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Assessment Method for Potential Educational Technology Competency Standard based on TPCK in Malaysian 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 at university level has not reached the desired level among educators and students. What is the missing link for the realisation of the expected return-of-investment? Recent researches (C Akarawang, 2015; Bibi, 2017; Hersh, 2014) indicate that the problem is due to the gap between technical ICT skills and the knowledge of good pedagogical practice among educators. 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 highlighting the assessment method that was used during the implementation of ETC *standard in our institutions. Overall, the descriptive result using pre and post means scores as assessment method towards proposed standard shows that the educators' acceptance score in our institutions are mostly good. However the element within the standard least accepted are TCK (Technology Content Knowledge) and TPK (Technology Pedagogical Knowledge). The assessment and finding in this study nevertheless are suggested to be used as a guidance for ETC Standard implementation in university setting in order to stress the importance of considering technological possibilities in light of developmentally appropriate practices and specific learning goals in ICT/ET training provided for educators in HEI in Malaysia.*

Keywords*: educational technology; TPCK, ICT standard, university, educators, student*

INTRODUCTION

Educational technology plays an important role in improving educational outcomes and a promising future for tertiary students. Technology in education is designed purposely 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 efficiently and effectively. There are however cases in which technology in education can be frustrating and annoying for both parties. Usage of new IT is complex and multifaceted and, as research in psychology shows, cognitive models do not capture all of the antecedents of behaviours (Beaudry & Pinsonneault, 2010). Various researches (Guasch, Alvarez, & Espasa, 2010; Hechter, Phyfe, & Vermette, 2012a; Hennessy, Harrison, & Wamakote, 2010; Herrero *et al.*, 2015) have found that the value of educational technology is directly linked to the educators' capability in which the more knowledgeable the educators are on technology, the more the students are able to understand them.

Technology by itself does not necessarily cause more learning. For example, by having MOOC or Massive Open Online Course as a way to give free education worldwide may be a convenient way to learn, it however cannot immediately turn a person into a scholar. Another example is the bare use of interactive whiteboard to present information without any interaction. This has no real pedagogical advantage over traditional whiteboards. The use of interactive whiteboards to actively engage students with the subject matter through the use of technology would probably justify the additional expense compared to the cost of a traditional whiteboard. To date, schools are already widely equipped with interactive whiteboards in the U.K., the U.S., Australia, South Korea, and elsewhere (Kim, Kim, Lee, Spector, & DeMeester, 2013).

It is generally agreed that engaged students learn more and retain more of what they learn. As budgets tightens and pressure increases to deliver high-quality education at an affordable price, class enrollments have increased (La Roche & Flanigan, 2013). Technology integration involves perceptions and practices associated with technology use (Liu, 2011). Though technology has the potential to enhance student's engagement, it should not be used as a substitute for good old-fashioned teaching (La Roche & Flanigan, 2013) because teacher's pedagogical beliefs about technology integration can influence teaching methods when using technology (Liu, 2011). Within UNESCO standards, two types of knowledge should be possessed by educators nowadays which are knowledge deepening and knowledge creation. Knowledge deepening refers to a teacher's awareness of a variety of subject-specific technological tools and applications, and the ability to flexibly use ICT to create supports for students during problem-solving and project-related activities. Knowledge creation refers to teacher's ability to design ICT-based communities and communication channels in support of their students' learning (Martinovic & Zhang, 2012).

PROBLEM STATEMENT

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 education 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 realisation of the expected return-of-investment? Recent researches (Chaiya Akarawang, Kidrakran, & Nuangchalerm, 2015; Bibi, 2017; Hersh, 2014) indicate that the problem is due to the gap between technical ICT skills and the knowledge of good pedagogical practice among educators. Even though the need for solid ICT competency standard among educators has been discussed among researchers in many parts of the education world (Fong, Ch'ng, & Por, 2013; Sani, 2016; Sani & Arumugam, 2017), most research are focused on pre-school teachers but rarely in Higher Education Institutions (HEI) or at the university level. The purpose of this study is to identify the Educational Technology standard to be applied in university setting using TPCK (Technological Pedagogical Content Knowledge) as the basic framework (Abdullah, Yau'Mee Hayati, & Jantan, 2017). This paper will only highlight a part of the standard development in the assessment method that will be used during the implementation of ETC standard in our institutions. It is hoped to allow university management to review and regulate the educational technology efforts prepared to uplift the standards of teaching and learning to be in compliance with the Malaysia Education Blueprint 2015-2025 (Higher Education). This study is hoped to answer the question on the possible elements in TPCK that can be used as the foundation in producing Educational Technology Competency Standard in our local institutions.

SIGNIFICANCE OF THE RESEARCH

Knowledge deepening, as one of the teacher's competency standards in ICT (UNESCO, 2008) is much related to the skilled and constructive use of the subject-related technologies, related to the application of Technology Content Knowledge. Teachers noted that the strongest barriers preventing other teachers from using technology are their existing attitudes and beliefs toward technology, as well as their current levels of knowledge and skills (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Thus, if teachers are required to implement the kind of pedagogical change indicated in current educational reform agendas, professional development programmes must look beyond first-order barriers to the intrinsic, more complex second-order barriers of teacher's beliefs and how they influence ICT implementation in the classroom (Prestridge, 2012).

In this study, the main aim is to provide Educators' Technology Competency (ETC) Standard in our local university by using TPCK as the basic (Yau'Mee Hayati, Sarah Syazwani, & Nur Hazwani, 2015). This paper however will only discuss the finding of the pre-development of this study to drive the use of ETC standards among the educators about the elements that should be included in the standard. It is hoped to be a guidance roadmap for an ETC Standard in university setting that would ultimately contribute to the educator- student learning utilisation to the fullest. A part of our standard development is to highlight the assessment method that will be used during the implementation of ETC standard in our institutions. It is hoped to allow university management to review and regulate the educational technology efforts prepared to uplift the standards of educational technology in teaching and learning to be in compliance with the Malaysia Education Blueprint 2015 - 2025 (Higher Education).

METHODOLOGY

Research Framework

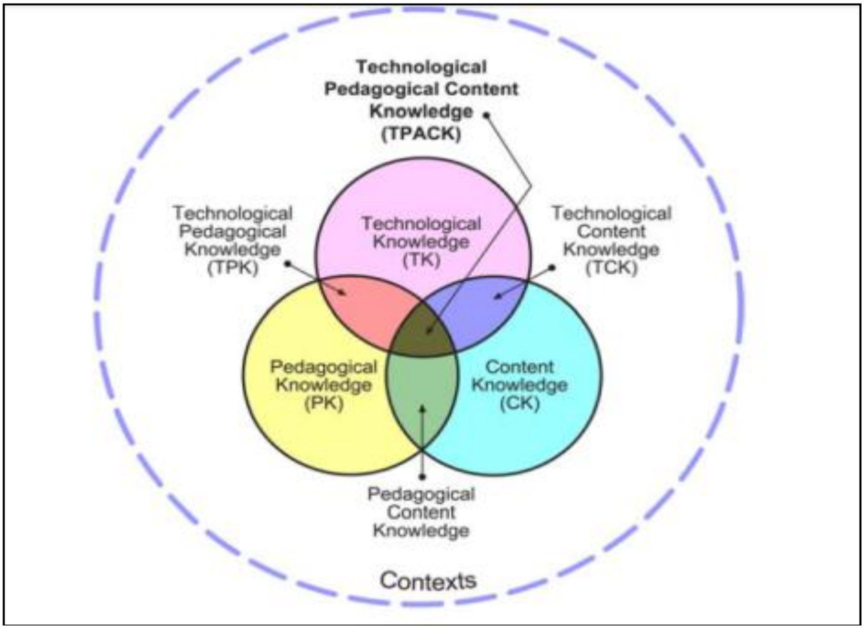


Figure 1: TPCK Framework
Adopted from: The components of the TPACK framework (graphic from TPCK - Technological Pedagogical Content Knowledge, 2010)

Technology Pedagogy Content Knowledge or TPCK (as in Figure 1) is a framework that emphasizes the importance of preparing pre-service teachers in making sensible choices in their use of technology when teaching specific content to a specific target group. According to this framework, technology integration required more than a single pedagogical orientation; it includes a spectrum of approaches to teaching and learning (Tondeur *et al.*, 2012). TPCK acts as a useful framework for preparing the knowledge that teachers must have in order to integrate technology into teaching and how they might develop this knowledge (Baran, Chuang, & Thompson, 2011). There are seven (7) components in this framework which can be seen in Table 1.

Table 1: Components of the TPCK framework

Technology knowledge (TK)	Knowledge of various technologies, ranging from low-tech technologies, such as pencil and paper, to digital technologies, such as the Internet, digital video, interactive whiteboards, and software programmes.
Content knowledge (CK)	Knowledge about the actual subject matter that teachers must know in order to teach.
Pedagogical knowledge (PK)	Knowledge about the methods and processes of teaching such as classroom management, assessment, lesson plan development, and student learning.
Pedagogical Content Knowledge (PCK)	PCK represents the blending of content and pedagogy into an understanding of how particular aspects of the subject matter are organised, adapted, and represented for instruction.
Technical Content Knowledge (TCK)	Technological content knowledge (TCK) is a knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations.
Technological Pedagogical Knowledge (TPK)	Technological pedagogical knowledge (TPK) is a knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, knowing how teaching might change as the result of using particular technologies.

TPCK represents a class of knowledge that is central to teachers' work with technology. This knowledge would not typically be held by technologically proficient subject matter experts, or by technologists who know little of the subject or of pedagogy, or by teachers who know little of that subject or about technology (Koehler & Mishra, 2009).

TPCK USAGE IN OTHER RESEARCH

The enthusiasm among both researchers and practitioners for the TPCK framework has been very strong in most countries around the world (Ansyari, 2015; Hechter, Phyfe, & Vermette, 2012b; Tajudin & Kadir, 2014). The framework has provided a valuable tool, both for designing teacher's education experiences and for assessing teacher's knowledge in the area of technology integration. The interest of using TPCK framework and the TPACK survey for designing and assessing teacher's knowledge in various international teacher education contexts is a clear indication of the worldwide impact of TPCK as an emerging research and development tool for teacher and educators (Baran *et al.*, 2011) as it is also used in research within ICT training among new teachers (Hofer, Grandgenett, Harris, & Swan, 2011; Hwee & Koh, 2013; Jordan & Dinh, 2012). TPACK provides a theoretical framework for measuring educators' knowledge required for effective technology implementation (Larsen, 2014).

Philosophers of science have argued that one of the most important functions played by theoretical frameworks is that they guide observation. So using TPCK in our research allows us to make sense of the complex web of relationships that exist when educators attempt to apply technology to the teaching of subject matter. Figure 2 describes the research methodology that has been planned to be executed to produce Educational Technology Competency Standard (ETC) to be implemented in university setting.

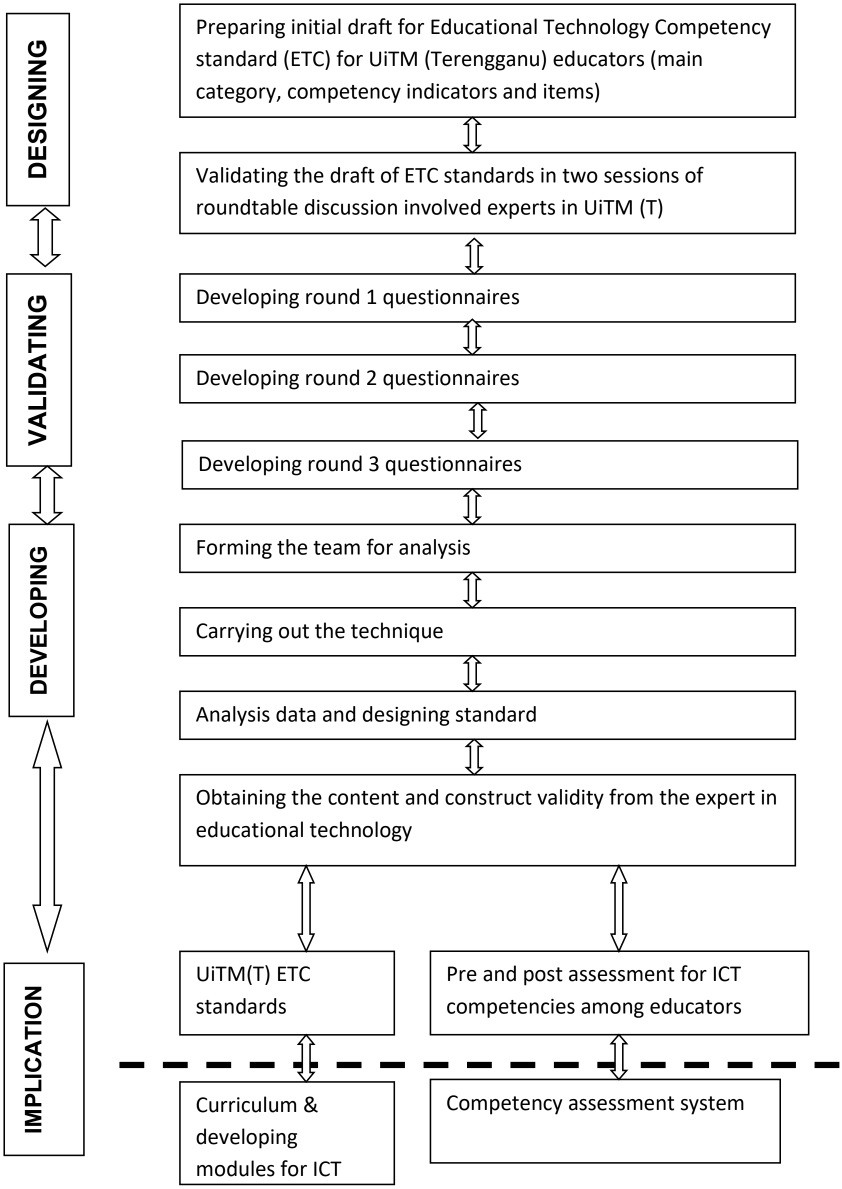


Figure 2: Educational Technology Competency (ETC) standard to be implemented in university setting

The proposed standard (Yau'Mee Hayati, Jantan, & Abdullah, 2016) may be relevant in many aspects of many university settings as it might have common shared mission, vision and also national aspiration in term of enhancing technology in education. There are a few considerations that need to be undertaken in this proposed standard which are to : 1) refine standards to suit local needs and conditions; 2) develop better indicators to evaluate ET/ICT training programme; and 3) improve educators' levels of ET/ICT competency.

PRE AND POST EVALUATION TRAINING

The pre-test is a set of questions given to participants before the training begins in order to determine their knowledge level of the course content (I-Tech, 2010). After the completion of the course, participants are given a post-test to answer the same set of questions, or a set of questions of comparable difficulty. Comparing participants' post-test scores to their pre-test scores enables the training provider to see whether the training was successful in increasing participants' knowledge of the training content. The selection of the content used for pre and post assessment are based on set of instrument by Albion, 2010; Jamieson-Proctor *et al*., 2013; Albion, Jamieson-Proctor, & Finger, 2010 in their previous study.

Table 2 : Pre and Post Assessment 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

RESULT

Reliability Test

The result of reliability test shows that all four measurement items used in Pre and Post are reliable (A: Interest in and Attitudes toward using ICT = 0.776 >1); (C and D: Validation of competence =0.741>1); (B Confidence = 0.703>1); (E: Life-Long Learning = 0.928>1). The measurement items are basically fit to be used in this survey.

Table 3 : A (Interest in and Attitudes toward using ICT)

Cronbach's Alpha	N of Items
.776	5

Table 4 : B (Confidence)

Cronbach's Alpha	N of Items
.703	20

Table 5: C and D (Validation of competence)

Cronbach's Alpha	N of Items
.741	6

Table 6: E (Life-Long Learning)

Cronbach's Alpha	N of Items
.928	12

Analysis from Pre and Post Tests

Comparing participants' post-test scores to their pre-test scores enables the training provider to see whether the training was successful in increasing participant knowledge of the training content. To do this, five randomly ICT /ET Courses has been conducted in January 2017 to Jun 2017. (See result in Appendix 1)

Grading Evaluation

The result of Pre and Post are then used to be a guidance map in categorising the band: Beginner (x<0), Intermediate (0>x>1) and, Advanced (x>1) according to Category Items as in Table 3 and Table 4. The number within Table 4 are the total number of trainee score according to band.

Table 7: Band Score

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

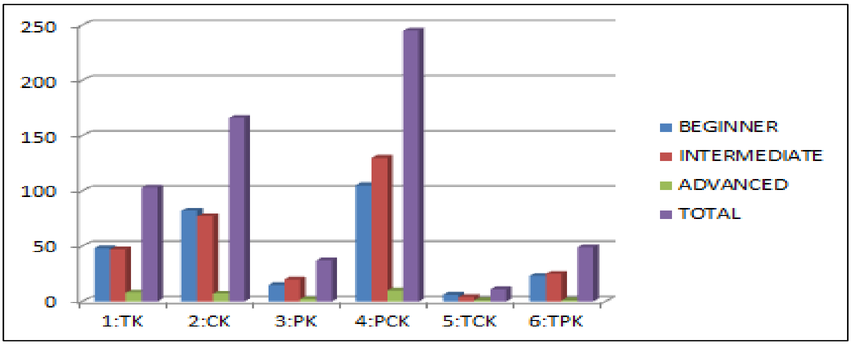
Table 8: Total Number of Trainee Score

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

From the 75 respondents in Pre Assessment and Post Evaluations conducted in five different ET/ICT courses in the local institutions averaging 15 participants each, only 35 respondents have completed their pre and post assessment. These respondents are then given the proposed UiTMT (T) ETC standard self-acceptance which their mean score of Pretest and Post Evaluation are filtered through three categories: Beginner, Intermediate and Advanced. The reason for this division is to make sure the standard can be adopted in ICT/ET training for our university educator ET/ICT training further usage in the selected aspects: ICT Application, Digital Competencies Competence and Professional Capabilities of the ICT Vocational Self

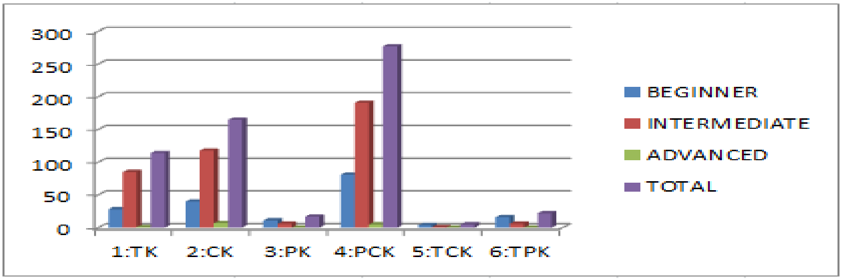
Efficacy Scale regardless of any band score. Only 19 participants are able to finish their Standard Self-Acceptance Test which enabled the researchers to get some ideas on how evaluate themselves based on the standard. The trainee are required to choose the scale ((5) 'extremely good' to 'extremely poor' (1)) to depict their acceptance towards the standards. The result of Standard Self Acceptance Test is based on scale 'good' score among the ICT trainees in the local institutions and it can be seen in descriptive Figure 3, Figure 4 and Figure 5.



Category/Standard Criteria	1:TK	2:CK	3:PK	4:PCK	5:TCK	6:TPK
Beginner	48	82	15	105	6	23
Intermediate	47	77	20	130	4	25
Advance	8	7	2	10	1	1
Total	**103**	**166**	**37**	**245**	**11**	**49**

Figure 3: ICT Competence Graph and Data Comparison according to Category

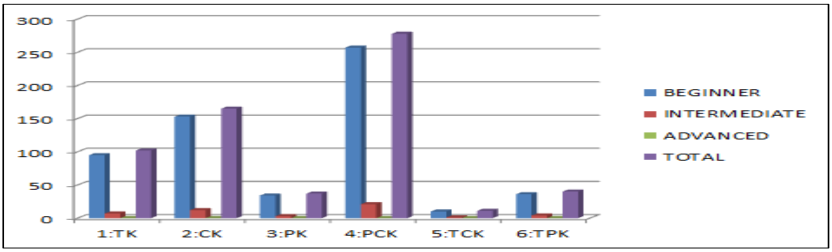
Finding in ICT Competence category shows that those who are from Beginner to Advanced evaluate themselves, majority as 'good' in term of their acceptance towards UiTMT ETC Competency Standard which can be seen in Figure 3. However, the least score of elements in the UITMT ETC standard are TPK and CK where else the other elements are well accepted by most trainee.



Category/Standard Criteria	1:TK	2:CK	3:PK	4:PCK	5:TCK	6:TPK
Beginner	28	40	11	81	4	16
Intermediate	85	118	6	191	1	6
Advance	1	7	0	5	0	0
Total	**114**	**165**	**17**	**277**	**5**	**22**

Figure 4: Digital Competence Graph and Data Comparison according to Category

Finding in Digital Competence category shows that majority rate themselves as good in terms of their acceptance towards UiTMT ETC Competency Standard which can be seen in Figure 4. However, the least score of elements in the UiTMT ETC standard are TPK and TCK where else the other elements are well accepted by most trainees.



Category/Standard Criteria	1:TK	2:CK	3:PK	4:PCK	5:TCK	6:TPK
Beginner	95	153	34	257	10	36
Intermediate	7	12	3	21	1	4
Advance	0	0	0	0	0	0
Total	**102**	**165**	**37**	**278**	**11**	**40**

Figure 5: Professional Competency Self Scale Graph and Data Comparison according to Category

Finding in Professional Competency Self Scale category shows that those who are from Beginner to Intermediate evaluate themselves majority as ‘good’ in term of their acceptance towards UiTMT ETC Competency Standard which can be seen in Figure 5. The least score of elements in the UiTMT ETC standard are TPK and TCK while the other elements are well accepted by most trainees.

DISCUSSION & CONCLUSION

Overall, the descriptive result using pre and post mean scores as band category; an assessment method among the educators in our institutions are considered GOOD towards our proposed standard, mostly are able to accept the elements and criteria in our proposed UiTMT ETC Standard. From the result, it can be seen that most elements within SCORE :GOOD that are least accepted are TCK (Technology Content Knowledge) and TPK (Technology Pedagogical Knowledge).This finding seems to support the research done by (C. Akarawang, 2015; Bibi, 2017; Hersh, 2014) 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 the 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 generalised 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. This assessment and finding in this study nevertheless are suggested to be used as a guidance for ETC Standard implementation in university setting in order to stress the importance of considering technological possibilities in light of developmentally appropriate practices and specific learning goals in ICT/ET training provided for educators in HEI in Malaysia.

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APPENDIX 1

Analysis from Pre and Post

C: ICT Application

MEAN S4		
POST	**PRE**	**GAP**
0.65	1.35	-0.7
1.1	1.8	-0.7
1.7	1.65	0.05
2.25	2.25	0
2.35	2.35	0
1.15	1.5	-0.35
2.4	1.85	0.55
3.05	2.55	0.5
3.65	3.85	-0.2
1.6	1.9	-0.3
0.6	1.45	-0.85
2.7	2.5	0.2
3.9	2.4	1.5
1.2	1.45	-0.25
2.45	2.3	0.15
1.85	1.85	0
1	1.35	-0.35
2	2.35	-0.35
3	2.85	0.15
1.55	1.95	-0.4
1.85	1.8	0.05
2.1	2.45	-0.35
2.5	2.4	0.1
2.6	2.35	0.25
3	2.2	0.8
2	2.25	-0.25

2.4	2.65	-0.25
1.7	2.15	-0.45
4	3.15	0.85
2	2.35	-0.35
3.75	2.6	1.15
1.65	1.9	-0.25
0.7	1.4	-0.7
0.85	1.6	-0.75
0.95	1.65	-0.7

D: Digital Technologies (ICT) Competence

MEAN S5		
POST	**PRE**	**GAP**
2	1.29	0.71
2.29	2	0.29
2.71	1.57	1.14
3.71	3.14	0.57
2.29	2	0.29
2	1.43	0.57
2.43	2	0.43
4	3.43	0.57
4	3.86	0.14
2.71	2.71	0
0.86	1.43	-0.57
3	3	0
4	2.71	1.29
0.29	1.86	-1.57
3	2.71	0.29
2.57	1.86	0.71
2.43	1.43	1
3	2.14	0.86
4	3.29	0.71
2.43	2.57	-0.14
2	1.86	0.14

3	3.14	-0.14
3	3.14	-0.14
2.86	2	0.86
3	2.14	0.86
2.86	2.57	0.29
4	3.29	0.71
3	3.14	-0.14
4	3	1
3	3	0
4	3.71	0.29
3	2.57	0.43
1.71	1.43	0.28
3	2.86	0.14
2.43	1.43	1

E: The Professional Capabilities of the ICT Vocational Self Eficacy Scale

MEAN S6		
POST	**PRE**	**GAP**
2	2.17	-0.17
2.29	4	-1.71
2.71	3.5	-0.79
3.71	4.17	-0.46
2.29	3	-0.71
2	2.42	-0.42
2.43	4	-1.57
4	5	-1
4	4.75	-0.75
2.71	3.83	-1.12
0.86	3.42	-2.56
3	4	-1
4	4.58	-0.58
0.29	3.83	-3.54
3	4	-1

2.57	3	-0.43
2.43	3.17	-0.74
3	4	-1
4	4.42	-0.42
2.43	3.92	-1.49
2	3.67	-1.67
3	4	-1
3	4	-1
2.86	4	-1.14
3	4	-1
2.86	4	-1.14
4	4	0
3	3	0
4	4	0
3	4	-1
4	4.08	-0.08
3	3.58	-0.58
1.71	3.25	-1.54
3	3.83	-0.83
2.43	3.08	-0.65

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