Assessment Method for Potential Educational Technology Competency Standard Based on TPCK in Malaysia Higher Education Institutions

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Abstract: Technology in education is purposely designed to help both educators and students in knowledge transfer and knowledge gain simultaneously. In many aspects, technology in education is supposed to prove that education can be delivered effectively and efficiently. However, there are cases in which technology in education can be frustrating and annoying for both parties. Government and university management have invested a lot of money to ensure that educators and students can really benefit from the technology. In spite of huge investment on educational technology tools (hardware and software) over the past decades in various education initiatives, the potential of technology usage in university level has not reached the desired level among educators and students. What is the missing link for the realization of the expected return-of-investment? The outcome of this study proposes an Educational Technology standard to be applied in university setting using TPCK (Technological Pedagogical Content Knowledge) as the basic framework. However, this paper will only discuss a part of our standard development in which highlighting the assessment method that was used during the implementation of ETC standard in our institutions.

Keywords: Educational Technology; TPCK, ICT Standard, University, Educators, Student

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Introduction

For tertiary students, improved educational outcomes are a result of instructional technology. It is considered to be able to prepare this population for a bright future. Technology in education is intended to support knowledge transmission and knowledge acquisition for both teachers and students at the same time. And it supposed to demonstrate in numerous ways that instruction may be delivered successfully and efficiently. But there are times when using technology in teaching may be irritating and frustrating for everyone. Technology alone does not necessarily result in increased learning. Even though Massive Open Online Courses, or MOOCs, are a convenient way to learn and provide free education worldwide, they cannot instantly transform a person into a scholar. Another example is presenting information on an interactive whiteboard without engaging audience members. Educational technology contributes to the improvement of educational outcomes for postsecondary students. It is believed to be able to provide a bright future for this population. Technology in education is intended to facilitate knowledge transfer and knowledge acquisition simultaneously for both educators and students.

Occasionally, technology in education can irritate and frustrate both sides. To guarantee that instructors and students can fully benefit from the technology, the government and university administration have made major financial investments. Despite significant investments in Education Technology instruments (hardware and software) by various education initiatives over the past few decades, the potential for technology use among university educators and students has not yet reached the desired level. The pandemic Covid-19 that occurred within the past two years has drastically altered the majority of aspects of physical education. During the Covid-19 epidemic, educators were forced by their institutions to complete self-training in order to make sure they could give their lessons online or through another medium. What is missing in order to realize the anticipated return on investment? How are educators' ICT competencies in higher education assessed both before and after the Covid-19 pandemic?

Past and recent research (Ahmed & Rasheed, 2020; Chaiya Akarawang, Kidrakran, & Nuangchalerm, 2015; Hersh, 2014; Matherson, Wilson, & Wright, 2014; Zainani, Esfijani, & Damaneh, 2016) indicates that the issue stems from educators' lack of technical ICT skills and knowledge of effective pedagogical practice . Researchers in a variety of education-related disciplines have discussed the need for educators to have a solid ICT Competency standard (Fong, Ch'ng, & Por, 2013; Sani & Arumugam, 2017). Rarely is research conducted at the Higher Education Institutions (HEI) or University level, with the majority of studies focusing on pre-teacher education. The assessment strategy that will be used when the ETC standard is implemented at our institutions, however, will be the only topic covered in this paper, which will only cover a small part of the standard development process. In accordance with the Malaysia Education Blueprint 2015 - 2025 (Higher Education), it is predicted that university management will be able to evaluate and control educational technology initiatives intended to raise standards for teaching and learning.

Utilising modern IT is intricate and multifaceted, and psychological research shows that cognitive models may not fully account for the antecedents of conduct (Beaudry & Pinsonneault, 2010; Maatuk, Elberkawi, Aljawarneh, Rashaideh, & Alharbi, 2022). Researchers have discovered that the value of educational technology is directly proportional to the technological knowledge of educators, such that the greater the educators' technological expertise, the greater the students' ability to comprehend it (Guasch, Alvarez, & Espasa, 2010; Hechter, Phyfe, & Vermette, 2012; Hennessy, Harrison, & Wamakote, 2010; Herrero et al., 2015). This has no significant educational advantage over conventional whiteboards. In comparison to the price of a traditional whiteboard, the interactive use of interactive whiteboards to actively engage students with the subject matter through technology would likely justify the additional cost, schools in the United Kingdom, the United States, Australia, South Korea, and other countries are already largely equipped with interactive whiteboards (Kim, Kim, Lee, Spector, & DeMeester, 2013).

It is generally acknowledged that students who are actively involved learn and remember more material. Class enrollments have increased in response to tighter budgets and growing pressure to offer a high-quality education at a competitive price. While technology has the potential to increase student engagement, it should not replace traditional teaching methods (La Roche & Flanigan, 2013). Technology integration encompasses attitudes and behaviours affiliated with technology use. Therefore, if technology and teaching approaches are combined, instructors' technological pedagogical views may have an impact (Liu, 2011). In addition, the majority of teachers indicated that internal factors (such as a passion for technology and a problem-solving mindset) and external support (administrators and personal learning networks) influenced their practises significantly (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Since the advent of educational technologies in the classroom, teacher education has been faced with the task of improving in-service teacher education. As a result, it's crucial for the institution to prepare teachers for the delivery of teacher education in a constructivist learning environment and to give student teachers a welcoming, nonthreatening atmosphere in which to successfully integrate computer instruction, since the challenge of improving in-service teacher education has been present in the field of teacher education (Sang, Valcke, Braak, & Tondeur, 2010). Consequently, professional development programmes must look past first-order barriers to the intrinsic, more complex second-order barriers of teachers' beliefs and how they influence ICT implementation in the classroom if teachers are to implement the type of pedagogical change outlined in current educational reform agendas (Prestridge, 2012).

This study aims to answer the question of which TPCK elements can serve as the basis for establishing Educational Technology Competency Standards in our institution. The primary objective of this study is to establish Educators' Technology Competency (ETC) Standards at our local university using TPCK as the foundation (Yau'Mee Hayati, Sarah Syazwani, & Nur Hazwani, 2015). This paper will, however, only discuss the findings of the pre-development of this study to guide educators' use of ETC Standards regarding the elements that should be included in the standard. It is envisaged that this paper will serve as a guide for a thorough ETC Standard in academic contexts, which will ultimately help to maximise the use of educator-student learning. One aspect of our standard development that will be proposed as a Competency Assessment Based System is the clarification of the assessment method that will be used throughout the implementation of

ETC standards in our institutions. In accordance with the Malaysia Education Blueprint 2015 - 2025 (Higher Education), it is anticipated that university administration will be able to review and regulate efforts to improve the educational technology standards in teaching and learning. There are two questions that has been asked in the beginning of the study which are as following:

1. What is the elements in TPCK which can used as standard in UiTM(CT) ?
2. How to use TPCK to produce a practical standard for UiTM(CT) ?

Literature Review

Competency Standard

Standards are used in the field of educational technology to assess the potential qualities a teacher or student must possess in order to pass a specific competency level or proficiency. It is necessary for them to upgrade their abilities because doing so is a crucial part of self-development. All educators agree that a standard is an essential requirement before a new educator may join the education queue. Most of the criteria (as stated in Table 1) are frequently applied to ICT training programmes for teachers in elementary and secondary schools. Some of them, nevertheless, focus on postsecondary education. It is obvious that the ET/ICT Standard can be implemented into professional development programmes for educators of the highest calibre. The instruments of the standard can be used in training courses to prepare new educators and advance the abilities of experienced educators. As a result, it is possible to evaluate educators' proficiency with the standards, which is necessary for professional development. Competency standards would improve in-service teacher training courses that are in line with competency standards and would reduce teachers' gaps in ICT proficiency (Fong et al., 2013).

Table 1. Prominent ICT Standard

Standard	Description
UNESCO ICT Competency Framework for Teachers 2018(Fallis, 2018)	The UNESCO ICT Competency Framework for Teachers was created by UNESCO in 2018 with the purpose of offering recommendations for structuring teacher preparation courses and training to help prepare teachers or to promote professional growth in ICT-integrated pedagogy. The three main parts of the UNESCO ICT Standard are knowledge production, knowledge deepening, and technology literacy.
ISTE STANDARD (International Society for Technology in Education, 2008)	The International Society for Technology in Education has created a formal standard that many American institutions will use when providing ICT teacher training.

NATIONAL PROFESSIONAL STANDARDS FOR TEACHERS	The "NATIONAL PROFESSIONAL STANDARDS FOR TEACHERS: ICT Elaborations for Graduate Teacher Standards," published by the Australian Institute of Teaching and School Leadership, serves as a manual for future educators before they start their fieldwork in classrooms.
CHINA ICT STANDARD	China Educational Technology Standards (CETS) were developed and adopted in 2004. A new set of necessary teacher's certificate requirements has been put into place. The development of in-service teacher training programmes was funded by the Chinese government, which also kept an eye on it. The government chose regional testing and training institutes authorised for certification through a competitive tendering process. The pre-service teacher training courses were updated as a result.

To train graduates, pre-service teachers, and some in-service teachers, all of these criteria are generally used in elementary and secondary schools. There aren't many current criteria that concentrate on the levels of collegesand other higher education institutions. This can be because research is valued more highly in higher education than teaching and learning. But now that ICT tools and applications have advanced, instructors in higher education institutions need to be prepared with the abilities and information required for their own professional development.

Technological Pedagogical Content Knowledge (TPACK)

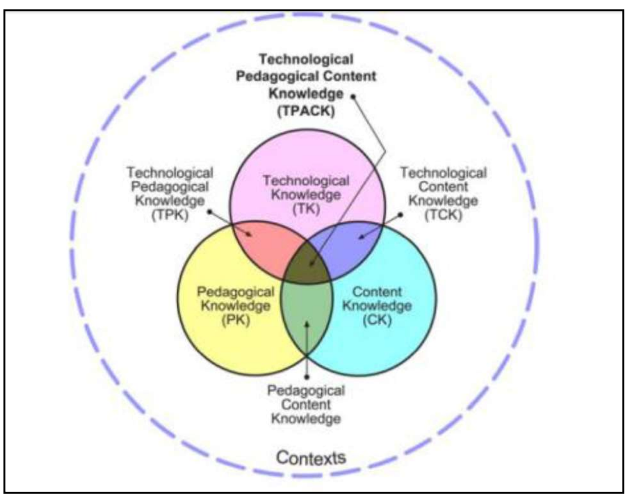

Figure 1. TPCK Framework (Adopted: The components of the TPACK framework (graphic from TPCK - Technological Pedagogical Content Knowledge, 2010).)

Technology Pedagogy Content Knowledge, or TPCK (as shown in Figure 1), is a framework that emphasises the importance of educating future teachers to use technology wisely while delivering a particular lesson to a particular group of students. This approach contends that technology integration spans a continuum of teaching and learning philosophies rather than calling for a particular pedagogical orientation (Becuwe et al., 2017). The

TPCK framework is helpful for giving instructors the information they need to incorporate technology into the classroom and how to grow this expertise (Baran, Chuang, & Thompson, 2011). The accompanying Table 2 lists the seven (7) components of this framework.

Table 2. Seven (7) Components Included in the Framework

Technology knowledge (TK)	The ability to use a variety of technologies, from low-tech ones like pencil and paper to digital ones like the Internet, digital video, interactive whiteboards, and software.
Content knowledge (CK)	Knowledge of the actual subject matter that teachers need to be knowledgeable about in order to teach.
Pedagogical knowledge (PK)	Knowledge of teaching techniques and procedures, such as lesson planning, assessment, and classroom management.
Pedagogical Content Knowledge (PCK)	PCK is an awareness of how certain subject-matter aspects are organised, modified, and portrayed for instruction. It is the merging of content and pedagogy.
Technical Content Knowledge (TCK)	Technical content knowledge (TCK) is an understanding of the relationship between technology and content. Technology limits the types of representations that can be used; however, newer technologies frequently allow for newer, more varied representations and provide users with a higher degree of flexibility while exploring these representations.
Technological Pedagogical Knowledge (TPK)	Technological pedagogical knowledge (TPK) is the understanding of the existence, elements, and capabilities of various technologies as they are applied in learning and teaching environments, as well as the potential effects on teaching of the usage of particular technologies.

A class of knowledge called TPCK is essential to technology instructors' work. Topic matter experts who are technologically savvy, technologists with limited topic or pedagogical understanding, and instructors with limited subject or technology knowledge are unlikely to possess this knowledge (Koehler & Mishra, 2009).

The TPCK framework has received a great deal of support from both scholars and practitioners in the majority of countries (Jang & Chang, 2016; Kihoza, Mandela, Zlotnikova, & Bada, 2016; Wu, Hu, Gu, & Lim, 2016). The framework has offered a useful tool for planning teacher education programmes and evaluating teachers' expertise in technology integration. An obvious aspect of the TPCK's global effect as an emerging research and development tool for teachers and educators is the interest in using the TPCK framework and the TPACK survey for designing and assessing teachers' knowledge in various international teacher education contexts. According to Larsen (2014), TPACK is a theoretical framework for evaluating educators' understanding of how to use technology, and it is still applicable today, post-pandemi

Malaysia Education Blueprint 2015 – 2025 (Higher Education).

The overall percentage of Malaysians enrolled in higher education in 2021 was 48%. With 1.2 million students enrolled in public and private HLIs, such as public universities, polytechnics, community colleges, private universities, private university institutions, and private colleges, this marks a 70% increase in enrolment over the previous ten years. The number of students enrolling in bachelor's degree programmes climbed sixfold between 1990 and 2019, while the number of students enrolling in master's and doctoral degrees increased tenfold. According to the Executive Summary Malaysia Education Blueprint 2015–2025 (Higher Education) (Kementerian Pengajian Tinggi Malaysia (KPM), 2012), Malaysia currently ranks third among ASEAN countries for enrollment in Master's and Doctoral programmes, after Singapore and Thailand. Integrated learning models will spread throughout all HLIs as a common pedagogical approach in order to maintain the standard of HLI education at the neighbourhood university.

The strong cyber infrastructure that underpins innovations like videoconferencing, live streaming, and Massive Open Online Courses (MOOCs) will be advantageous to students. Malaysian HLIs will engage in worldwide MOOC consortiums in addition to creating MOOCs in their own fields of expertise, building the reputation of Malaysian education abroad. In terms of effectiveness, the Ministry aims to maximise the return on investment in higher education and sustain the existing level of government spending per student across all public institutions. The Ministry will work with HLIs to strengthen the capacities of the academic community in order to achieve these goals, and it will also take into consideration creating a national e-learning platform to oversee and direct content creation. Higher education is experiencing a huge disruption due to new digital technologies and delivery methods on a global scale. This chapter underlines crucial prerequisites for online learning in Malaysia's higher education system going forward. With the support of globalised online learning (GOL) platforms, Malaysia hopes to be a top educational hub. These platforms will improve education for Malaysians and the rest of the world in terms of accessibility, equity, and quality. Additionally, they will boost Malaysia's international education brand, enable more effective course delivery, and raise the profile of Malaysian HLIs, particularly in specialised disciplines.

Figure 2. Malaysia Education Blueprint 2015-2025

Launching MOOCs on

Malaysia-specific disciplines such as Islamic banking and finance in collaboration with renowned international MOOC consortiums like EdX and Coursera to strengthen Malaysia's international reputation; Making blended learning models a requirement for up to 70% of programmes; making online learning an essential part of higher education and perpetual learning, starting with the conversion of typical undergraduate courses into MOOCs; creating the necessary cyber infrastructure (physical network infrastructure, information structure, platform, devices, and equipment); and improving the academic community's capacity to deliver online learning on a large scale. In Malaysia, HLI has used e-learning as a tool for education in one of two ways: entirely through e-learning or through blended learning, which blends traditional and online learning. The main method of instruction at Open University Malaysia (OUM) in Malaysia is e-learning through blended learning. OUM began operations in 2001 with 753 students; however, this figure rose sharply throughout the course of the year. This data indicates that there is interest in e-learning among students. It also shows that e-learning has achieved parity with conventional education without sacrificing the standard of instruction. According to Persidangan Meja Bulat E-Learning, IPTA, held in 2008 at UiTM, very few HLIs in Malaysia have created their own policy, guidelines, or standard for the implementation of e-learning facilities within their institutions. However, after the COVID-19 global campaign, many universities have come up with a lot of creative ways to use and improve their e-learning facilities.

Multi Criteria Decision Making (MCDM)

The multi-criteria decision-making (MCDM) approach takes into account the decision-making process with numerous goals. A decision-maker (DM) must choose from a variety of quantitative or qualitative criteria. One of the main objectives of MCDM is to help DMs combine objective measurements with value assessments that are based on group consensus rather than individual viewpoints (Aruldoss, Lakshmi, & Venkatesan, 2013). When the best course of action is extremely complex, this strategy makes effective decision-making possible (Aruldoss et al., 2013). Generally speaking, the goals are incompatible; hence, the best course of action is a compromise depending on the decision-maker's preferences. There are many circumstances where it is vital to analyse conflicting factors before making a choice.

In MCDM models, a decision-maker often has to rank and choose among a limited number of possibilities. In many cases, it is also required to assess the relative relevance of a small number of factors. Researchers develop a list of criteria to decide which MCDM approach is best for a particular application because there are so many different MCDM methods available. Seven (7) methods, including (ELECTRE), (MAUT), (ANP), (MACBETH), (AHP), (TOPSIS), and (PROMETHEE), were used in the study by Kolios, Mytilinou, Lozano-Minguez, and Salonitis (2016) in the area of real estate and land management; Four (4) criteria were also used to choose the MCDM method that is best suited for the proposed model. In the assessment of competency, different approaches have also been applied (Chung & Chang, 2015; Heidary Dahooie, Beheshti Jazan Abadi, Vanaki, & Firoozfar, 2018; Lin & Kuo, 2022). Due to their ease of calculation, SAW and WPM have been employed in our suggested methodology.

Table 3. MCDM Approach in Training Evaluation

Area/Applications	**Criteria**	**Source of Criteria's**	**SAW**	**TOPSIS**	**ELECTRE**	**CFPR**	**AHP**
Finding the Right Personnel in Academic Institutions	Qualification Marks Experience in years Salary Expectation Ability handle different subject Research Activities Technical Skill Presentation/Communication Skill	NONE	(Kumar, Radhika, & Suman, 2013)	(Kumar et al., 2013)			(Kumar et al., 2013)
Academic Staff Selection	Individual Factor Academic Factor Work Faculty	NONE			(Rouyendegh &		
Evaluation of Personnel Selection Criteria Using Consistent Fuzzy Preference Relations	Activity Fee Education Internal Factors Business Factors	NONE				(Ozdemir, Nalbant, & Basligil, 2017)	
Academic staff promotion in higher education by using Analytic Hierarchy Process (AHP)	Teaching and Supervision Research and Publication Administration and Management Professional Contribution to Society Scholarly Recognition	NONE					
Fuzzy Analytic Hierarchy Process for Multi-criteria Academic Successor Selection.	Personal and Interpersonal Outcomes Learning and Teaching Out- comes Recognition and Reputation Financial Performance Effective Implementation	(Scott, Coates, & Anderson. 2008)					(Jantan, Yusof, & Ishak, 2019)

For example in the study done by (Kolios et al., 2016) in area of real estate and land management, they used seven (7) methods such as (ELECTRE), (MAUT), (ANP), (MACBETH), (AHP), (TOPSIS), (PROMETHEE) and four (4) criteria of choosing MCDM method that is suitable for the proposed model. Another study (Aruldoss et al., 2013) also comes with numerous methods and criteria such fuzzy TOPSIS, fuzzy VIKOR, and fuzzy GRA for evaluation on urban mobility projects. As proposed by (Aruldoss et al., 2013), the best alternative method can also use the veto rule to select. In other word, the alternative(s) that the majority of methods rank the highest will lastly be selected. The summary can be seen from Table 3.

UiTM-CT ETC Standard

The first campus of UiTM (Terengganu), often known as UiTMT, was established in Sura Gate, Dungun, on

July 1, 1975. The cornerstone ceremony in Sura Hujung was conducted on October 19, 1978, under the direction of the late Sultan Ismail Nasiruddin Shah. The major campus expansion was carried out over time in a number of phases. UiTMT has successfully developed the entire seaward area and 500,000 square metres across the lake as a result of putting the four phases and physical development indicated in the sixth and seventh Malaysian plans into practise. UiTM (Kuala Terengganu) was founded as a branch campus in 2008, and UiTM (Bukit Besi) followed in 2012. The UiTMT campus has been given full liberty to manage its own administration, stage by stage, by the Vice Chancellor of UiTM by 2013. The list of ICT training that has been provided in the past and is still being provided today via online webinar is shown in Table 4 below. Each educator at our institutions must complete 42 hours of training over the course of a year, including ICT training, as shown in Table 5.

Table 4. Pre-Pandemic

Course	Types	Frequency in a year
E-Learning		
Blended Learning	Software	4 times per year
Web 2.0 Tools	Software	3-5 times per year
Application for Productivity and Professional Software (APPS)	Hardware/Software	
Ipad for Teaching & Learning	Hardware	Once a year
Web Development :- Joomla	Software	Once a year
Microsoft Productivity Suite	Software	1-2 times per year
Image and Video Processing	Software	1 time per year
Research Productivity Suite	Software	3-8 times per year

***Details above are based on iLQAM (Terengganu) Working Calendar 2015**

(Source: iLQAM (2015) ,UiTM (Terengganu)

Table 5. Training Requirement for each educator in UiTM

Senarai Latihan / Kursus anjuran ILD/iTraining yang telah disertai bagi Tahun 2022

Tiada Maklumat

Maklumat Jumlah Jam & Bilangan Penyertaan Latihan

Jumlah Jam Kompetensi

Umum	Khusus	ICT	Tiada Kategori
40.5 jam	76 jam	14 jam	2 jam

We have come across the need to choose two forms of knowledge: internal and external expertise within our institution, in order to set the standard for our regional institution. External expertise relates to educators outside of our institution who are knowledgeable about the history of our institution, whereas internal expertise refers to our local educators within our university. These are chosen on a volunteer basis based on two criteria: experience and a strong interest in using ICT and ET in the classroom. Selected experts have received a number of the elements used in the initial draught of the proposed standard.

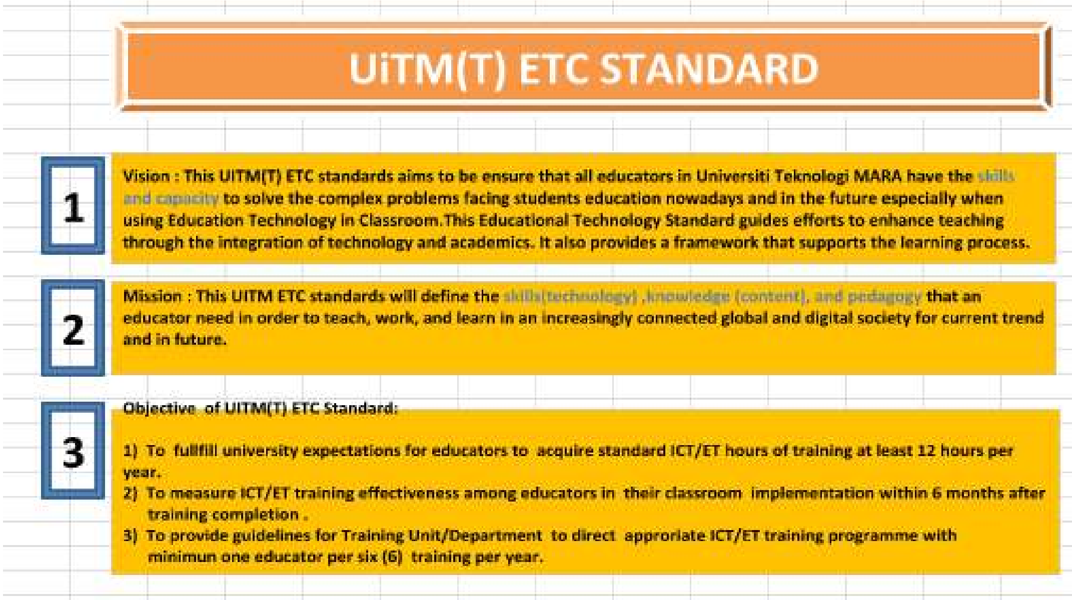

Figure 3. UiTM(T) ETC Standard interface - 1

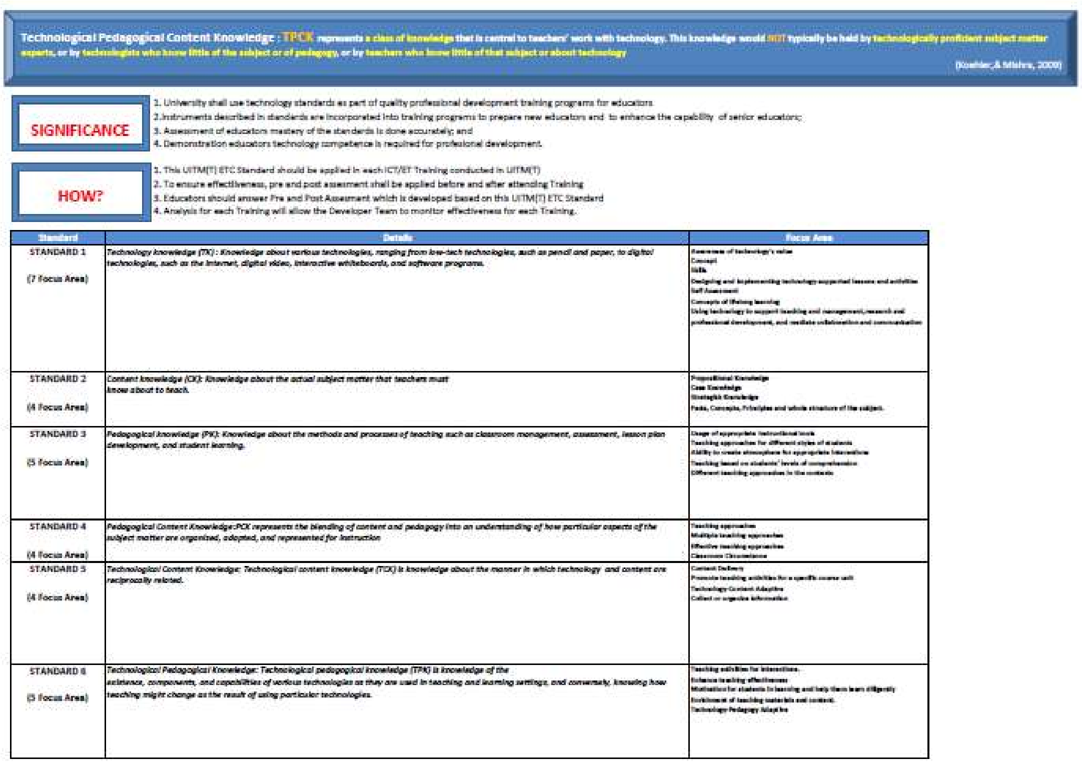

Figure 4. UiTM(T) ETC Standard interface - 2

URL : http://uitmt-etc.weebly.com

The best term and description for the focal area, description, and ICT Elaboration must be chosen and validated by specialists. Expertise had two weeks to complete the three rounds of their evaluation. The changes were made in accordance with the advice provided by the experts. This paper (Yau'Mee Hayati Mohamed Yusof, Abdullah, & Hamidah, 2019) draws conclusions from the analysis and proposes an educational technology standard to be implemented in university settings using TPCK (Technological Pedagogical Content Knowledge) as the foundational framework through the Deplhi method.

The proposed standard's shared mission, vision, and national aspiration for advancing technology in education make it potentially useful in a range of academic situations. This suggested standard needs to take into account a variety of factors, including 1) tailoring standards to local needs and circumstances, 2) creating better indicators to evaluate ET/ICT training programmes, and 3) raising educators' ET/ICT competency.

Pre and Post Evaluation Training

The pre-test is a set of inquiries given to participants before the training begins to ascertain their level of familiarity with the course material (I-Tech, 2010). Prior to the start of the programme, participants took a pre-test to gauge their level of familiarity with the course material. Participants take a post-test that either has the same questions or questions of a similar level of difficulty after finishing the course. The training provider can establish whether the training was successful in improving participants' knowledge of the training subject by comparing the post-test scores of participants to their pre-test scores. Pre- and post-testing material was chosen using a set of instruments (Table 6) created by Albion, Jamieson-Proctor, and Finger in 2010 and Jamieson-Proctor et al. in 2013.

Table 6. Pre and Post Assessment are Based on Set of Instrument

Items		Number of Items
A	Interest in and Attitudes toward using ICT	5
B	Confidence	2
C	ICT Applications	20
D	Digital Technologies (ICT) Competence	7
E	The Professional Capabilities of the ICT Vocational Self Efficacy Scale	12

The training provider can establish whether the training was successful in improving participants' knowledge of the training subject by comparing the post-test scores of participants to their pre-test scores. Five ICT/ET courses were offered at random in order to achieve this. The band is then categorised as follows using the pre- and post-results: Beginner (x0), Intermediate (0>x>1), and Advanced (x>1) in accordance with Table 7. The sum of the trainees' scores within each band is shown in Table 8 as a number.

Table 7. Band

Band	Mean Score
Beginner	x<0
Intermediate	0>x <1
Advanced	x>1

Table 8. Band According to Items

Band	Total Achiever based Category Items		
	ICT Application	Digital Technologies (ICT) Competence	Professional Capabilities of the ICT Vocational Self Efficacy Scale
Beginner	18	6	0
Intermediate	11	21	3
Advanced	15	8	32

Standard Self-Acceptance Test

Only 35 respondents have completed their pre- and post-assessments out of a total of 75 who participated in pre- and post-assessments delivered in five distinct ET/ICT courses with an average of 15 students in our local institutions. These selected respondents will then be assigned our proposed UITMT ETC criteria for self-acceptance based on their mean pretest and post-evaluation scores, which are then filtered through three categories: Beginner, Intermediate, and Advanced.

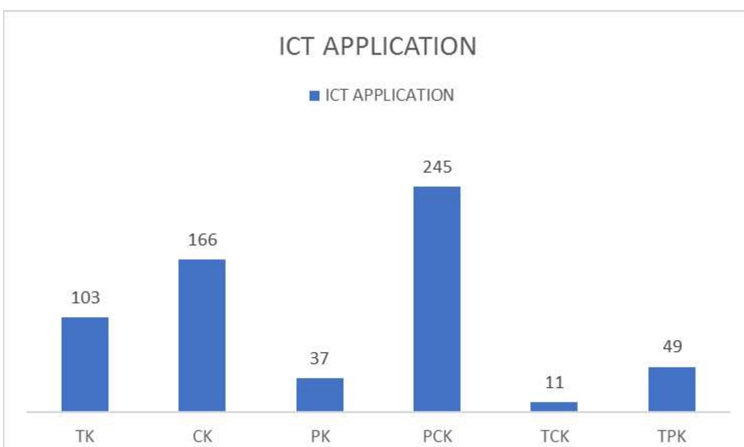

Figure 5. ICT Application

This division's purpose is to ensure that the standard can be adopted in ICT/ET training for our university educators' ET/ICT training in the selected areas: ICT APPLICATION, DIGITAL COMPETENCIES COMPETENCE, and PROFESSIONAL CAPABILITIES OF THE ICT VOCATIONAL SELF EFFICIENCY

SCALE, irrespective of band score. Only 19 individuals are able to complete the Standard Self-Acceptance Test, allowing us to deduce how they perceive themselves in comparison to the standard. The learner must select the scale (ranging from extremely good to extremely poor) that best shows his or her acceptance of the criteria. The results of the STANDARD SELF ACCEPTANCE TEST for the ICT trainees in our local institutions are depicted in Figures 4, 5, and 6 below. These figures elicit a GOOD score.

Findings in the ICT Competence category reveal that individual in the Beginner to Advanced range rate their adoption of the UiTMT ETC Competency Standard as GOOD, as shown in Figure 5. TCK and PK, on the other hand, receive the lowest scores among the elements in the UITMT ETC standard, whereas the other aspects are generally highly received by trainees.

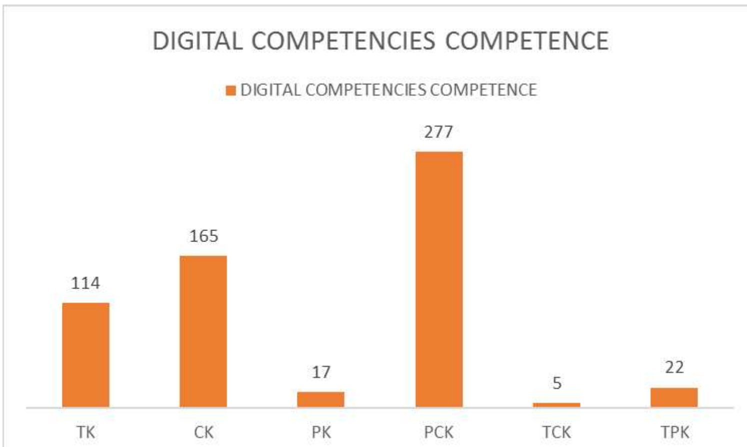

Figure 6. Digital Competencies Competence

The majority of people who rate themselves as GOOD in terms of accepting the UiTMT ETC Competency Standard in the Digital Competence category range from Beginner to Advanced, as shown in Figure 6. TCK and PK, on the other hand, receive the lowest scores among the elements in the UITMT ETC standard, while the other aspects are generally well-received by trainees.

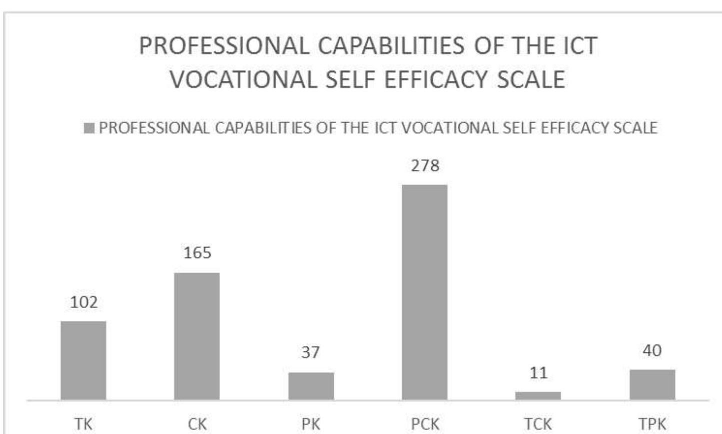

Figure 7. Professional Capabilities of the ICT Vocational Self Efficacy Scale

According to results from the Professional Competency Self Scale category, persons who rate themselves as Beginner to Intermediate rate themselves most frequently as GOOD in terms of their acceptance of the UiTMT ETC Competency Standard, as shown in Figure 7. The UITMT ETC standard's TCK and PK elements, however, receive the lowest scores overall, whereas the other elements are generally well-received by trainees.

Summary of the UITMT ETC Standard

According to Figure 8, majority of the educators at our institutions are able to accept the elements and criteria in our proposed UiTMT ETC Standard, as evidenced by the descriptive result using pre- and post-mean scores as band categories; this assessment approach is considered good towards our proposed standard. The results show that TCK (Technology Content Knowledge) and TPK (Technology Pedagogical Knowledge) are the most SCORE:GOOD components that are least accepted. This result appears to corroborate previous studies (Chaiya Akarawang et al., 2015; Bibi, 2017; Hersh, 2014) that suggest the knowledge of good pedagogical practises among educators may be lacking in technical ICT skills, which may prevent the potential for technology usage in universities from reaching the desired level among educators and students. It demonstrates that these components are crucial for combining technology, content, and pedagogy and should be emphasised during ICT/ET training at HEI. Due to the small number of sample respondents that were tested at our institutions, the descriptive analysis in this study should not be generalised as an overall response from educators in HEI in Malaysia.

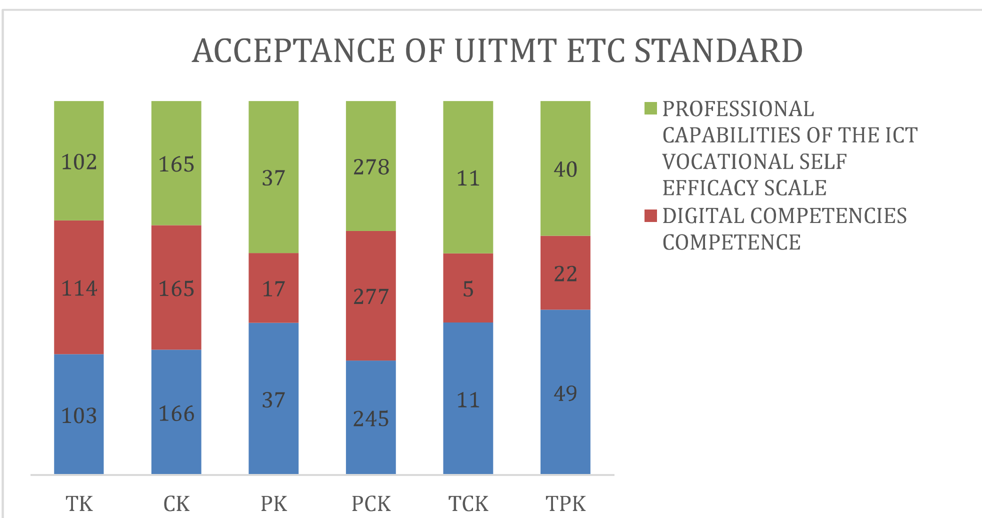

Figure 8. Acceptance of UiTMT ETC Standard

Research Methodology

Science philosophers have suggested that one of the most significant roles played by theoretical frameworks is that they direct observation. In order to make sense of the complicated web of relationships that emerges when educators try to apply technology to the teaching of subject matter, we used TPCK in our research. The study technique that will be used to generate the Educational Technology Competency Standard (ETC), which will be used in university settings, is depicted in Figure 8.

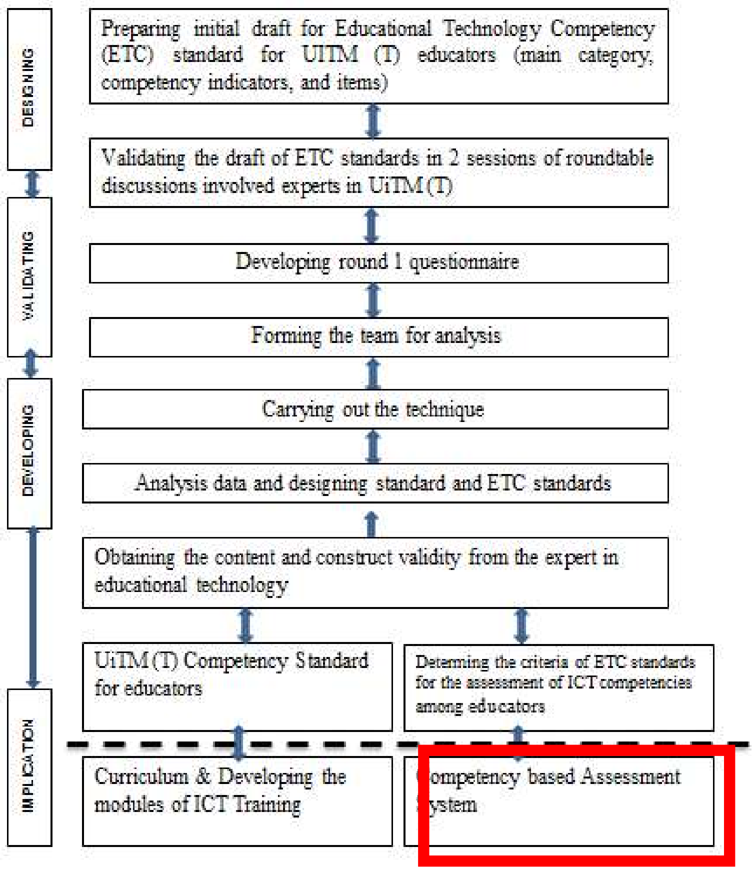

Figure 9. UITMT ETC Standard (Adopted: Research Methodology in Fong, Ch'ng, Por, & Abu Saada (2011))

This study also incorporates elements of the Delphi technique, which uses a group procedure to conduct surveys and gather expert opinions on a given subject (Hsu & Sandford, 2007). Using a variety of data collection and analysis tools, the Delphi technique is an iterative, multistage procedure used to reach consensus among experts (Fong et al., 2013). It is used whenever the basis for policies, programmes, or concepts must be sound judgement. Creating an instructional model is one of the reasons the Delphi technique is used (Linstone & Turoff, 2002). Figure 9 illustrates the process used to design, validate, and develop the instruments and items for the proposed ETC standards in our institutions using three (3) rounds of Delphi methodologies. The phase to which this paper refers is depicted by the red box square.

Problem Formulation

One trainee UiTMT ETC report who has taken three ICT-related training sessions was employed in this case scenario.

The steps of using any MCDM technique begin with the following 13 steps: -

1. Identifying the suitable weights.
2. Among the different methods of calculating weights, Geometric Mean Method is popular because of its simplicity and consistency.
3. Find the relative importance of different attributes concerning achieving the goal.
4. Construct a pairwise comparison matrix by taking a suitable scale as given in Figure 4.
5. When there is an M number of attributes the relative importance matrix is a square matrix of size M X M.
6. All the diagonal elements Relative Importance matrix are 1 Because the attribute is checked by itself.
7. The remaining elements are to be filled from table 0.11. By following the rule A1 ij= 1/ A1ji. Where A1 is Relative importance matrix.
8. Calculate the Geometric mean and weights
9. Calculate A3 and A4 matrices such that A3 = A1 X A2 A4 = A3/A2

Where A1 is the Relative Importance matrix and A2 is weight matrix [w1,w2, ….wj up to j attributes]

10. Calculate the maximum eigenvalue ʎmax, by taking the average of A4 matrix.
11. Determine Consistency index CI = λmax – M / M-1.
12. Obtain the Random index value from Figure 10 for the required attributes.

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Figure 10. Random Index Value

13. Calculate Consistency ratio: CR = CI / RI

In general CR value <0.1 is acceptable, if CR value is greater than 0.1, then we have to rethink the relative importance.

To each of the attributes in MC TKAF, the decision-maker assigns the important weights which become the coefficients of the variables. The steps are the following:

1. Determine Criteria from Alternative (Table 9)
2. Weightage for each criterion (Table 10 & 11)
3. Develop Normalization Matrix (Table 12)

4. Preference (which is the result is based on MCDM techniques used)

By using the assumption weightage, the result is based on the following table:

Pair Wise Comparison

Table 9. Weighted Normalized Decision Matrix

Weighted Normalized Decision Matrix											
Weight Criteria							Weight	Average	Consistency Measures		
	TK	CK	PK	PCK	TCK	TPK					
TK	1.00	2.00	3.00	3.00	3.00	3.00	0.19	0.03	12.87		
CK	2.00	1.00	2.00	3.00	3.00	3.00	0.18	0.03	12.86		
PK	2.00	2.00	1.00	3.00	3.00	3.00	0.18	0.03	12.86		
PCK	2.00	2.00	2.00	1.00	3.00	3.00	0.16	0.03	12.92	CI=	4.93
TCK	2.00	2.00	2.00	2.00	1.00	3.00	0.15	0.03	13.08	RI=	1.24
TPK	2.00	2.00	2.00	2.00	2.00	1.00	0.14	0.02	13.36		
TOTAL	11.00	11.00	12.00	14.00	15.00	16.00	1.00			C Ratio = 3.98	

Decision Matrix

Evaluate Alternative

Table 10. Base Data

Base Data						
	35	20	25	20	20	25
	TK	CK	PK	PCK	TCK	TPK
TRAINING A	20	15	15	15	15	15
TRAINING B	30	15	15	15	15	15
TRAINING C	25	20	20	10	10	20

Table 11. Normalised Data

Normalised decision Matrix	35	20	25	20	20	25
	TK	CK	PK	PCK	TCK	TPK
TRAINING A	0.57	0.75	0.60	0.75	0.75	0.60
TRAINING B	0.86	0.75	0.60	0.75	0.75	0.60
TRAINING C	0.71	1.00	0.80	0.50	0.50	0.80

Table 12. Weight for attributes

TK	CK	PK	PCK	TCK	TPK
0.19	0.18	0.18	0.16	0.15	0.14

SAW

This method can help in decision making for a certain case, and the calculation that generates the greatest value will be chosen as the best alternative (Karlitasari, Suhartini, & Benny, 2017). It is based on based on the weighted average (Jafari, Jafarian, Zareei, & Zaerpour, 2008). The formula using SAW are based on following criteria:

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$$S^* = \{S_i \mid \max_i \sum_{i=1}^{n} \mu_j^{c_1}(x) \times \mu_j^i(x) / \sum_{j=1}^{n} \mu_j^i(x)\}$$

Pi = normal (i)
Where wj is weight matrix, Mij Normal is a normalized matrix of basic table.
Formula for Normalization Matrix as following:

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$$x_n = \{\frac{x_n}{\max_i x_j}$$

$$x_n = \{\frac{\min x_n}{x_j}$$

The decision maker can then obtain a total score for each alternative simply by multiplying the scale rating for each attribute value by the importance weight assigned to the attribute and then summing these products over all the attributes SAW (Jafari, Jafarian, Zareei, & Zaerpour, 2008).

Table 13. SAW

	TK	CK	PK	PCK	TCK	TPK	
TRAINING A	0.11	0.13	0.11	0.12	0.11	0.08	0.67
TRAINNG B	0.16	0.13	0.11	0.12	0.11	0.08	0.72
TRAINING C	0.14	0.18	0.14	0.08	0.08	0.11	0.72

WPM

Weighted Product Method (WPM) is similar to SAW Method but instead of addition, there is multiplication in the model. The normalized values are calculated and each normalized value is raised to the power of relative weight. The alternative with highest Pi is the best alternative among others.
Pi= [normal] w j (ii)

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$$A^{*}_{WSM} = \max \sum_{i}^{m} a_{ij} w_j$$

Hata! Burada görünmesini istediğiniz metne Caption uygulamak için Giriş sekmesini kullanın..4

$$R\left(\frac{A_k}{A_l}\right) = \underset{j=1}{\overset{n}{\pi}} \left(\frac{a_{kj}}{a_{lj}}\right)^{wj}$$

Table 14. Rank of Training Type

	TK	CK	PK	PCK	TCK	TPK	
TRAINING A	0.90	0.95	0.91	0.95	0.96	0.93	0.66
TRAINNG B	0.97	0.95	0.91	0.95	0.96	0.93	0.72
TRAINING C	0.94	1.00	0.96	0.89	0.90	0.97	0.70

The final normalized weight is calculated to rank the training type. The highest value of final weight indicates the first rank of the training type. The final weight results for all techniques will be used to rank the three (3) training type for the best result on educators training program as shown in Table 14 respectively.

Although we can infer from this chart that Training B (Figure 11) has had a greater impact on this trainee's UITMT ETC Standard Competency than any other sort of training, there is some consistency in the results. However, based on the regularity of the results, we can state that this trainee succeeded in adapting to the UiTMT ETC Standard at a very Excellent level.

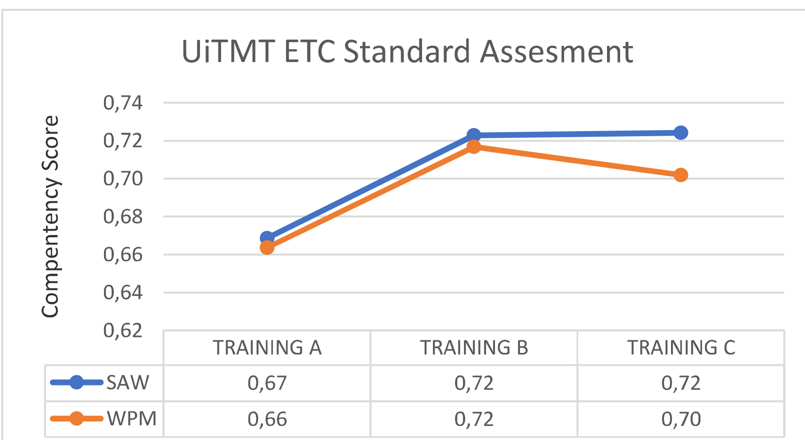

Figure 11. UiTMT ETC Standard Assessment

Digital / ICT Training Competency Based Assessment System

Below is the proposed Training Competency Assessment Based System (Figure 12) that been proposed to help the university administration to monitor their educators Digital/ICT Competency. This proposed flow chart is hoped to make the university administration are clear with their Digital /ICT training direction towards upgrading their educators in public HLI institutions to meet with Malaysia Ministry of Higher Education Blueprint 2015-2025 vision and mission.

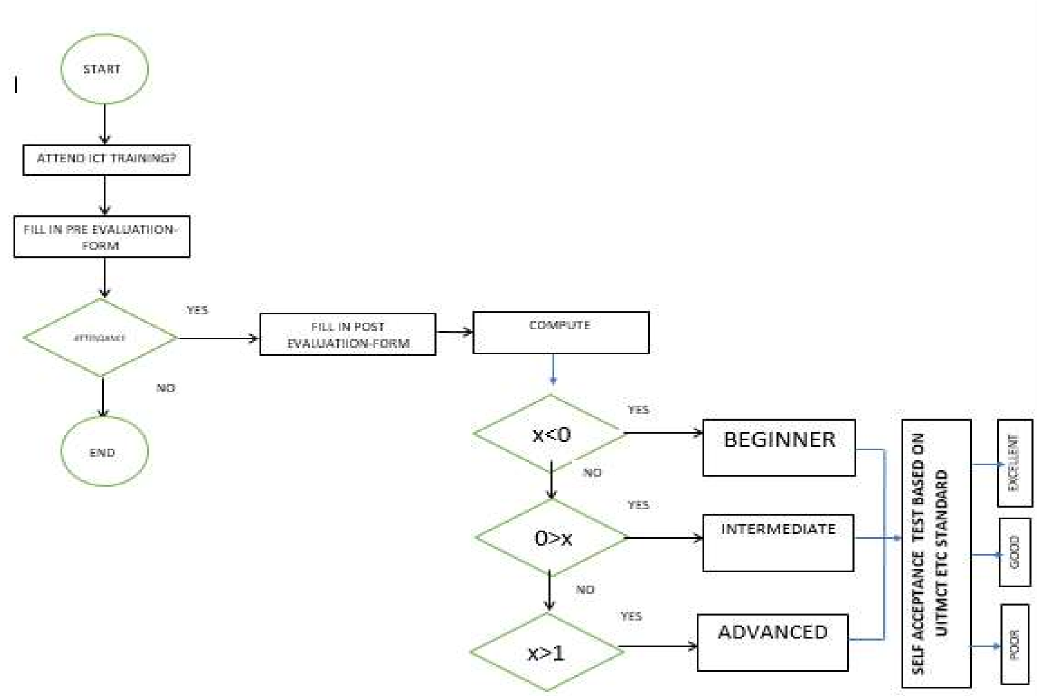

Figure 12. Flow Chart Training Competency Assessment

Discussion

To emphasise the significance of taking into account technological possibilities in light of developmentally appropriate practises and specific learning objectives in ICT/ET training provided for educators in HEI in Malaysia, it is nonetheless suggested that this assessment and study's findings be used as a guidance method for ETC Standard implementation in university settings. In this study, it is hoped that the following questions will be addressed:

1. What is the elements in TPCK which can used as standard in UiTM(CT) ?

A Standard using TPCK for UiTM (T) Educator as Educational Technology Competency Standard has been developed using delphi method via three round of analysis. Almost most elements in TPCK are accepted by the expert choice.

2. How to use TPCK to produce a practical standard for UiTM(CT) ?

Analysis the sample of Educators who used the standard be done, and the result showed that UiTMT ETC standard were well received by the respondents. This finding seems to support the research done by (C Akarawang, 2015) that indicates that the gap between technical ICT skills and the knowledge of good pedagogical practice among educators might disallow the potential of technology usage in University to reach the desired level among educators and students. It shows that these elements should be stressed out during the ICT/ET training in HEI as it is the most needed elements in integrating technology-content – pedagogy. The descriptive analysis in this study however should not be generalized as a whole response from educators in HEI in Malaysia due to limitation of sample respondents that has been tested in our institutions. Further detail analysis must be taken to carry out realistic result of the effectiveness of this proposed standard.. However to make sure that this UiTMT ETC Standard much more practical to be used, we would like to propose a Digital / ICT Training Competency Based Assessment System to evaluate educator competency using multi criteria decision making approach such SAW and WPM based on the standard.

Conclusion

However, the utilisation of ICT/ET instruments in the classroom is entirely dependent on the training and skills of our local educators. Therefore, it is imperative for UiTMT to establish a firm competency standard for their educators in order to ensure that the use of educational technology in the teaching and learning process is a worthwhile endeavour. In order to maximise the potential of Educational Technology instruments in Malaysian universities, this study will cast light on the context of the Educational Technology Competency (ETC) standard in a university setting. The findings of this study will contribute to the full utilisation of educator-student learning by introducing strategies that can be guided by the application of ETC Standards.

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