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Adaptive Strategies for Technical and Vocational Education and Training (TVET) Science Educators: Navigating Online Home-Based Learning

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ABSTRACT

Skills for teachers in Information and Communication Technology (ICT) skills are crucial because they represent a facet of their creativity in manipulating applications to entice students to focus more on their teaching and learning processes. Numerous instructors and pupils were ill-equipped to utilize virtual classrooms, especially during the pandemic outbreak. The purpose of this study was to determine the relationship between teachers' ICT knowledge (TPACK Model) and utilization (TAM Model) in the field of refrigeration and air conditioning as one of the educational topics in science during the implementation of online home-based learning at Technical and Vocational Education and Training (TVET) institutions. The level of teachers' ICT knowledge and utilization was determined. The results indicated that these instructors had a comprehensive comprehension of and proficiency with ICT. Overall, teachers have a high level of ICT knowledge and ICT usage. In addition, there is indicated a moderately strong correlation between ICT knowledge and usage among TVET teachers at this institution. The results of the study indicate that teachers' ICT knowledge influences their adoption of ICT usage.

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1. INTRODUCTION

Malaysia's education system is presently undergoing a transformation towards education that uses information and communication technology (ICT) as a medium for teaching and learning. The establishment of the Multimedia Super Corridor (MSC) in 1996 acted as a catalyst for the development of ICT in Malaysia, as numerous initiatives guided by ICT were introduced and deployed by teachers to make the teaching and learning process more enjoyable. The phenomenon of online home-based learning is a novel practice that teachers and pupils have recently encountered. Therefore, teachers must effectively plan their lessons to meet the requirements of students with varying levels of knowledge and mastery (Tay *et al*., 2021). This motivates teachers to attempt, find, and learn strategies that can be implemented in the classroom to attract students. The Malaysia Education Development Plan 2013-2025 outlined their hopes for utilizing ICT to enhance the quality of learning in Malaysia (Anamalai and Yatim, 2021). Consequently, the use of ICT in education in Malaysia has increased over the past 15 years (Anamalai and Yatim, 2021).

Online home-based learning in Malaysia began when the virus that caused the health calamity named COVID-19 was also known as the coronavirus (Gunther *et al*., 2020). According to UNESCO, the virus has caused a global epidemic, which has affected teaching and learning in schools worldwide (Mazlan *et al*., 2021; Antoninis *et al*., 2020). As a result, when the world was shocked by this pandemic, the entire national system, including Malaysia, was also affected, particularly in the field of education, as they had to undergo and adapt to the new norm in terms of teaching and learning strategies, particularly in online home-based learning following the Ministry of Education Malaysia's guidelines. The teaching and learning process through online home-based learning has been delivered through the use of digital technology and the internet where the material delivered using this media has text, visual graphics, words, animation, video, and audio based on computer technology resources and equipment (Azhar and Hashim, 2022).

Nevertheless, many instructors and students were unprepared to utilize virtual classrooms, particularly during the pandemic outbreak (Mansor *et al*., 2021). Home learning sessions with primary school pupils who still require guidance present even greater constraints. Due to the pandemic, online home-based learning is the most appropriate method for pupils who must study at home. This poses a challenge from every conceivable angle for both educators and parents. At the teacher level, likely, students do not adhere to the set learning time without parental supervision, and students may lose concentration because they are at home. At the same time, parents face the challenge of providing internet access for their children as well as influencing them, which has an impact on the entire online home-based learning process (Liu, 2021). In addition, failure to locate resources directly related to a lack of teacher training or reluctance to use technology as a true teaching tool in the classroom will negatively impact student achievement (Hu *et al*., 2022).

The characteristics of online home-based learning are contingent on the use of ICT instruments in online learning (Wen *et al*., 2021). According to Song *et al*. (2016), online learning complicates the situation for educators because the approach behavior has changed in terms of pedagogical contexts such as communication, expression, eye contact, smiles, physical distance, movement, and content in teaching. According to Moorhouse (2020), the primary challenge in implementing online learning is the absence of ICT expertise and experience among educators. Since the introduction of ICT in education, issues regarding teachers' difficulties with ICT have become a common topic in teacher training (Ja'ashan, 2020). According to Ghavifekr *et al*. (2016), the issue of ICT training among teachers arises

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due to a lack of training on digital aspects, a lack of pedagogical training using ICT in the classrooms, and a lack of training related to the use of technology in certain subjects, which prevents them from utilizing ICT in the teaching and learning process.

In the Technical and Vocational Education and Training (TVET) environment, this new norm creates difficulties for students' stream, particularly for the implementation of assignments and practicals that require special equipment and a workshop or laboratory, as the majority of programs offered by TVET institutions involve practical activities that cannot be completed online because students cannot do them themselves (Yeap *et al*., 2021). The implementation of ICT among TVET students is more effective in developing cognitive learning compared to occupational hands-on skills (Ghavifekr and Yulin, 2021). As a result, students can only observe their lecturers' demonstrations and communicate online, with the possibility that they do not comprehend the lecturers' true meaning or purpose. Due to the increasing market demand, particularly in the industrial sector, the country is in urgent need of human capital with advanced vocational knowledge and skills. Education in TVET is a means of cultivating highly skilled, knowledgeable, and innovative human capital that is capable of confronting global and regional competition and risks (Weiwei, 2022). In tandem with the current demand, the nation's performance is robust, and this cannot be met if the human capital in the TVET sector is deficient due to students' lack of competency during a pandemic outbreak.

As a result, teachers in TVET institutions are not exempt from the successful transformation of education in TVET; rather, their ICT skills should be emphasized as a means of enhancing their teaching and learning processes (Hassan *et al*., 2021). The significance of ICT as an instrument for the learning process must be consistent with the ever-changing ICT landscape in education. Incorporating electronic media into the learning process increases the process's productivity and fascination for students. Using a technology that unifies voice, audio, picture, video, and text approaches can make the learning process more engaging and entertaining (Ashima, 2021).

Because the number of teachers, particularly in the TVET sector, with adequate ICT skills is still low and the majority of applications used for online home-based learning are based on the most cutting-edge technology (Prasad, 2023), it is necessary to conduct this study. According to Mansor *et al*. (2021), many instructors in Malaysia are not yet prepared for the implementation of online home-based learning due to the significant change in approach. Thannimalai and Baloh (2021), stated that teachers face problems during online home-based learning where the use of applications provided by the Ministry of Education Malaysia requires a high level of ICT knowledge and no resources or guidelines can be referred to help implement the teaching and learning process. In addition, instructors were not required to participate in a training program before the application's implementation to ensure that they were competent with its use. To plan for changes in the field of education that will occur as a result of natural disasters or changes in the education sector, teachers in the field of TVET must have a high level of knowledge about ICT (Akther, 2022).

To determine the relationship between teachers' ICT knowledge (Technological Pedagogical Content understanding (TPACK) Model) and usage (Technology Acceptance Model (TAM) Model) in the field of refrigeration and air conditioning at TVET institutions in and around Johor, Malaysia, this study was conducted. Online applications like Google Classroom and Zoom have become the platform of choice for online home-based learning by instructors (Husni *et al*., 2020). Moreover, many applications or platforms can aid teachers in facilitating online home-based learning, but the majority of them require teachers to possess virtuous ICT skills, which has become one of the greatest obstacles for some educators (Kundu and Bej, 2021).

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Typically, a conceptual framework is proposed and used as a guide to accomplish the study's research objectives. The variable factors were examined using two models of ICT knowledge: the TPACK Model (Mishra and Koehler, 2006) and the ICT usage through the TAM Model (Davis, 1989). In the input phase, the ICT knowledge and utilization level of refrigeration and air conditioning teachers at TVET institutions in and around Johor, Malaysia will be discussed. The conceptual framework aims to conduct an exhaustive analysis of the relationship between independent variables and dependent variables in the context of ICT (Fadel *et al*., 2022). **Figure 1** depicts the conceptual framework of the study, which was created to illustrate the overall concept of this study.

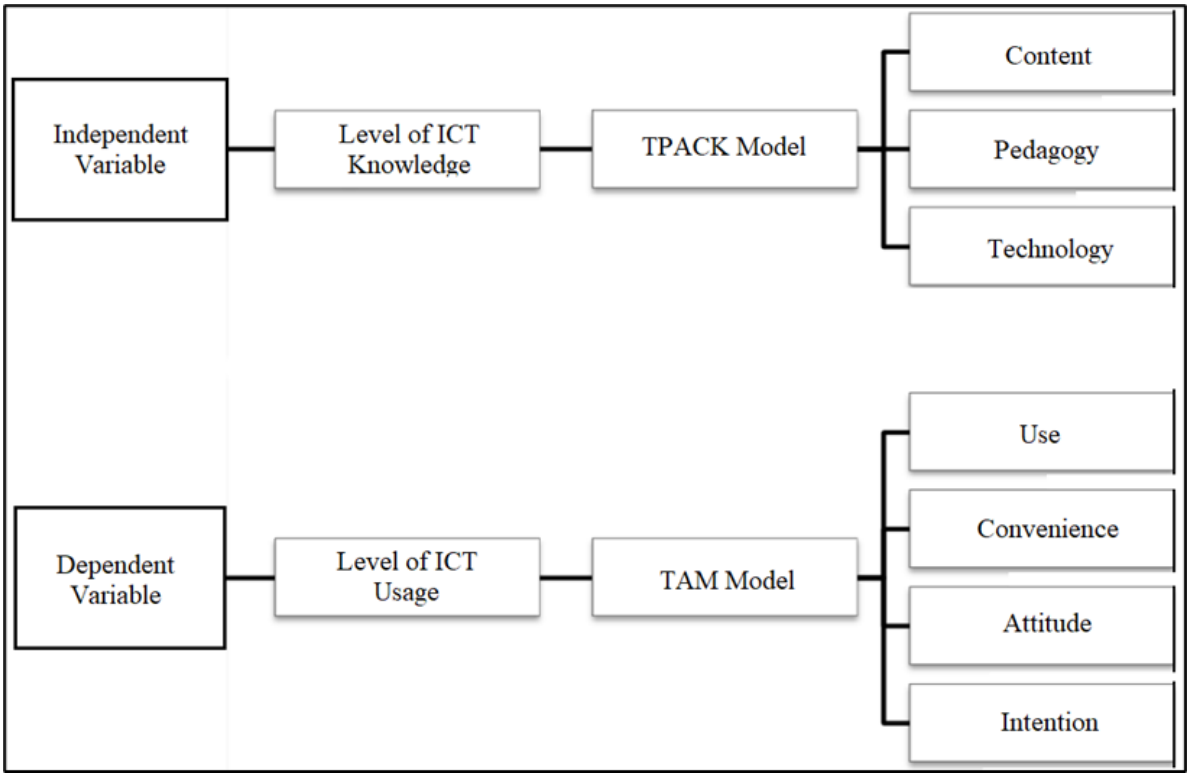

Figure 1. Conceptual framework of the study.

The relationship between the independent factors and dependent variables is elucidated by the conceptual framework, as depicted in Figure 1. The TPACK Model, proposed by Mishra and Koehler (2006), emphasizes the significance of possessing knowledge in content, pedagogy, and technology for TVET teachers. This knowledge is essential in maintaining a proficient level of ICT competence among teachers, as it enables them to comprehend the complexities associated with educational technology and fosters the development of innovative problem-solving approaches within educational contexts (Drajati *et al*., 2018). The content element pertains to the teacher's possession of content knowledge, whereas the pedagogical element pertains to the teacher's knowledge of pedagogical practices in teaching and learning. Finally, the technological component pertains to the teacher's proficiency, abilities, and perspectives about the utilization of technology in forthcoming times.

The TAM Model Davis (1989) was employed to assess the amount of teacher ICT usage. This model is particularly suitable as it enables the measurement of several elements that impact an individual's acceptance of ICT, with a specific focus on a teacher's attitude towards incorporating ICT in educational settings. Furthermore, the TAM can provide insight into the factors influencing teachers' behaviors about their beliefs, attitudes, and intentions towards the utilization of ICT. The TAM model encompasses four distinct conceptual clusters that aim

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to elucidate the variances and objectives of individuals utilizing ICT. These clusters are centered around the factors of use, convenience, attitude, and intention. The TAM demonstrates the correlation between the usability of ICT and individuals' intentions and behaviors about its usage. Furthermore, it has been empirically validated as a theoretical framework that aids in comprehending and forecasting consumer behavior during ICT interactions (Ritter, 2017). Thus, the primary aim of this study was to:

(i) Determine the proficiency of TVET instructors in ICT during the execution of remote, web-based educational instruction.
(ii) Determine the extent to which TVET teachers utilize ICT in the context of online home-based learning implementation.
(iii) Examine the correlation between the proficiency of TVET educators in ICT and their utilization of ICT tools in the context of online home-based learning.

2. METHODS

The study employed a quantitative methodology to get definite and irrefutable evidence through statistical analysis (Hou and Aryadoust, 2021). The study employed a survey design as the chosen approach for data collection to achieve the research objectives. The researcher in this study has employed random sampling as the chosen sampling technique. Random sampling utilizes randomization, ensuring that every individual within the population has an equal opportunity to be included in the selected sample. The present study pertains to a population-based investigation, specifically targeting a sample of 38 teachers affiliated with refrigeration and air conditioning programs across five TVET schools in Johor, Malaysia. The selection of these participants was conducted by a random sampling method. Rampazzo and Beghi (2018) assert that the discipline of refrigeration and air conditioning offers students comprehensive instruction encompassing both theoretical and practical aspects of refrigeration and air conditioning systems. According to Rosado and Levinson (2019), the discipline of refrigeration and air conditioning, commonly referred to as HVAC (Heating, Ventilation, and Air Conditioning), holds significant significance in the United States. The authors assert that competence and research in this sector are crucial for the nation. According to Neupane (2020), the domain of refrigeration and air conditioning is identified as one of the six key areas of emphasis in TVET.

The questionnaire serves as the primary data collection instrument in this study due to its suitability in addressing research questions and achieving research objectives. It is commonly employed as a standardized tool and ensures consistent interpretation among all respondents (Shrestha, 2021). In this study, a custom-designed instrument was utilized, comprising three distinct sections labeled Part (A), Part (B), and Part (C), encompassing a total of 28 individual items. Section (A) of this survey aims to gather information about the demographic characteristics and personal background of the respondents. In contrast, Section (B) aims to evaluate the level of ICT knowledge among TVET teachers during the implementation of online home-based learning. This assessment is conducted by modifying the TPACK Model, as proposed by Mishra and Koehler (2006). The objective of Part (C) is to assess the extent to which TVET teachers utilize ICT during the implementation of online home-based learning. This will be achieved by applying the TAM developed by Davis in 1989.

To assess the reliability of the instrument, the researcher has sought input and validation from three professionals specializing in the content area, specifically lecturers and language specialists (Ian O'Byrne *et al*., 2021). Following the validation process carried out by the instrument verification specialist, the researcher proceeded to undertake a pilot study for this particular investigation. The purpose of this pilot study was to assess the instrument's

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reliability and identify any necessary amendments to enhance the clarity of the questionnaire and encourage respondents to submit feedback (Pimentel *et al*., 2021). Before distributing the questionnaire to the intended respondents, who are the teachers in the refrigeration and air conditioning program from five TVET institutions in Johor, Malaysia, a pilot study was done. This study aims to assess the reliability of the instrument by conducting a random selection of 10 respondents from the pool of teachers enrolled in the refrigeration and air conditioning program at a TVET institution in Melaka, Malaysia.

The researcher's analysis of the pilot study's findings revealed a reliability value of 0.825, as determined by the use of Cronbach's Alpha (α) coefficient (MERDİN *et al*., 2022). This finding demonstrates that the acquired value accurately reflects the significance of the instrument utilized in mild conditions, hence affirming the instrument's dependability as assessed by the researcher. A survey was conducted using a hand-distributed questionnaire, with a total of 38 respondents from the entire population providing their responses. Upon obtaining the survey questionnaire, the researcher proceeded to gather data for analysis utilizing the Statistical Package for Social Sciences (SPSS) version 24.0 software. Descriptive statistics were employed to assess the level of ICT knowledge and utilization among TVET teachers in the context of implementing online home-based learning. The Spearman correlation has been employed to assess the inferential statistical analysis aimed at examining the association between the level of ICT knowledge and usage among TVET teachers during the implementation of online home-based learning (Dabi, 2022). This approach is advantageous as it does not make any assumptions regarding the distribution of the data. The utilization of Spearman's correlation analysis in this dataset is justified due to its suitability in cases when big outliers may obscure significant correlations between variables or when the variables are not regularly distributed (Janse *et al*., 2021).

3. RESULTS AND DISCUSSION

The researcher has provided an explanation and clarification of the initial research question, which aims to determine the extent of ICT knowledge possessed by TVET teachers throughout the implementation of online home-based learning. This has been achieved through the utilization of descriptive analysis, whereby each part of the study has been examined by applying the TPACK Model.

Regarding the section about the level of ICT knowledge, the findings of the study analysis revealed that the dimension of pedagogy, which acknowledges the understanding that the utilization of ICT can enhance the range of stimuli in instructional practices, obtained the highest average score (M=4.63, SD=0.48) in comparison to other measures. This phenomenon can be attributed to the acquisition of this skill by educators through their participation in activities such as delivering presentations, facilitating open discussions, and completing written reports and assignments as part of the teaching and learning process. The instrument ranked second in the sequence pertains to the implementation of ICT strategies in learning material, which demonstrates a strong explanatory capacity (M=4.60, SD=0.49) within the content dimension. The utilization of ICT by teachers has resulted in the efficiency and effectiveness of management systems, thereby leading to improvements in their work processes.

In terms of the technological aspect of the instrument, I possess a high level of proficiency in utilizing the ICT equipment that is accessible at the TVET institution. This proficiency is reflected in the highest mean value obtained (M=4.55, SD=0.5). This phenomenon is feasible due to the widespread adoption of ICT by educators, who utilize specialized software to integrate ICT facilities into their instructional practices. However, in terms of my proficiency

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in utilizing software tools like AutoCAD or SolidWorks to create engineering drawings related to air conditioning topics, which falls under the realm of technology, it appears to have received the lowest average score (M=3.90, SD=0.73). In general, the mean value of ICT knowledge among TVET teachers throughout the implementation of online home-based learning was found to be significantly high (M=4.36, SD=0.52). The findings of the first research objective of this study will be shown in **Table 1**.

Table 1. The descriptive analysis of TVET teachers' level of ICT knowledge during the implementation of online home-based learning.

Items	Dimension	Mean	Std. Dev.	Tendency Level
I am adept at using laptops or mobile devices	Technology	4.28	0.45	High
I am proficient in using general software such as Microsoft Word, Excel & PowerPoint		4.15	0.75	High
I am adept in using software such as AutoCAD or SolidWorks to draft engineering drawings for air conditioning subject		3.90	0.73	High
I am proficient in handling the ICT equipment available at the TVET institution		4.55	0.50	High
I know that the implementation of ICT will make my teaching and learning process more effective	Pedagogy	4.55	0.51	High
I am aware that the implementation of ICT will make students more fun in the teaching and learning process		4.34	0.48	High
I know that the implementation of ICT can improve the process of delivering lessons		4.31	0.47	High
I am aware that the implementation of ICT can diversify the variety of stimuli in teaching		4.63	0.48	High
I find that the use of ICT can strengthen the learning content approach	Content	4.52	0.55	High
I find that the implementation of ICT facilitates learning topics and is understood by students		4.28	0.45	High
I know the implementation of ICT strategies in learning content can provide a good explanation		4.60	0.49	High
I know that the teaching content in ICT can be used as my teaching material		4.28	0.45	High
Total Average		**4.36**	**0.52**	**High**

The primary research purpose is to assess the level of ICT expertise among TVET teachers in the context of implementing online home-based learning. During the deployment of online home-based learning, the average mean value of ICT expertise among TVET teachers was observed to be at a high level. The observed outcome can be attributed to the advent of technology as a tool for online home-based learning, which facilitates more effective communication of concepts and aids students in retaining the supplied information.

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According to Esfijani and Zamani (2020), the utilization of ICT in education has the potential to enhance students' comprehension of instructional materials through the incorporation of textual, visual, and auditory elements. The consideration of incorporating technology, such as computers, the internet, and various mobile technologies, into educational settings is warranted due to the inherent appeal these instruments hold for the present generation of students. According to Valtonen *et al*. (2018), educators who possess extensive expertise in the domain of ICT are more inclined to exhibit a favorable attitude towards the utilization of ICT in instructional practices, particularly in the context of online home-based learning. Additionally, according to Guillén-Gámez *et al*. (2021), teachers who possess a strong understanding of ICT and are proficient in utilizing it for personal activities or administrative purposes have a distinct advantage when it comes to integrating online home-based learning. The recognition of the necessity to enhance knowledge within a specific domain serves as a significant driver in expediting the self-development of educators by acquiring supplementary competencies.

Next, the researcher discusses the results of the study analysis for the second research question in this study which is the descriptive analysis of TVET teachers' level of ICT usage during the implementation of online home-based learning. The results of the analysis of the study showed that the dimension of convenience that states I feel that ICT facilitates my teaching and learning process has the highest mean score (M=4.50, SD=0.50) compared to another instrument. This is because of the integration of ICT through the use of learning technology to introduce, strengthen, and add skills during their teaching and learning process. Then, the highest mean in intention dimension was an instrument of I will recommend the use of ICT in teaching and learning process to other teachers (M=4.44, SD= 0.50). This is because the teachers play an important role in every learning process starting from preparation before, during, and after teaching and learning sessions. Failure of teachers to plan carefully will be detrimental to students and make the teaching and learning process less effective.

Subsequent, for the use dimension on the instrument of I, use ICT in my lesson because it helps increase my productivity while teaching has the highest mean value (M=4.44, SD= 0.50). This is possible because the use of ICT will lead to the discovery of various new and innovative methods in the teaching and learning process. Among them, teachers can use video or animation to give students a clearer understanding of a concept. Then, the highest mean in the attitude dimension was an instrument of I believe that ICT has increased my teaching and learning efficiency (M=4.42, SD= 0.50). This possibly happened because teachers need to provide clear guidelines to monitor and ensure good student discipline while using the internet or electronic communication.

However, for an instrument I will use ICT to carry out tasks other than my teaching and learning routine which is also from the intention dimension seems to get the lowest mean value (M=4.18, SD= 0.45). This problem arises among teachers who have difficulties accepting the change in the way of learning from traditional to modern. They have trouble using the programs available on the computer during the learning session because of limited ICT skills and computer use. Overall, the average mean value of TVET teachers' level of ICT usage during the implementation of online home-based learning was at a high level (M=4.37, SD= 0.48). The results of the study findings for the first research objective in this study will be demonstrated in **Table 2**.

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Table 2. The descriptive analysis of TVET teachers' level of ICT usage during the implementation of online home-based learning.

Items	Dimension	Mean	Std. Dev.	Tendency Level
I use ICT in my daily routine because it helps me to do my job faster.	Content	4.39	0.49	High
I use ICT in my lessons because it improves my teaching and learning performance		4.39	0.49	High
I use ICT in my lessons because it helps increase my productivity while teaching		4.44	0.50	High
I feel that ICT has facilitated my teaching and learning process	Convenience	4.50	0.50	High
I feel comfortable when using ICT in my teaching and learning process		4.44	0.50	High
I found that ICT has simplified my teaching and learning operation		4.31	0.47	High
I believe that ICT has increased my teaching and learning efficiency	Attitude	4.42	0.50	High
I want to use ICT in my teaching and learning process in the future		4.36	0.48	High
I will use ICT regularly in my teaching and learning process		4.36	0.48	High
I will recommend the use of ICT in the teaching and learning process to other teachers	Intention	4.44	0.50	High
I frequently use ICT in my teaching and learning process		4.28	0.45	High
I will use ICT to carry out tasks other than my teaching and learning routine		4.18	0.45	High
Total Average		**4.37**	**0.48**	**High**

The second research goal pertains to the determination of the extent to which TVET teachers employ ICT during the execution of online home-based learning. The mean value of ICT usage among TVET teachers throughout the deployment of online home-based learning was found to be significantly high. The increasing demand for the integration of ICT in the context of online home-based learning has necessitated a fundamental re-evaluation of pedagogical approaches, instructional material, teaching objectives, and the dynamics of online student learning (Lawrence and Tar, 2018). Hence, the impact of teachers and their instructional methods on student accomplishment can be observed through enhanced comprehension, heightened engagement, and shifts in students' attitudes toward the learning process.

Lubis *et al*. (2018) assert that the utilization of interactive ICT has witnessed a surge in students' engagement in their academic pursuits, hence catalyzing their motivation to acquire knowledge through online home-based learning. This is due to the presence of multimedia components in ICT, which assist in generating a heightened level of stimulus or incentive. The inclusion of training and styling in the field of ICT presents students with a valuable opportunity to enhance their comprehension of the subject matter being taught. Consequently, all educators must be adequately equipped to embrace and adapt to technological advancements within the realm of education. The proficiency of educators in utilizing ICT is crucial in fostering an engaging pedagogical experience. The level of confidence

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that teachers possess in their ability to effectively implement instructional strategies plays a crucial role in driving educational innovation and enhancing student accomplishment (Semerci and Aydin, 2018).

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Lastly, the researcher explained the results of the study analysis for the third research question in this study which is to identify the relationship between TVET teachers' level of ICT knowledge and usage during the implementation of online home-based learning through the results of the inferential analysis. It showed that there was a moderately strong strength of the linear relationship between TVET teachers' level of ICT knowledge and usage as the correlation coefficient value, r is (r=0.518, sig=0.000), as the correlation coefficient value, r is between 0.51 and 0.80 (0.51 < r <0.80). The TVET teachers' level of ICT knowledge and usage has also a statistically significant linear relationship as satisfied the assumption of (p<0.01). It is, therefore, there is a statistically significant relationship between TVET teachers' level of ICT knowledge and usage during the implementation of online home-based learning. The results of the study findings for the third research objective in this study will be demonstrated in **Table 3**.

Table 3. The inferential analysis for the relationship between TVET teachers' level of ICT knowledge and usage during the implementation of online home-based learning.

	TVET teachers' level of ICT usage			**Interpretation**
	N	**r**	**Sig. (2-tailed)**	
TVET teachers' level of ICT knowledge	38	0.561**	0.000	Moderately Strong

The third research objective pertains to examining the correlation between the level of ICT knowledge and usage among TVET teachers during the execution of online home-based learning. The findings indicate a moderate level of strength in the linear association between the level of ICT knowledge and usage among TVET teachers. The level of ICT knowledge

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possessed by TVET teachers has a significant impact on their use of ICT tools during the execution of online home-based learning. This finding aligns with the findings of a study conducted by Rashid *et al*. (2021), which posits that teachers' familiarity and expertise in utilizing a Virtual Learning Environment (VLE) in their instructional practices have an impact on their preparedness, acceptance, and ease of incorporating VLE into their teaching methodologies. The utilization of ICT by educators is crucial to developing effective instructional methods and engaging students in various learning activities (Amhag *et al*., 2019).

Factual knowledge serves as the foundation for the transmission of knowledge and skills. In the realm of ICT, knowledge can be further classified into two categories: declarative knowledge and procedural knowledge. Before a teacher attains procedural knowledge, which pertains to the ability to perform tasks such as utilizing technological devices like computers and their associated icons, the individual must possess declarative knowledge, which encompasses factual information. For instructors to effectively implement ICT skills in online home-based learning, they must possess a comprehensive understanding and retention of factual knowledge, such as the proper utilization of technological devices (Joo *et al*., 2018). The obstacles faced by educators in the implementation of online home-based learning, particularly in adapting to the utilization of technology, are very substantial. According to Walkington and Bernacki (2020), educators must enhance their own understanding and expertise in alignment with contemporary advancements. According to Hu *et al*. (2018), the advancement of technology across several domains necessitates teachers to invest both time and financial resources in enhancing their competencies and skills.

4. CONCLUSION

This study aims to assess the proficiency of instructors in the field of refrigeration and air conditioning at TVET institutions in Johor, Malaysia, in terms of their understanding and usage of ICT based on the TPACK Model, as well as their attitudes towards ICT adoption based on the TAM. Consequently, the findings of this study indicate that a majority of TVET teachers possess a commendable degree of ICT proficiency and demonstrate effective utilization of technology throughout the execution of online home-based learning. However, the findings of the study suggest that they possess a modest level of preparedness to succeed in the context of the industrial revolution. However, the present study employed the Spearman Correlation Test to assess the inferential statistical analysis and ascertain the association between ICT knowledge and usage among teachers in this TVET school. Therefore, it can be concluded that there exists a reasonably robust correlation between the level of ICT expertise possessed by TVET teachers and their utilization of ICT in the specific TVET institution under consideration. This suggests that the ICT proficiency of TVET teachers has a significant role in determining their utilization of ICT tools during the execution of online home-based learning. The study's findings have effectively addressed all of the research inquiries mentioned by the researcher.

Therefore, TVET teachers must possess a strong foundation of content knowledge, pedagogical knowledge, and technological knowledge to effectively integrate ICT into their teaching and learning practices. Furthermore, it is worth noting that there exist four distinct clusters of TVET teachers who exhibit a commendable degree of ICT utilization. These clusters are categorized based on their intended purposes and the variations and objectives they aim to achieve. The aspects that contribute to these clusters include use, convenience, attitude, and intention. The present task involves the imperative of sustaining the motivation and passion of TVET educators in order to effectively instruct students and surmount obstacles or

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limitations that arise during the implementation of technology-driven remote learning in TVET establishments.

In summary, the researcher anticipates that the conducted study would provide valuable contributions to the stakeholders or parties concerned. Specifically, it aims to enhance the preparedness of TVET teachers in terms of their ICT understanding and use within their particular TVET institutions. The rapid advancement of ICT is leading to significant societal transformations, often occurring swiftly and without our full awareness or conscious evaluation of the implications. The difficulty of online home-based learning necessitates the collective participation of all involved parties. The duty of ensuring the successful implementation of online home-based learning and the achievement of the ambitions outlined in the Malaysian Education Development Plan (2013-2025) lies with teachers and parents of students.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

7. REFERENCES

Akther, W. (2022). SDG 4: A review of challenges-Bangladesh perspective. *International Journal of Multidisciplinary Informative Research and Review, 2*(1), 11-19.

Amhag, L., Hellström, L., and Stigmar, M. (2019). Teacher educators' use of digital tools and needs for digital competence in higher education. *Journal of Digital Learning in Teacher Education, 35*(4), 203-220.

Anamalai, T. R., and Yatim, M. H. M. (2021). A preliminary observation of teacher challenges in implementing home-based teaching and learning. *Journal of ICT in Education, 8*(4), 55-63.

Antoninis, M., April, D., Barakat, B., Bella, N., D'Addio, A. C., Eck, M.,and Zekrya, L. (2020). All means all: An introduction to the 2020 global education monitoring report on inclusion. *Prospects, 49*, 103-109.

Ashima, R., Haleem, A., Bahl, S., Javaid, M., Mahla, S. K., and Singh, S. (2021). Automation and manufacturing of smart materials in additive manufacturing technologies using Internet of things towards the adoption of Industry 4.0. *Materials Today: Proceedings, 45*, 5081-5088.

Azhar, E. I., and Hashim, H. F. M. (2022). 2D public service announcement: Challenge home-based learning during Pandemic on University Students. *Journal of Computing Technologies and Creative Content (JTEC), 7*(2), 71-77.

Dabi, G. K. (2022). Implementation of integrated functional adult literacy curriculum in South Eastern Ethiopia: Preconditions and challenges. *Journal of Equity in Sciences and Sustainable Development (JESSD), 5*(1), 58-75.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Drajati, N. A., Tan, L., Haryati, S., Rochsantiningsih, D., and Zainnuri, H. (2018). Investigating English language teachers in developing TPACK and multimodal literacy. *Indonesian Journal of Applied Linguistics, 7*(3), 575-582.

Esfijani, A., and Zamani, B. E. (2020). Factors influencing teachers' utilization of ICT: The role of in-service training courses and access. *Research in Learning Technology, 28*, 2313.

Fadel, N. S. M., Ishar, M. I. M., Jabor, M. K., Ahyan, N. A. M., and Janius, N. (2022). Application of soft skills among prospective TVET teachers to face the industrial revolution 4.0. *Malaysian Journal of Social Sciences and Humanities (MJSSH), 7*(6), e001562-e001562.

Ghavifekr, S., and Yulin, S. (2021). Role of ICT in TVET education: Teaching and learning amid COVID-19 pandemic. *International Journal of Advanced Research in Education and Society, 3*(1), 119-131.

Ghavifekr, S., Kunjappan, T., Ramasamy, L., and Anthony, A. (2016). Teaching and learning with ICT tools: Issues and challenges from teachers' perceptions. *Malaysian Online Journal of Educational Technology, 4*(2), 38-57.

Guillén-Gámez, F. D., Mayorga-Fernández, M., Bravo-Agapito, J., and Escribano-Ortiz, D. (2021). Analysis of teachers' pedagogical digital competence: Identification of factors predicting their acquisition. *Technology, Knowledge and Learning, 26*(3), 481-498.

Günther-Bel, C., Vilaregut, A., Carratala, E., Torras-Garat, S., and Pérez-Testor, C. (2020). A mixed-method study of individual, couple, and parental functioning during the state-regulated COVID-19 lockdown in Spain. *Family Process, 59*(3), 1060-1079.

Hassan, R. H., Hassan, M. T., Naseer, S., Khan, Z., and Jeon, M. (2021). ICT enabled TVET education: A systematic literature review. *IEEE Access, 9*, 81624-81650.

Hou, Z., and Aryadoust, V. (2021). A review of the methodological quality of quantitative mobile-assisted language learning research. *System, 100*, 102568.

Hu, X., Gong, Y., Lai, C., and Leung, F. K. (2018). The relationship between ICT and student literacy in mathematics, reading, and science across 44 countries: A multilevel analysis. *Computers and Education, 125*, 1-13.

Hu, Y., Ow Yong, J. Q. Y., Chng, M. L. C., Li, Z., and Goh, Y. S. (2022). Exploring undergraduate nursing students' experiences towards home-based learning as pedagogy during the COVID-19 pandemic: A descriptive qualitative exploration. *BMC Nursing, 21*(1), 1-9.

Husni, H., Munandar, A. A., Darisman, D., and Rizal, S. S. (2020). Preferable applications for home-based learning during the coronavirus (COVID-19) outbreak in Indonesia Islamic

Higher Education. *International Journal of Scientific and Technology Research, 9*, 281-284.

Ian O'Byrne, W., Savitz, R. S., Morrison, J., Kane, B., Lilly, T., Ming, K. M., and Aldrich, C. (2021). Literacy across the disciplines: Development and validation of an instrument to assess literacy instruction in middle and high school classrooms. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 94*(2), 63-75.

Ja'ashan, M. M. N. H. (2020). The challenges and prospects of using e-learning among EFL students in Bisha University. *Arab World English Journal (AWEJ), 11*, 1-14.

Janse, R. J., Hoekstra, T., Jager, K. J., Zoccali, C., Tripepi, G., Dekker, F. W., and van Diepen, M. (2021). Conducting correlation analysis: Important limitations and pitfalls. *Clinical Kidney Journal, 14*(11), 2332-2337.

Joo, Y. J., Park, S., and Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology and Society, 21*(3), 48-59.

Kundu, A., and Bej, T. (2021). COVID 19 response: An analysis of teachers' perception on pedagogical successes and challenges of digital teaching practice during new normal. *Education and Information Technologies, 26*(6), 1-24.

L Ritter, N. (2017). Technology acceptance model of online learning management systems in higher education: A meta-analytic structural equation model. *International Journal of Learning Management Systems, 5*(1), 1-16.

Lawrence, J. E., and Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in the teaching/learning process. *Educational Media International, 55*(1), 79-105.

Liu, S. (2021). Family engagement in the home-based learning mode: An enlarging divide in education. *Social Transformations in Chinese Societies, 17*(2), 92-100.

Lubis, A. H., Syed Idrus, S. Z., and Sarji, A. (2018). ICT usage amongst lecturers and its impact on learning process quality. *Jurnal Komunikasi Malaysian Journal of Communication, 34*(1), 284-299.

Mansor, A. N., Zabarani, N. H., Jamaludin, K. A., Mohd Nor, M. Y., Alias, B. S., and Mansor, A. Z. (2021). Home-based learning (HBL) teacher readiness scale: Instrument development and demographic analysis. *Sustainability, 13*(4), 2228.

Mazlan, A. F., Mohamad, M., Reesha, A., Kassim, R., Othman, Z., and Kummin, S. (2021). Challenges and strategies to enhance online remote teaching and learning by tertiary institution educators: A literature review. *Creative Education, 12*(4), 718-726.

MERDİN, D., ERSÖZ, F., and TAŞKIN, H. (2022). Digital transformation: Digital maturity model for Turkish businesses. *Gazi University Journal of Science, 36*(1), 263-282.

Mishra, P., and Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers' College Record, 108*(6), 1017-1054.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *Journal of Education for Teaching, 46*(4), 609–611.

Neupane, M. S. (2020). TVET programs in Nepal: Issue of access and relevancy. *Journal of Training and Development, 5*, 16-28.

Pimentel, C. B., Clark, V., Baughman, A. W., Berlowitz, D. R., Davila, H., Mills, W. L., and Hartmann, C. W. (2021). Health care providers and the public reporting of nursing home quality in the United States Department of Veterans affairs: Protocol for a mixed methods pilot study. *JMIR Research Protocols, 10*(7), e23516.

Prasad, M. (2023). Technological intervention in educational industry-post pandemic development and growth. *Carmelight, 21*, 41-44.

Rampazzo, M., and Beghi, A. (2018). Designing and teaching of an effective engineering continuing education course: Modeling and simulation of HVAC systems. *Computer Applications in Engineering Education, 26*(4), 739-748.

Rashid, A. H. A., Shukor, N. A., Tasir, Z., and Na, K. S. (2021). Teachers' perceptions and readiness toward the implementation of virtual learning environment. *International Journal of Evaluation and Research in Education, 10*(1), 209-214.

Rosado, P. J., and Levinson, R. (2019). Potential benefits of cool walls on residential and commercial buildings across California and the United States: Conserving energy, saving money, and reducing the emission of greenhouse gases and air pollutants. *Energy and Buildings, 199*, 588-607.

Semerci, A., and Aydin, M. K. (2018). Examining high school teachers' attitudes towards ict use in education. *International Journal of Progressive Education, 14*(2), 93-105.

Shrestha, N. (2021). Factor analysis as a tool for survey analysis. *American Journal of Applied Mathematics and Statistics, 9*(1), 4-11.

Song, H., Kim, J., and Luo, W. (2016). The teacher-student relationship in online classes: A role of teacher self-disclosure. *Computers in Human Behavior, 54*, 436–443.

Tay, L. Y., Lee, S. S., and Ramachandran, K. (2021). Implementation of online home-based learning and students' engagement during the COVID-19 pandemic: A case study of Singapore mathematics teachers. *The Asia-Pacific Education Researcher, 30*(3), 299-310.

Thannimalai, T., and Baloh, S. (2021). Challenges of Tamil language PDPR in rural schools. *Muallim Journal of Social Sciences and Humanities, 5*(2), 183-190.

Valtonen, T., Kukkonen, J., Kontkanen, S., Mäkitalo-Siegl, K., and Sointu, E. (2018). Differences in pre-service teachers' knowledge and readiness to use ICT in education. *Journal of Computer Assisted Learning, 34*(2), 174-182.

Walkington, C., and Bernacki, M. L. (2020). Appraising research on personalized learning: Definitions, theoretical alignment, advancements, and future directions. *Journal of Research on Technology in Education, 52*(3), 235-252.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Weiwei, Z. (2022). Concepts and practice used in vocational education for international development during COVID-19 in China. *Higher Education and Oriental Studies, 2*(3), 15-23.

Wen, Y., Gwendoline, C. L. Q., and Lau, S. Y. (2021). ICT-supported home-based learning in K-12: A systematic review of research and implementation. *TechTrends, 65*(3), 371-378.

Yeap, C. F., Suhaimi, N., and Nasir, M. K. M. (2021). Issues, challenges, and suggestions for empowering technical vocational education and training education during the COVID-19 pandemic in Malaysia. *Creative Education, 12*(8), 1818-1839.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295