Measuring Teachers' Readiness to Use Technology: Pedagogical and Content Knowledge (TPACK) pilot study

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Abstract - *Accepted as an integral part of education, technology in teaching and learning can enhance practice not only in the traditional class but also beyond it. Schooling can now be extended to learning beyond the four enclosed walls of the classroom into the almost limitless possibility of education across time and space accessible via the domain of cyber technology. The significant contribution of technology to education has prompted educational bodies like the Malaysian Ministry of Education to prominently point out that online learning becomes the main pedagogical approach in higher learning institutions in the nation's educational blueprint. The powerful potential of technology however, can only be realised through informed and purposeful use of it by teachers. Integrating technology in the language classroom requires that teachers not only have knowledge about the Technology but interplay between three components of knowledge – Technology, Pedagogy, and Content Knowledge (TPACK) which determines the essential qualities of teacher knowledge that are required when teachers employ technology in their teaching. The main study is therefore designed to measure teachers' readiness to use technology in teaching English language in tertiary level classrooms to enhance student learning. To serve this purpose, a pilot study was carried out on 20 English language instructors to evaluate the reliability and the validity of a questionnaire that was adapted to gauge instructors' readiness in carrying out technology-mediated classrooms at a public university in Malaysia. Correlations among items in the current study reveals lower coefficients compared to a previous study on the same instrument probably due to the smaller sample size in the current study but the correlationships are mostly positive which still suggests convergence validity. The internal consistency of the items was mostly better than two previous similar studies. Five items that seemed to be misbehaving in their respective measures were chosen based on their inter-item correlation and the item-total statistics and scrutinized via cognitive interviews with selected respondents to gain insights into the items but the results of the interviews revealed that the items are functioning as intended.*

Keywords: Technology, pedagogy, content knowledge, teacher knowledge, higher education.

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1 Introduction

In the digital age that the world is currently experiencing, technology permeates almost every aspect of day to day life so much so that any event not touched by technology is a rarity. Proven in many situations as an integral part of education, an educator must get to grips with the impact of technology or lack thereof. If this is so, to what extent technology is used effectively and how well it is being used in the classroom are crucial issues to consider ensuring that learners do not miss out on any benefits that may come with technology-mediated classrooms.

The main aim of this research is to adapt and validate the TPACK instrument for higher education language teachers. A widely-used instrument on technology integration in the classroom was adapted and adopted for use to suit the context of the study.

The paper begins with the introduction to the topic and main aim of the study in Section 1 followed by the background to the study in Section 2. Section 3 spells out the problem statement and the research questions. Section 4 follows by discussing the methodology and the instrumentation. Results and findings are described in

detail in Section 5 and the paper ends with Section 6 in a discussion that highlights issues found and their significance as well as recommendations for future directions.

2 Background of the Study

Instrumentation play an important role in research. Instruments enable researchers to observe, measure and make sense of the phenomena being studied. While many instruments are readily available, it is crucial to ensure that an instrument's use suit the objective and context of the study. Often, the pre-existing instrument need to be adapted to suit the specific context of the study, thus needs to be validated.

2.1 Instrument development

Van de Vijver (as cited in Harkness, 2003, p. 233) specifically stated that "statistical sophistication in data analysis cannot compensate for poor quality of study design" and instrumentation often falls victim to this oversight. An effective measurement instrument takes into consideration key aspects that include the purpose it is built for, the target population, the construct domain, the method to be employed, the time and duration of administration and lastly the place and context it is to be used. McKennel (1974) described the process of concept clarification of a study design into 3 stages which are the qualitative pilot which attempts to classify and describe the content, the scale development pilot which deals with the structure of the instrument and the main survey stage which explores the context of the study. The steps to be taken during scale development and writing items for an instrument begins with identifying the purpose or purposes, defining the construct and content domain, followed by creating a test blueprint. Once these are completed, initial item pool is generated which are then reviewed by experts as well as laypersons to see the suitability of the items. Dillman (2000) and Schuman and Presser (1996) provide helpful guidelines on how this should be done. Pretesting of the items can be carried out to identify problems with the items and check if they really work for the purpose that they are designed (Presser & Blair, 1994) and some methods used are conventional pretests, behavioural coding, cognitive interviewing and expert panels. Pilot testing using the conventional pretest involves a representative sample to assess for reliability, validity, utility and practicality is usually done once the preliminary try outs have weeded out bad items.

Many researchers have opted to adapt and adopt established instruments to carry out their own studies. However, the steps in scale development and pretesting are still required to ensure measurement items are relevant and suitable for the objectives of their study. A pilot study to evaluate the instrument for reliability, validity, utility and practicality must be carried out and poor items removed or revised.

2.2 TPACK development and use

In this study, the Technological Pedagogical Content Knowledge (TPACK) framework (see Figure 1 below) was developed and used by Mishra and Koehler (2006) to measure the types of knowledge teachers have and need, to enable them to integrate technology within a complex, intricate and situated nature of teacher knowledge. This framework was developed from the knowledge bases of teacher education. According to Harris and Hofer, 2011, p. 212), "TPACK is a specialized, highly applied type of knowledge that supports content-based technology integration." These knowledge bases concern the information that teachers should have, know, and understand that can support them to reflect and enhance pedagogical practices. It is the interplay between the three components of knowledge – Technology, Pedagogy and Content Knowledge (TPACK) that determines the essential qualities of teacher knowledge that are required when teachers integrate technology in their pedagogical practices (Koehler & Mishra, 2009; Mishra & Koehler, 2006).

The components are based on the constructivism theory of learning enhanced with the power of Web 2.0 (Mishra & Koehler, 2006). Constructivism puts emphasis on experience as part of learning and to do this in the formal learning situation, active learning and learner-centeredness are crucial. Misha and Koehler added that to promote active learning and learner-centeredness, group work is highly recommended. This framework also emphasizes the use of cognitive tools to achieve success in the next age (Mishra, Koehler, & Henriksen, 2011).

Since its inception, TPACK has been used to measure the types of knowledge teachers have and need, to enable them to integrate technology within a complex, intricate and situated nature of teacher knowledge (Koehler & Mishra, 2009). Schmidt *et al*. (2009, p. 125) put forth that "Using TPACK as a framework for measuring teaching knowledge could potentially have an impact on the type of training and professional development experiences that are designed for both preservice and in-service teachers." Consequently, TPACK has been used to examine the knowledge bases of instructors from various disciplines such as mathematics (Handal, Campbell, Cavanagh, Petocz, & Kelly, 2013), Geography (Su, Huang, Zhou, & Chang, 2017), and Science (Bilici, 2016).

In English language teaching, TPACK has been used to examine the knowledge bases of pre-service teachers (Baser, Kopcha, & Ozden, 2016), in-service teachers pursuing graduate studies (Hossein and Kamal, 2012; Zoch & Myers, 2017), and EFL students (Hasniza Nordin & Tengku Faekah Tengku Ariffin, 2016; Tseng, 2016).

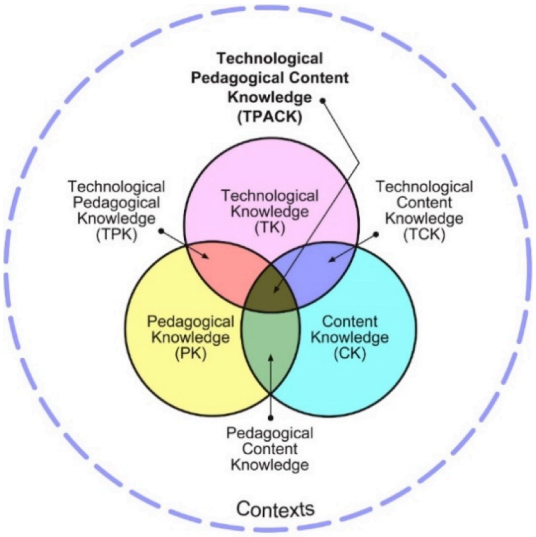

Figure 1: TPACK Framework (Reproduced by permission of the publisher, © 2012 by tpack.org)

3 Problem Statement and the Research Questions

While the studies above have investigated the knowledge that these teachers have, there is a greater need to measure their readiness based on the TPACK framework and for under explored contexts such as university level English language teachers. This study is therefore aimed at designing an appropriate instrument that can indicate English language teachers' level of TPACK to measure their readiness to use technology in teaching English language in tertiary level classrooms to enhance student learning.

The two research questions to be dealt with in this pilot study are as follows.

I. Are the items in the TPACK framework suitable to measure teachers' readiness to use technology in teaching English language in tertiary level classrooms?
II. Are the scores obtained from the adapted instrument valid and reliable?

4 Methodology

This pilot study employed both quantitative and qualitative approaches to investigate tertiary level English language teachers' TPACK responses. For the quantitative stage, a questionnaire was adapted from a previous study by Hosseini and Kamal (2012) which not only reviewed studies using TPACK- based questionnaire but also thoroughly reviewed commonly used items in the questionnaire from each component of the framework. This current study used the same seven main components of the original TPACK of Mishra and Koehler (2006) which are Technology Knowledge (TK), Pedagogy Knowledge (PK), Content Knowledge (CK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). The items themselves are those borrowed from Hosseini and Kamal's (2012) work. The items in the TPACK are measured using a 5-point Likert scale ranging from 1 Strongly Disagree = SD; 2 Disagree = D; 3 Neither Agree/Disagree = N; 4 Agree = A; and 5 Strongly Agree = SA.

The items for each TPACK component were selected based on their respective overall alpha readings as shown in Hossein and Kamal (2012). An item if deleted from the component caused a drop in the overall alpha value is deemed crucial for the component and was retained. For example, in the Technology Knowledge (TK) component where the overall Cronbach alpha was .91 the item "I know how to solve my own technical problems" was selected as removing it would reduce the overall alpha for the TK component to .895. If a deleted item caused an increase in the overall alpha value, it will not be included for the component.

Once the relevant items for each component were identified and compiled to be part of the instrumentation, the research team carried further analyses of the items to ensure that they fit the requirements a good item that fits the purpose of the main study. As a result, modifications were made to two items in the PCK component because these items were consisted of two different aspects which may cause confusion to the intended participants of this study. The revisions are shown in Table 1.

Table 1: Revision of two PCK component items

Original PCK:	I know how to select effective teaching approaches to guide student **thinking and learning** in English language
Revised: PCK 12	I know how to select effective teaching approaches to guide student **thinking** in English language
PCK 13	I know how to select effective teaching approaches to guide student **learning** in English language
Original PCK :	I know **how and what** to assess for English language
Revised: PCK 14	I know **how** to assess for English language.
PCK 15	I know **what** to assess for English language.

The complete instrument is made to consist of two main sections – A and B. Section A elicited participants' demographic information. This information consisted of age, gender, academic qualifications, employment status, and years of teaching English language. Section B consisted of all selected items representing the TPACK components in the teacher knowledge bases. In total there were 27 items in this section.

A print copy of the questionnaire was distributed as a pilot study to a randomly selected group of 20 respondents from a list of 40 English language instructors who were representative of the intended participants of the main study. There were 14 females and 6 males with ages ranging from 25 to 55 years of age. All respondents have a bachelor's degree with most majoring in TESL and English Language while 12 have a master's degree and 2 holds a Ph D degree. Upon obtaining their consent, the respondents were each given the instrument to be completed and collected within the same day on an agreed time. The duration of this whole study was six weeks.

5 Results and Findings

Correlations among items in the current study reveals lower coefficients compared to a previous study by Hosseini and Kamal (2012) as shown in Table 2 below. This may be due to the smaller sample size in the pilot study. However, the correlationships are mostly positive which suggests convergence validity of the items.

Table 2: Correlations of this study (bottom) and Hosseini & Kamal's (top)

Components	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	-	.66**	.48**	.59**	.27	.50**	.69**
CK	0.06	-	.47 **	.89 **	.48**	.58**	.72**
PK	-0.08	0.35	-	.64 **	.55**	.81**	.79**
PCK	0.05	0.61**	0.53*	-	.66 **	.64**	.76**
TCK	0.56*	0.46*	0.09	0.35	-	.48**	.64**
TPK	0.34	0.12	0.30	0.01	0.57*	-	.75**
TPACK	0.22	0.33	0.56*	0.34	0.60**	0.84**	-

** Correlation is significant at the 0.01 level (2-tailed).
n1 = 20; *n2* = 236

The data obtained were also analysed to assess for internal consistency of the items in each of the TPACK component based on Cronbach α. The overall α is .90 which shows a high internal consistency among the various items throughout the whole instrument. Scale reliabilities on each of the 7 measures range from the lowest of .64 for the CK component to the highest of .93 for the TK component. The other measures reveal an alpha value of .85, .79, .79, .80, and .85 for PK, PCK, TCK, TPK and TPACK respectively. In spite the small sample size, the internal consistency of the items were as good as or better than two previous studies as shown in Table 3 below.

Table 3: Comparison of internal consistencies of items in 3 studies

Components	α		
	Current Study	Hosseini & Kamal (2012)	Hasniza Nordin & Tengku Faekah Tengku Ariffin (2016)
TK	.93	.91	.82
CK	.64	.81	.85
PK	.85	.85	.88
PCK	.79	.90	.85
TCK	.79	.87	.84
TPK	.80	.89	.79
TPACK	.85	.90	.84
Total items	27	50	37
n	20	236	150

Upon examining the inter-item correlation matrix and the item-total statistics of each measure, several items were found to have low correlations with items in their respective components and if deleted would raise the Cronbach α of the whole measure. The items identified were TK2: *I can learn technology*, PK4: *I can adapt my teaching style to different learners*, PCK4: *I know what to assess for English language*, TPK3: *I am thinking critically about how to use technology in my English language classroom* and TPACK3: *I can provide leadership in helping others to coordinate the use of English language content, technologies, and teaching approaches at my faculty*.

To obtain a better understanding of the behaviour of the suspicious items above, cognitive interviews were conducted. Ten instructors who completed the questionnaire had volunteered for an interview by indicating their consent at the end of the survey. They were also selected based on their answers which are deemed different from the rest of the group by endorsing extreme responses at either end of the scale. Three participants requested for the interview to be conducted through the telephone while the rest agreed for a face-to-face individual interview in a location where participants were alone with the interviewer/researcher. The cognitive interviews were conducted over a period of four weeks. The responses from both the phone and face-to-face interviews were transcribed verbatim.

Four participants were interviewed regarding TK2 because they responded either strongly agree or strongly disagree. For the 2 who responded strongly disagree, they admitted that they are not very good when it comes to technology. One participant reported that, 'But other things such as video conferencing, uploading lessons, how to do that? I see useful videos and YouTube and I don't even know how to download! Morpheus is useful, you have quiz but how do to do it?*'*. For the other two who responded strongly agree, they claim that using technology is easy. In the words of one respondent, 'I believe I can learn it easily compared to older people like Mr. X (a senior lecturer) and you (the researcher). I compare myself with these older ones when I was responding to this statement it.' Three out four interviewers say they can and are willing to learn to use technology while one reported that she 'cannot learn technology easily, because there are too many steps in learning it … I can learn if I want to but I don't see the point, there's not much benefit in it for me.' However, all four participants view technology in teaching as only 'using computers and the Internet' disregarding other forms of technology.

For PK4, only one participant was interviewed who rated the item as strongly agree and her justification for it when asked was that she adapts her teaching strategies to student's learning styles, proficiency level and 'context' in the curriculum. Recalling on her previous experience teaching at a school as compared to the university, she claimed that, *'*Teaching style to me means strategies – either student centred, or teacher centred. … The high school students were smart so I was more student centred. Here at the university I am more teacher centred especially, the students are not high achievers.'

Two participants were interviewed for PCK4, where one disagrees while the other strongly agree. When asked why the disagreement, the participant claimed that *'*This statement was from a flow of the previous one (I know how to assess for English language – the respondent had responded SA to it) While I know how to assess I have no idea what to assess*.'* There seems to be a disconnect here even though the participant has been teaching for more than 20 years in school and in university. This may have an impact on how the item behaves in the study if this is prevalent among teachers. For the participant who strongly agree to the item, the justification for the response was that when she 'was completing this statement, I was thinking of the subjects I was teaching. I responded strongly agree to this statement because the marks moderation meeting tells me that my marks is similar to others.'

For TPK3, 2 respondents who stated strongly agree and one who strongly disagree were chosen to seek clarification for the differences. The 2 who strongly agree say that they do think critically about the use of technology because they decide when and how to use technology when it is most effective. As one pointed out 'if I can do something effectively on paper, why use technology*?*' and the other responded with 'Thinking critically means finding ways to include technology in the lesson and also outside the classroom such as their use of social media*.*" For the participant who disagree, she admitted that she does not do critical thinking in using technology because to her it is 'extra work'.

For the last item, TPACK3, only 2 participants were interviewed. One strongly agree while the other strongly disagree. One of the reasons given by the participant who strongly agree to the statement was that he has 'the knowledge on technology use in teaching and learning and can provide the leadership that is required.' He also claimed that he has offered recommendations to lead but the offer has yet to be investigated. The participant who strongly disagree to the item justified his response by saying technology is something to do with online learning and he has never learned to use that technology so claimed that he cannot lead when he is not knowledgeable enough to do it. He stated that "if other technology such as PowerPoint I can lead but that's not online is it?"

From the interviews, the responses from these participants indicated the items were mostly functioning as intended. They all fully understood what each of the selected items were asking. These findings indicated that further revisions of the items in Section B were unnecessary. The only issue that came up during the interviews were the varied interpretations of what technology in teaching is all about. Two of the respondents argued that technology in teaching involves learning management systems while three view educational technology as anything to do with new devices of software.

6 Discussion and Recommendations

Nevertheless, in the design of the questionnaire for the actual study, an item was added to Section A (Demographic Information) which required the participants to briefly explain what technology in teaching is to them. Their explanation to this item is important to shed light on items that refer specifically to technology in the TPACK instrument. Another section (Section C) was also added to the questionnaire to invite voluntary participation for the face-face to interview which is the qualitative aspect of the main study. The questionnaire consisting of three sections (Section A, B, and C) has been distributed to all English language instructors in the institution.

Further analyses need to be carried out to validate the adapted instrument to asses for its reliability and validity before any worthwhile interpretations can be made from its use. It was reported that a TPACK version used with chemistry teacher trainees showed four types of validity which are convergent, discriminant, factorial and predictive validities (Feng, Chai, So, Qian, & Chen, 2017). Feng *et al.* (2017) carried out both exploratory and confirmatory factor analyses as well as a factorial analysis on gender to come out with the results. The next step for this study is to carry out similar analyses on the final version of the instrument above.

Acknowledgements

This research was supported by Universiti Malaysia Sarawak through the Scholarship of Teaching and Learning Grant No: C02/SoTL7/1346/2016(7)

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