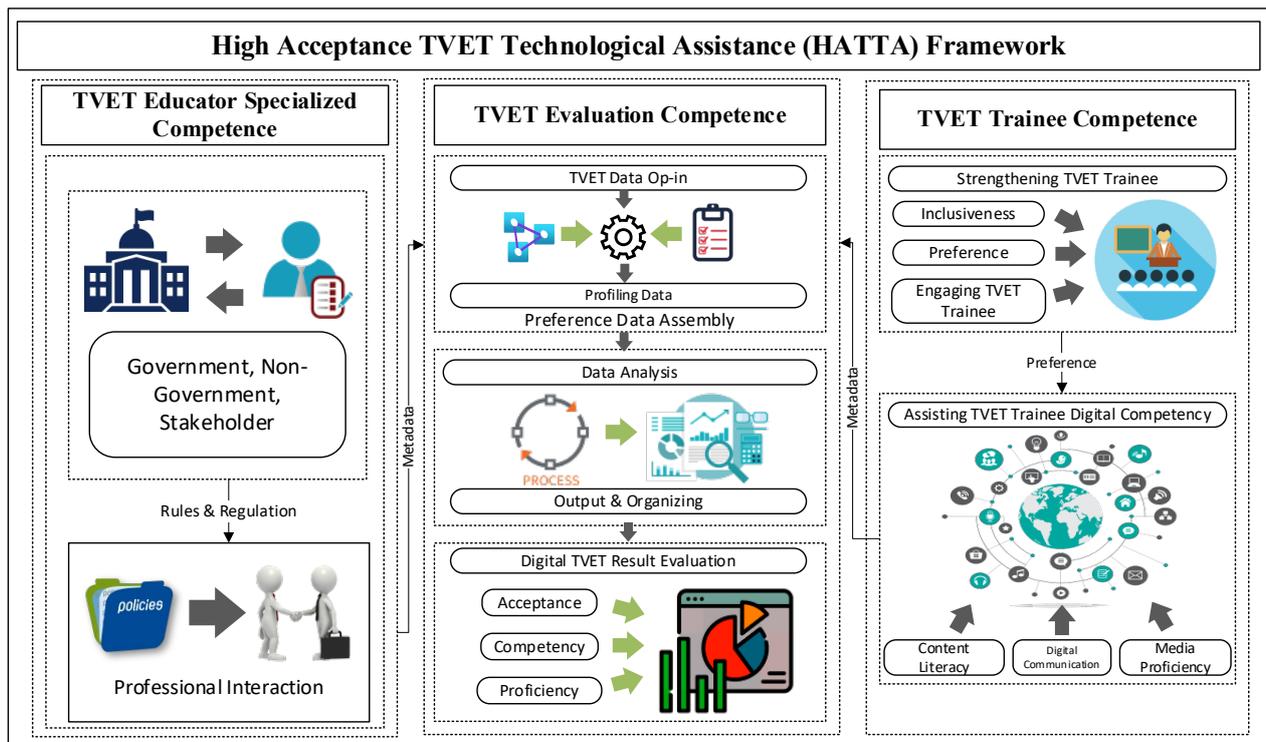
Further research by Rusdin (2018), Li et al. (2019), and Aditya (2021) indicate that inadequate readiness in terms of knowledge, skills, and attitudes can impede effective educational practices. Given these challenges, it is crucial to prioritize building the digital competence of TVET educators to meet the demands of the twenty-first century. Developing digital competency models specifically for TVET educators is essential to bridging the current technology gap and successfully adopting digital tools and practices within TVET. This approach will significantly contribute to the broader goal of digital transformation in TVET, equipping educators with the necessary skills to drive educational innovation and enhance learning outcomes in a rapidly evolving technological landscape.

## 2.7 Efforts and Commitments by The Malaysian Government to Empowering TVET

Significant investments and strategic initiatives underscore the Malaysian government's proactive efforts to strengthen TVET to enhance the program across all levels. As part of the 12th Malaysia Plan (2021), the government allocated RM6.7 billion to TVET projects, demonstrating its commitment to the sector. This dedication is further reflected in a range of policies, including the Malaysian Education Development Plan - Higher Education (PPPM-PT) 2015-2025, which builds on previous strategic plans and aims to elevate the country's higher education system to meet new challenges (Ministry of Education, 2015; Yahya, 2022). A vital aspect of these efforts is the establishment of the National TVET Council (MTVET) in 2020, which aligns with broader governmental initiatives to reform Malaysia's TVET ecosystem. The Malaysia Technical University Network (MTUN), comprising UTHM, UniMAP, UTeM, and UMPA, has collaborated with various TVET institutions to create the TVET 4.0 Framework Book, a strategic guide for navigating the challenges of the Fourth Industrial Revolution (4IR) from 2018 to 2025. This framework outlines six key components that support strategies designed to enhance TVET programs, develop skilled human capital, and contribute to humanitarian efforts. The Malaysian Ministry of Higher Education (KPT) has also developed action plans, including digitization projects, to align with the Malaysia Education Blueprint 2015-2025, the Malaysian Higher Education Action Plan 2022-2025, and the KPT Digitalization Strategic Plan 2021-2025. These plans prioritize the digital transformation of KPT management and operations, addressing current ICT challenges and advancing the delivery system through digital technology. This focus on digital skills is crucial for ensuring that TVET educators can navigate the digital technology transition and contribute to the broader digitization of education. Enhancing educators' digital competence is vital for realizing the full benefits of digitization in education. As Nor et al. (2018) emphasized, the quality of an educational system is closely linked to the commitment and competence of its educators. Thus, Malaysia's comprehensive approach to digital transformation in TVET, supported by substantial government investment and strategic planning, is essential for preparing educators and students to thrive in a rapidly evolving technological landscape.

### 3. High Acceptance TVET Technological Assistance (HATTA) Framework Propose

To ensure the highest quality of learning within the TVET ecosystem, the active support of various stakeholders, including the government, industry, business sector, and non-governmental organizations, is essential. This collaborative effort fosters an environment where educators, students, and support staff thrive in a rapidly digitizing landscape. A new model comprising three phases has been proposed to enhance the effectiveness of the TVET system. These phases include TVET Educator Specialized Competence, TVET Trainee Competence, and TVET Evaluation Competence. As in Figure 1, this model emphasizes the importance of specialized skills for educators, tailored training for students, and a robust evaluation mechanism to ensure that the digital transformation in TVET is comprehensive and practical. The integration of such a model reflects a strategic approach to adopting technology in TVET, focusing on building competencies at multiple levels within the education system. This approach aligns with broader efforts to ensure that TVET institutions are well-equipped to meet the demands of a digitalized workforce and that all participants in the ecosystem are adequately prepared to leverage technological advancements in their respective roles.



**Fig. 1** Propose High Acceptance TVET Technological Assistance (HATTA) framework

Fig. 1 shows several entities involved in the HATTA framework. These entities and all the elements will be explained further as follows:

#### 3.1 Initial Stage: TVET Educator Specialized Competence

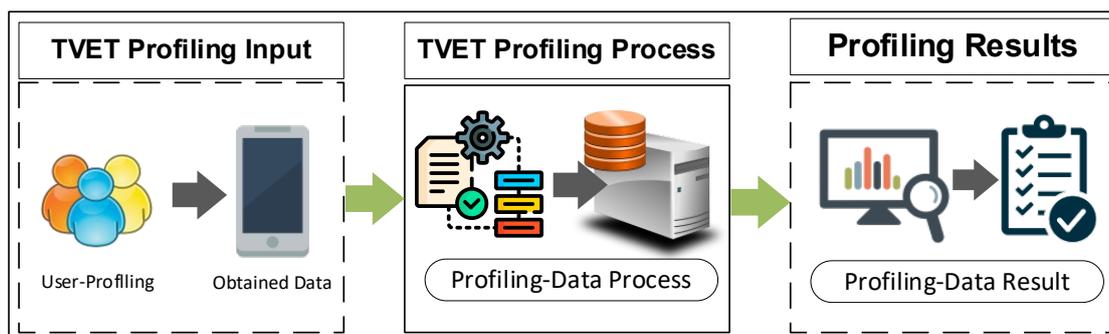
The Malaysian government is committed to advancing the professional development of TVET educators as part of its broader strategy to enhance the TVET system. To initiate these efforts, the government will gather input from various stakeholders, including public and private educational institutions, to assess the overall proficiency of TVET educators. This collaborative approach aims to establish guidelines and standards for the specialized skills required by TVET educators, which will be formalized into significant professional policies. The metadata collection, following stakeholder consensus, marks a critical step in the process, facilitating the transition to subsequent phases of development. This strategy reflects a systematic approach to adopting technology in the digital transformation of TVET, ensuring that educators are equipped with the necessary skills and competencies to effectively integrate digital tools and methodologies into their teaching practices. By involving a wide range of stakeholders and focusing on professional standards, the government aims to create a robust framework that supports the ongoing growth and digital readiness of TVET educators.

### 3.2 Execution Stage: TVET Trainee Competence Footnotes

The government plays a pivotal role in maintaining the stability and efficiency of TVET trainee competence, focusing on three critical elements: financial support, human resources, and facilities. In digital transformation, TVET trainees must prioritize inclusiveness, preference, and active engagement in digital practices. This situation involves strategically planning, designing, and organizing digital technologies to foster collaboration and promote self-directed learning. Key elements contributing to digital competency among TVET trainees include content literacy, digital communication, and media proficiency. These elements are integral to developing digital skills and will be closely evaluated in subsequent phases of the training process. To ensure the success of these initiatives, practical guidance and support measures must be in place to facilitate student-led learning processes. This approach underscores the importance of a well-rounded digital competency framework for TVET trainees, supported by the government's commitment to providing the necessary resources and infrastructure. By focusing on these elements, the digital transformation of TVET can be more inclusive and effective, ultimately enhancing trainees' preparedness for the demands of a digitalized workforce.

### 3.3 Evaluation Stage: TVET Evaluation Competence

In the digital transformation of TVET, data collection and profiling are critical processes that influence the evaluation and effectiveness of competency models. During these stages, raw data transforms to align with the intended modelling objectives, directly impacting data management practices. The quality of data profiling, particularly when involving subjective input from human participants, is essential for obtaining accurate results and feedback. Two primary approaches—subjective and objective—are utilized to ensure profiling quality, with a combination of context-aware measurement methodologies and direct metrics techniques offering a comprehensive capture of data from the user's perspective (Ghadiyaram et al., 2018; Chen et al., 2019). Data profiling in this context is categorized into application-based profiling, which relies on historical numerical data, and event-based profiling, which is gathered in real-time (Peltonen et al., 2015). By integrating user-perspective profiling findings with the expertise of TVET educators, the study seeks to enhance the accuracy and relevance of digital competency models. This approach underscores the importance of meticulous data management and profiling in the broader effort to adopt and implement digital technologies within the TVET ecosystem, ultimately contributing to more informed and effective digital transformation strategies.



**Fig. 2** TVET competency acceptance data profiling sampling experiment

The adoption of technology in the digital transformation of TVET is highlighted by the use of advanced data profiling processes that involve cloud-based systems, as in Fig. 2. The initial step in this process consists of gathering TVET profiling input data, where data sampling is conducted for experimentation. This data is assembled through mobile devices and processed via Microsoft Azure cloud services. Metadata from this phase is transmitted to servers, where it is managed and displayed in real-time on a management dashboard, providing insights into profiling, sampling, and memory usage. In the subsequent data profiling phase, user profiling is set up, and data related to user acceptance is collected. This phase is crucial for TVET competence profiling, where significant parameters are filtered through specific definitions to ensure accuracy and relevance. The use of cloud services like Azure in this context underscores the integration of cutting-edge technology to enhance data management and profiling processes within the TVET framework. This approach facilitates a more sophisticated and effective digital transformation, allowing for real-time monitoring and precise data handling that supports the overall goals of TVET competence development.

**TVET Competence Profiling Definition 1.** A context feature defines user values concerning the profiling capability module and acceptance component. The first primary attribute is the user's or respondent's attitude toward the efficiency of accepting TVET competence.

$$Acc_{D1} = \{PA_{min}, PA_{med} \dots PA_{max}\}$$

$Acc_{D1}$  is defined as the data profiling from the TVET competence profiling acceptance component.  $PA_{min}$  The minimum acceptance profiling elements from the TVET trainee digital competency can be described as the acceptance of media assets from the TVET educator's perspective.

**TVET Competence Profiling Definition 2.** A context characteristic defines user values with the profiling capability module, the competency component. This component is related to the user's or respondent's attitude towards the efficiency of the competency TVET experience.

$$Co_{D2} = \{PC_{min}, PC_{med} \dots PC_{max}\}$$

$Co_{D2}$  is defined as the data profiling from the competency component.  $\{PC_{min}, PC_{med} \dots PC_{max}\}$  An be described as the minimum number, average, and highest number of profiling elements from the integration competency TVET experience, such as the transparency of the respondents' digital literacy knowledge that helps with their job or working experience.

**TVET Competence Profiling Definition 3.** The user values with the profiling capability module proficiency component are a specific context. The vital attribute in this equivalence is the user's or respondent's viewpoint about the proficiency efficiency towards digital literacy among TVET educators, whether it met the minimum requirement, and the definition can be described as follows.

$$Po_{D3} = \{PO_{min}, PO_{med} \dots PO_{max}\}$$

where  $Po_{D3}$  It is well-defined as proficiency component profiling, depending on related competency and acceptance placement.  $\{PE_{min}, PE_{med} \dots PE_{max}\}$  An be described as the minimum number, median, and utmost number of profiling factors from the proficiency TVET educators that affect digital literacy.

**Profiling Definition 4.** The result of  $Acc_{D1}$ ,  $Co_{D2}$  and  $Po_{D3}$  are depending on MOS suitable level ( $MSL$ ) based on the variable finding and user satisfaction towards profiling attributes ( $p_i^q$ ). Where the  $q$  value is an acceptable degree of the user conditions, in this circumstance,  $q$  is set on the respondent MOS solution, and  $i$  is set to the maximum number of respondents.  $p_i^q$  requirement must be attained at least  $p_i^q \geq MSL$ . The whole elements of  $Acc_{D1}$ ,  $Co_{D2}$  and  $Po_{D3}$  can be defined as the *ToTprofiling*.

$$ToTprofiling = \{Acc_{D1} + Co_{D2} + Po_{D3}\}$$

Furthermore, the *ToTprofiling* is an attribute accessibility environment for the total calculated user depending on the  $MSL$  acceptability. The whole data reliability will be covered in the *ToTprofiling*, Furthermore, the results will be analyzed in the next stage.

### 3.4 Analysis Stage

In the context of TVET's digital transformation, adopting stringent testing and validation techniques is critical for ensuring the accuracy and reliability of data profiling. User data, segmented by demographics such as gender and age, undergoes comprehensive testing to assess its reliability and validity. This process employs the Alpha-Cronbach reliability test, which is crucial in verifying the consistency of initial results before advancing to further phases. Such rigorous methods are essential for maintaining the integrity of digital competency assessments, ultimately contributing to the effective integration of technology in TVET education (Ghadiyaram et al., 2019).

The study employs the standardized Mean Opinion Score (MOS), a widely recognized metric referenced by bodies like the International Telecommunication Union (ITU) to gauge user acceptance levels. The MOS provides a scale from 1 to 5, measuring user perception from "Imperceptible" to "Very Annoying". This structured approach to data validation and user feedback is crucial for refining digital tools and technologies within the TVET ecosystem, ensuring they meet the needs and expectations of diverse user groups. By integrating these testing methodologies, the TVET system can more effectively tailor digital solutions to enhance learning experiences and outcomes.

**Table 1** Mean Opinion Score (MOS)

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very Annoying

The Mean Opinion Score (MOS), used to gauge user acceptability, is displayed in Table 1. If the test results are less than 0.6, the reliability is low. The reliability of the survey questions is assessed using Alpha Cronbach tests when utilizing a MOS survey (Som et al., 2017). The number of male and female respondents is equal for the subjective method testing in this pilot study. Both genders provide the 20-sample, and the Alpha Cronbach alpha value is 0.81. Specific algorithms will be used in user acceptance profiling, and this algorithm will measure how satisfied users are with the establishment of outcome data profiles. The suggested algorithm is derived from the user profiling sample general profiling approach. The steps involved in data collecting via a cloud application include device metadata capture, user preference apps, and network capabilities. Despite all other factors, the catered experimentation depends on a reliable connection for the duration of the testing. The proposed algorithm is one of the most important components between these levels. The use of a profiling element in this section also requires the construction of an appropriate algorithm.

**Algorithm 1:** Algorithm for *ToT*profiling

```

1. INPUT: profiling(n) node, accD1, coD2, poD3 ; // parameter input node
2. BEGIN
3. Initialization (n1, accD1) // system check
   session for node 1
4. S ← 0 // initial
   session starting
5. {
6. Enable
7. IF (accD1node < profiling_nodeN1) THEN //node user
   acceptance set up low to medium
8. { user acceptances interchange for node(1)}; // node MOS
   attribute def1
9. ELSE IF (accD1node =< profiling_nodeN2) THEN // node user
   acceptance setup for low to medium to high
10. { user acceptances interchange for node(2)}; // node MOS
   attribute def2
11. ELSE IF (accD1node =< profiling_nodeN3) THEN // node user
   acceptance setup medium to high
12. {user acceptances interchange for node(3)}; // node MOS
   attribute def3
13. ELSE (total_node == nodeProfiling) THEN //
   total_node for MOS attribute acceptance
14. {MOS interchange for total_node(n)}
15. }
16. Initialization (n2, coD2) // system
   check session for node 2
17. S ← 0 // initial
   session starting
18. {
19. Enable
20. IF (coD2node < profiling_nodeN1) THEN //node user
   competency setup low to medium
21. { user acceptances interchange for node(1)}; // node
   MOS attribute def1

```

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```

22.  ELSE IF (coD2_node =< profiling_nodeN2 ) THEN // node user
competency setup for low to medium to high
23.  { user acceptances interchange for node(2); // node MOS
attribute def2
24.  ELSE IF (coD2_node =< profiling_nodeN3) THEN // node user
competency setup medium to high
25.  {user acceptances interchange for node(3)}; // node MOS
attribute def3
26.  ELSE (total_node == profiling ) THEN // total_node for
MOS attribute competency
27.  {MOS interchange for total_node(n)}
28.  }
29.  Initialization (n3_poD3) // system
check session for node 3
30.  S ← 0 // initial
session starting
31.  {
32.  Enable
33.  IF (poD3_node < profiling_nodeN1 )THEN //node user
proficiency setup low to medium
34.  { user acceptances interchange for node(1)}; // node
MOS attribute def1
35.  ELSE IF (poD3_node =< profiling_nodeN2 ) THEN // node user
proficiency setup for low to medium to high
36.  { user acceptances interchange for node(2)}; // node MOS
attribute def2
37.  ELSE IF (poD3_node =< profiling_nodeN3) THEN // node user
proficiency setup medium to high
38.  {user acceptances interchange for node(3)}; // node MOS
attribute def3
39.  ELSE (total_node == profiling ) THEN // total_node for
MOS attribute proficiency
40.  {MOS interchange for total_node(n)}
41.  }
42.  RETURN 0;
43. END

```

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Algorithm 1 shows the adoption of open-source platforms, such as Android, in the digital transformation of TVET is pivotal for customizing and optimizing educational algorithms, such as those used in TVET educator acceptance profiling. The flexibility of the Android platform allows for the manipulation, adjustment, and tweaking of algorithms to better align with research objectives and specific educational contexts. This customization is crucial in ensuring that the profiling and evaluation processes are accurate, reliable, and tailored to the unique needs of TVET educators. By leveraging such open-source technologies, TVET institutions can more effectively implement and refine digital tools, enhancing overall digital competency and acceptance within the sector. The next phase in the profiling process is the initialization of algorithm implementation, where  $V \leftarrow 0$  indicates the start of the session execution. In line 7, **IF** ( $accD1\_node < profiling\_nodeN1$ ) is specified as restricting the TVET educator acceptance node profile and evaluating the user node's MOS demographic capabilities. The *user acceptance interchange for node(1)* node will be executed. Next is in Line 9 **ELSE IF** ( $accD1\_node =< profiling\_nodeN2$ ), where the *node user acceptances interchange for node(2)* Will be performed for the profiling, and lastly is the **ELSE IF** ( $accD1\_node =< profiling\_nodeN3$  ) where the profiling *user acceptances interchange for node(3)* is executed for the final results. In line 13, the **ELSE** ( $total\_node == nodeProfiling$ ) will be performed based on all three nodes that have been executed. In lines 16 and 29, the profiling algorithm is similar to line 3 for acceptance, competency, and proficiency. The next step is to define user profiling as TVET educators for experiment results.

## 4. Experiment Setup and Results

### 4.1 User Profiling

In the setting for user acceptability, the experiment's user profile demography is initially selected. Since several nodes are available, this study groups the user profiling settings according to responder region characteristics. The automatic establishment or modification of the profile node property, such as the financial components and facility, will depend on the user's requirements. When choosing a degree of happiness between 1 and 5, the user will be given a choice to allow control within the programs and the MOS methods for user satisfaction.

**Table 2** User acceptance profiling demographics for MOS experiments

Sampling Respondents	$N_1$	$N_2$	$N_3$
<i>TVET Respondents (Tp<sub>1</sub>)</i>	<i>Profiling Data (n<sub>1</sub>)</i>	<i>Profiling Data (n<sub>2</sub>)</i>	<i>Profiling Data (n<sub>3</sub>)</i>
	$\sum \mu = 4.45$	$\sum \mu = 3.71$	$\sum \mu = 2.31$
Male = 40	$\sum \mu = 4.42$	$\sum \mu = 3.12$	$\sum \mu = 2.52$
Female = 40			
<i>Demographic (Ap)</i>			
Male	$\mu = 40.8$	$\mu = 38$	$\mu = 40$
Female	$\mu = 38.2$	$\mu = 39$	$\mu = 37$

$\sum \mu$ : average of profiling  $n$  data;  $\mu$ : average/mean.

Table 2 shows the user acceptance profiling for MOS experiments and the random sampling with the average number of demographic respondents for data profiling. Forty male and female respondents were gathered for the TVET educators' profiling results. The sampling respondents are divided into three groups for preference data assembly: acceptance data, competency data, and proficiency data from sampling.  $\sum \mu$  shows the average of profiling respondents in the TVET educators while  $\mu$  represents the average/mean of respondents' ages. The average profiling data for male  $N_1 \sum \mu$  is 4.75,  $N_2 \sum \mu$  is 3.2, and  $N_3 \sum \mu$  is 2.31. The female respondent's results are  $N_1 \sum \mu$  is 4.42,  $N_2 \sum \mu$  is 3.12, and  $N_3 \sum \mu$  is 2.52. The average age for both respondents is around 30 to 45 in the age demographic.

**Table 3** User competency profiling demographics for MOS experiments

Sampling Respondents	$N_1$	$N_2$	$N_3$
<i>TVET Respondents (Tp<sub>1</sub>)</i>	<i>Profiling Data (n<sub>1</sub>)</i>	<i>Profiling Data (n<sub>2</sub>)</i>	<i>Profiling Data (n<sub>3</sub>)</i>
	$\sum \mu = 4.51$	$\sum \mu = 3.6$	$\sum \mu = 2.1$
Male = 40	$\sum \mu = 4.22$	$\sum \mu = 3.8$	$\sum \mu = 2.2$
Female = 40			
<i>Demographic (Ap)</i>			
Male	$\mu = 41.8$	$\mu = 39.6$	$\mu = 38$
Female	$\mu = 38.2$	$\mu = 38.3$	$\mu = 37.5$

$\sum \mu$ : average of profiling  $n$  data;  $\mu$ : average/mean;

Table 3 shows the user competency profiling for MOS experiments and the random sampling with the average number of demographic respondents for data profiling. Forty male and female respondents were gathered for the TVET educators' profiling results.  $\sum \mu$  shows the average of profiling respondents in the TVET educators while  $\mu$  represents the average/mean of respondents' ages. The average profiling data for male  $N_1 \sum \mu$  is 4.51,  $N_2 \sum \mu$  is 3.6, and  $N_3 \sum \mu$  is 2.1. Female respondent's results are  $N_1 \sum \mu$  is 4.22,  $N_2 \sum \mu$  is 3.8, and  $N_3 \sum \mu$  is 2.2.

**Table 4** User proficiency profiling demographics for MOS experiments

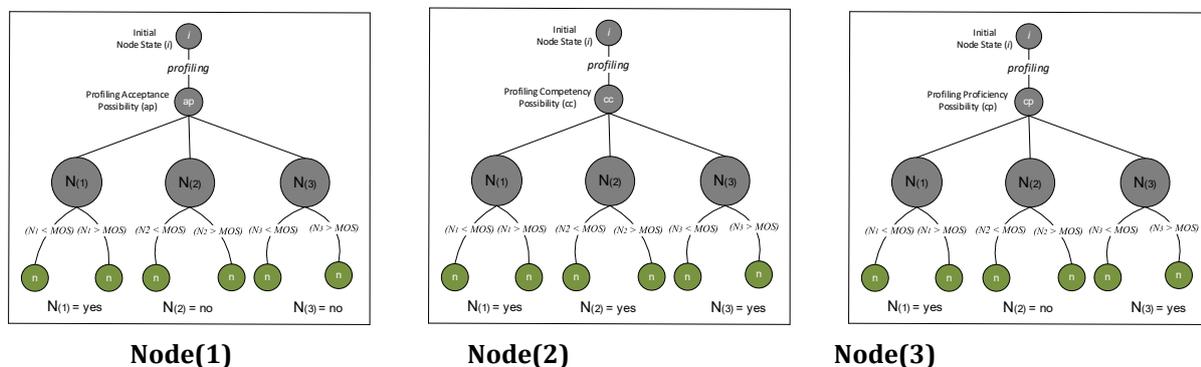
Sampling Respondents	$N_1$	$N_2$	$N_3$
TVET Respondents ( $Tp_1$ )	Profiling Data ( $n_1$ )	Profiling Data ( $n_2$ )	Profiling Data ( $n_3$ )
Male = 40	$\sum \mu = 4.1$	$\sum \mu = 2.98$	$\sum \mu = 2.11$
Female = 40	$\sum \mu = 4.05$	$\sum \mu = 3.02$	$\sum \mu = 2.2$
Demographic ( $Ap$ )			
Male	$\mu = 39.8$	$\mu = 39$	$\mu = 39.5$
Female	$\mu = 37.2$	$\mu = 39$	$\mu = 37$

$\sum \mu$ : average of profiling  $n$  data;  $\mu$ : average/mean;

Table 4 shows the user proficiency profiling for MOS experiments and the random sampling with the average number of demographic respondents for data profiling. Forty male and female respondents were obtained for the TVET educators profiling results.  $\sum \mu$  shows the average of profiling respondents in the TVET educators while  $\mu$  represents the average/mean of respondents' ages. The average profiling data for male  $N_1$   $\sum \mu$  is 4.1,  $N_2$   $\sum \mu$  is 2.98, and  $N_3$   $\sum \mu$  is 2.11. Female respondent's results are  $N_1$   $\sum \mu$  is 4.05,  $N_2$   $\sum \mu$  is 3.02, and  $N_3$   $\sum \mu$  is 2.2. The next stage is to set up the experiment for profiling the node method based on the respondents' findings after completing the profiling instruments element from the node capability selection and the user profiling.

### 4.1 Nodes Profiling

The information gleaned from the user profiling will be used in node profiling, where the node will be assessed using the node technique. The setup of the experiment begins with the simulated environment. The uninterrupted use of the laboratory space for testing forms the basis of the first experiment. The initial step in the configuration is to set up the network cloud server for the profiling session. This option was chosen due to its stability and absence of complex setup requirements. Developers must set up the trials, but it will be less expensive than buying a server altogether. The entire node sampling will then be added to this server for profiling analyses. The data transfer sampling rate for transcoding will be steady depending on the server used for this profiling. The user profile demography for experimentation is first chosen in the setup for user acceptability. This study categorizes the user profiling setting based on the responder region characteristic since numerous nodes are available there. Three different node profiling results have been given to the user profile demography for experimentation, first chosen in the setup for user acceptability for TVET educators' results. Figure 3 shows the node profiling of three TVET educator node profiling results from categories. The node is categorized depending on the three main elements attribute (node profiling" "="{"  $[\sum \mu]$  \_acc+  $[\sum \mu]$  \_Co+  $[\sum \mu]$  \_Po}) that related to the study proposed. First is  $[\sum \mu]$  \_acc is defined as user acceptance profiling while  $[\sum \mu]$  \_Co is defined as user competency profiling, and lastly  $[\sum \mu]$  \_Po can be defined as user proficiency profiling respectively.



**Fig. 3** Three categories of TVET educator's node profiling results: Node(1): Node acceptance; Node(2): Node competency; Node(3): Node proficiency

The node profiling, It will be auto-set or manipulated by the users to determine the level of user satisfaction. Additionally, this method deliberates factors that directly affect the user opinion through the TVET educator's satisfaction node results depending on elements (e.g., acceptance, proficiency, and competency quality). Figure 3 shows the three essential node profiling elements for the TVET educator's satisfaction with the experiment. The first element is node 1, as the  $\sum \mu_{acc}$ . Node 1 shows the increments of the diverse nodes increasing into three nodes

for user acceptance. There is only one acceptance node in this profiling method. Next, the subscript base, sum mu, end base, and the  $\sum\mu_{Co}$  represent the competency profiling node and the factor that affects the TVET educators in the results. There are three profiling satisfaction results for this node. The last profiling node experiment is the  $\sum\mu_{Po}$  elements that represent node 3 for this matter. The profiling result shows that only two nodes are acceptable for node profiling satisfaction. All these results will be presented in the following analysis using a linear regression method, which will depend on the TVET educators versus MOS.

### 4.2 Linear Regression Analysis for TVET Educators MOS Results

After the overall experimentation result has been attained, the next step is to build a relationship between the user's acceptance and the element's effectiveness. The slope value must first be considered before the values of  $\beta_0$  and  $+\beta_1$  are found. To determine the value of the  $\sigma$  (average TVET profiling results). The efficiency of the elements depends on the value of  $x$ , while the MOS result determines the value of  $y$ .

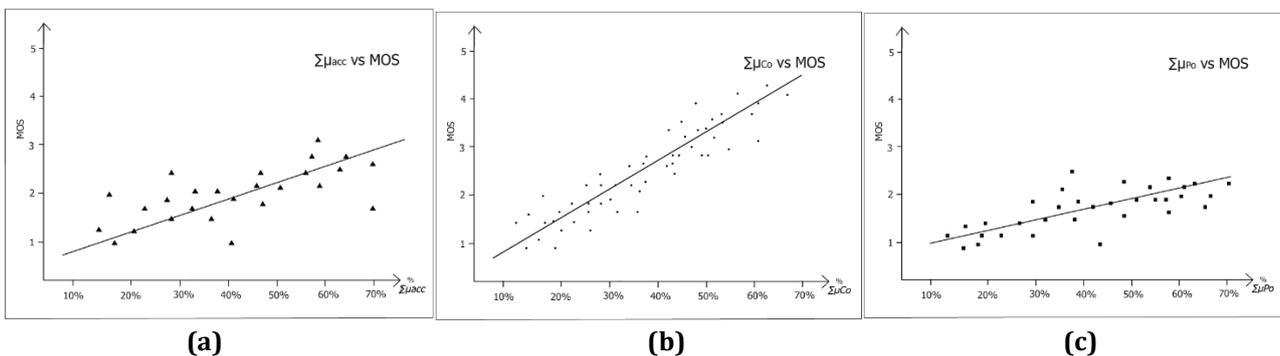
$$\sigma = \sum \frac{(x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

Where  $\sigma$  represents the least square method.  $\bar{x}$  is the mean value of  $x$ , and  $\bar{y}$  is the mean of  $y$  value. The total of  $(x - \bar{x})^2$  and  $(x - \bar{x})(y - \bar{y})$  will be derivatives on equation  $\sigma$  for the value of  $\beta_0$ . The least-square method is the technique to measure the regression line (line of best fit) possibility. It will be done by assembling the whole square of the errors as minor as possible. Usually, the common use of the least-squares method, denoted as linear or a straight line lessens the sum of the squares of the errors.

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$$\sigma = \sum \frac{(x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

Where  $\sigma$  represents the least square method.  $\bar{x}$  is the mean value of  $x$ , and  $\bar{y}$  is the mean of  $y$  value. The total of  $(x - \bar{x})^2$  and  $(x - \bar{x})(y - \bar{y})$  will be derivatives on equation  $\sigma$  for the value of  $\beta_0$ . The least-square method is the technique to measure the regression line (line of best fit) possibility. It will be done by assembling the whole of the square of the errors as small as possible. Usually, the common use of the least-squares method, denoted as linear or a straight line lessens the sum of the squares of the errors.



**Fig. 4** Linear regression results of TVET results (a)  $\sum\mu_{acc}$  VS MOS; (b)  $\sum\mu_{Co}$  VS MOS; and (c)  $\sum\mu_{Po}$  VS MOS

Figure 4 depicts the linear regression results of TVET results (a)  $\sum\mu_{acc}$  VS MOS, (b)  $\sum\mu_{Co}$  VS MOS, and (c)  $\sum\mu_{Po}$  VS MOS. (a) Results show a decline in the linear regression line, where most of the average MOS experiment results are below three (3) values. (b) results show the progressive line trend where almost all results are in three (3) MOS values or above. The last linear regression line (c) result shows the average result upside and below the three (3) values of MOS. The result displayed by calculating the average of linear regression =  $\{(a), (b), (c)\}$  is simple to calculate by converting the value of  $R^2$  for linear regression. By using the *RapidMiner* tool,  $R^2$  can be calculated. Since the dependent and independent variables of  $\beta_0$  and  $+\beta_1$  values are included in the regression, the calculation is based on the equation below.

$$R^2 = \frac{\sum (\hat{y} - y)^2}{\sum (y - \bar{y})^2}$$

Where  $R^2$  is the R-square of  $\beta_0$  and  $+\beta_1$  values,  $\hat{y}$  is the anticipated  $y$  value, and  $y$  is the definite value.  $R^2$  is defined as a percentage value; the value = 0 depends on data reliability and cannot fit actual data. Otherwise, the value = 1, explaining that the data perfectly fits with accurate data. The expected data for  $R^2$  is around 0.6, at least for the calculation to achieve fitting data. The first result of (a)  $\sum \mu_{acc}$  VS MOS shows an average of below MOS results of 2.97 MOS. For the second result of regression of (b)  $\sum \mu_{co}$  With an average of 3.68 MOS, VS MOS shows an upward trend. Lastly is the (c)  $\sum \mu_{po}$  VS MOS with an average of 3.02 MOS results. These results reflect the relationship between MOS and the TVET educator's element percentages. The higher the percentage of TVET educator's element increases, the more MOS results that satisfy user satisfaction.

## 5. Discussion

$\sum \mu_{acc}$  VS MOS: The user's acceptability is relatively low for the average result of MOS because of the poor quality of the profiling node attribute for TVET educators' results. In addition, the respondents have no control over modifying node features, such as how the designed survey is carried out and how the pieces relate. The findings indicate a low performance regarding TVET educators' acceptance by large groups of people. In this situation, all respondents lacked expertise or a better understanding of the value of digital TVET for educators and teachers seeking practical classroom experience that will aid them today.

$\sum \mu_{co}$  VS MOS: The second analysis concerns the TVET educator competency with the highest linear regression results. The elements shown most related to the subject for TVET educators are digital communication, content literacy, and media proficiency. All these three elements are combined with the TVET educator's expertise to produce a suitable educator for modern education. Digital communication for TVET educators is a powerful tool that helps them reach all the trainers locally and globally. Along with content literacy, TVET educators must be able to create and maintain non-online teaching content for their trainees. All The respondent's results state that the average number of the  $\sum \mu_{co}$  VS MOS is more than sufficient for TVET educators with an above score of 3 MOS results.

$\sum \mu_{po}$  VS MOS: The third analysis on TVET educators gives the average regression result between 3 MOS results. As for the proficiency of TVET educators, most respondents felt that these elements must be fulfilled after the competency for TVET educators is achieved. The digital communication, content literacy, and media proficiency elements for each TVET educator must be in place and obtained before educators have more experience and master the proficiency. For example, as a teacher or TVET educator, the basics of digital content creation, such as online video learning, are necessary for the skillset to be a perfect educator. After some experience, TVET educators can explore more content, such as augmented reality for teaching proposes.

With the resources at hand, all the parts of the TVET educator still need to be improved; nonetheless, the results of these elements touch on one crucial feature, namely the stability of the available resources. The first elements that must be encouraged to the TVET educator are (b)  $\sum \mu_{co}$  VS MOS. Competency is important to the educator in three components (digital communication, content literacy, and media proficiency). The next important elements after the analysis can be concluded are (c)  $\sum \mu_{po}$  VS MOS where TVET educators must be improved at (b)  $\sum \mu_{co}$  VS MOS first before mastering the (c)  $\sum \mu_{po}$  VS MOS. The third element after both are improved then the element of (a)  $\sum \mu_{acc}$  VS MOS must be in place for acceptability. Since the framework of this study is related to acceptance, the final element that all the TVET educators must be admitted (a)  $\sum \mu_{acc}$  VS MOS is for the better educator. TVET is a continual training and professional development program incorporating secondary, post-secondary, and workplace-based education. TVET also involves several community skill developments to help a nation's TVET sector thrive. TVET is a kind of education and training concentrated on job-related skills. To better educate TVET graduates for the future, a TVET educator's abilities must be indirectly reinforced by adapting diverse technical skills to the demands of the moment.

The study provides valuable insights for educators, policymakers, and educational technology developers. For Educators, adopting digital tools should be strategically integrated into vocational training to enhance hands-on skills and practical knowledge retention. Incorporating interactive learning platforms, digital simulations, and adaptive assessment tools can improve student engagement and competency development. For Policymakers: The findings highlight the need for structured digital competency frameworks tailored to TVET educators. Government bodies and institutions should invest in targeted professional development programs, provide infrastructure support, and implement standardized policies that align with Industry 4.0 demands. For Educational Technology Developers: There is a need for user-friendly, customizable digital platforms that cater specifically to TVET educators. The development of AI-driven adaptive learning systems, virtual reality (VR)-based vocational training tools, and data analytics dashboards for real-time performance tracking can significantly enhance the effectiveness of digital transformation in TVET.

While this research provides valuable contributions, several limitations must be acknowledged. First is about the sample diversity, where the study focuses on Malaysia Technical University Networks (MTUN), which may limit the generalizability of findings to other regions or educational institutions. Secondly, subjective assessment, where the use of MOS scoring relies on self-reported data, may introduce bias and variability in user responses. Finally, the longitudinal impact where the study does not account for long-term digital competency retention or the sustained impact of technology integration on educational outcomes.

To further strengthen the findings, future research should focus on several areas. The first is about expanding the study across different TVET institutions and global contexts to assess the effectiveness of digital competency frameworks in diverse educational and economic environments. Secondly, longitudinal studies to evaluate the long-term impact of digital skills training on educators' teaching effectiveness and student learning outcomes. Thirdly, exploring AI and predictive analytics to refine MOS-based user acceptance models, allowing for personalized digital competency assessments. Finally, investigate the role of emerging technologies such as VR/AR-based vocational training in enhancing practical skill acquisition and real-world application.

## 6. Conclusion

This study highlights the critical role of digital competency in enhancing TVET education. It proposes the High Aptitude TVET Technology Assistance (HATTA) framework as a structured approach to integrating digital tools into vocational training. The findings emphasize that improving educators' digital proficiency leads to greater educational satisfaction and more effective learning experiences for students. By employing Mean Opinion Score (MOS) analysis and linear regression modelling, this study establishes a direct correlation between user acceptability of digital technologies and TVET educator satisfaction.

On top of that, this study also reinforces the importance of systematic digital integration in TVET education, providing a blueprint for enhancing educators' digital proficiency through the HATTA framework. By addressing policy gaps, refining educational technologies, and fostering continuous professional development, stakeholders can ensure a sustainable digital transformation in TVET. Moving forward, collaboration between educators, institutions, and technology developers will be crucial in bridging digital competency gaps, ultimately preparing TVET graduates for success in a rapidly evolving workforce.

## Conflict of Interest

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

## Author Contribution

*The authors confirm their contribution to the paper as follows: **Introduction, study conception and design:** Mohd Hatta Md Hani, Affero Ismail; **Literature Reviews:** Mohd Hatta Md Hani, Sam Faheeda Abdul Samad; **High Acceptance TVET Technological Assistance (HATTA) Framework Propose:** Mohd Hatta Md Hani, Affero Ismail, Mohd Azahari Mohd Yusof; **Experiment Setup and Results:** Mohd Hatta Md Hani, Anwar Hafidzi, Mohd Azahari Mohd Yusof; **Discussion and conclusion:** Mohd Hatta Md Hani, Anwar Hafidzi **Draft manuscript preparation:** Mohd Hatta Md Hani, Sam Faheeda Abdul Samad. All authors reviewed the results and approved the final version of the manuscript.*

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