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The Development of the Survey of Technology Use, Teaching, and Technology-Related Learning Experiences among Pre-Service English Language Teachers in Indonesia

ABSTRACT
This study aims to design a survey instrument that can be used to collect information on the relationships between the ICT-related learning experiences of the English language pre-service teachers in Yogyakarta, Indonesia, and their technological pedagogical content knowledge (TPACK). Qualitative and quantitative research methods were used to analyse the degree of the reliability and validity of the instrument. The result suggests that this instrument meets the general requirements to be used in a larger scale of work in investigating the role of pre-service teachers' experiences in learning to use ICT in their pedagogical practice in influencing the development of their TPACK.
Keywords: learning experience; technological pedagogical content knowledge (TPACK); validity; reliability

INTRODUCTION
The purpose of this study is to develop an instrument that can be used to examine the relationship between the technology-related learning experiences of the English language pre-service teachers at a teacher training institution in Yogyakarta, Indonesia, and their current level of Technological Pedagogical Content Knowledge (TPACK). TPACK is a current framework which emerged as a response toward the ineffectiveness of Information and Communication Technology (ICT) to influence educational improvement and student learning achievement. Successful ICT integration in learning and teaching consider technology not as an

end in itself but it needs to be related to the content of school subject, good pedagogy, and classroom context (Mishra & Koehler, 2006).

This study is important within the recent context of education in Indonesia. The Indonesian Ministry of Education (MoNE) has mentioned that Indonesian teachers need to integrate ICT in the learning and teaching process (Ministry of National Education, 2007a; Ministry of National Education, 2007b; Ministry of National Education, 2009). To support the ICT integration MoNE has invested in the provision of ICT infrastructure in schools (Ministry of National Education, 2010) by providing schools with computers, Internet connection and online learning content (p. 28, 31). MoNE has also invested in various ICT-related teacher professional developments (The United Nations Educational, Scientific and Cultural Organization [UNESCO], 2007; Belawati, 2005).

ICT has the potential to contribute to the improvement of Indonesian students' English language proficiency. The Internet has made access to authentic materials, vast linguistic resources and an exhaustive range of materials in all languages easier. Thanks to the Web 2.0 technology, teachers and students of languages are able to communicate with each other across the globe. With ICT, learning languages is no longer confined within school walls. Students' preferred learning styles can also be catered for by the use of ICT. However, this potential of ICT will be realized if teachers' use of ICT in the classroom is guided by principles of good curriculum design and pedagogy for teaching English.

Within this context, the role of pre-service teacher education becomes crucial as it serves as the initial and primary source of teachers' knowledge. Putnam and Borko (2000) argue that "How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned" (p. 4). What teachers learned during their pre-service study would influence the way they teach as in-service teachers. Teachers' knowledge base needs to be expanded to include knowledge of ICT use in education that is closely connected with curriculum and good pedagogy. TPACK has become the framework for restructuring teacher education programs in preparing teachers to teach with technology.

There have been a number of studies that develop instruments to measure the teachers' TPACK (Koehler & Mishra, 2005; Koh, Chai, & Tsai, 2010; Sahin, 2011; Schmidt et al., 2009/2010). Koehler and Mishra (2005) conducted a survey to assess the impact of a certain course on educational technology in influencing the participants' perception of their understanding of content, pedagogy, and technology. Thus, this instrument is subject-specific. Schmidt et al. (2009/2010) designed a survey that measured teachers' understanding of each component of TPACK. Even though they claim that their survey was designed for general contexts and multiple content areas (p. 128), this survey is still content and context specific as it is designed to be used by K-12 pre-service teachers in the U. S. who are prepared to teach science, mathematics, social studies, and literacy. However, the items within each of these subjects are noticeably similar while there are differences in the content and pedagogy of each subject. Sahin (2011) also developed a TPACK survey for more general use. His survey is intended to measure the TPACK of pre-service teachers regardless of their major. Koh, Chai, and Tsai's (2010) instrument was designed for general use as well but

within Singapore educational contexts. Since the TPACK framework itself indicates that the effective use of technology has to be context-specific, the instrument needs to be specifically developed for a particular school subject within the unique classroom context surrounding the teaching of that subject.

Teacher knowledge is influenced by their learning experience. Research on effective teacher professional development (PD) suggests that ICT-related teacher PD should value teachers as adult learners and be conducted in a constructivist instructional approach to facilitate meaningful learning (Hawley and Valli, 1999; Garet, Porter, Desimone, Birman, & Yoon, 2001; Desimone, 2009). Most importantly, ICT-related teacher PD needs to be seen as a systematic effort by taking into consideration teachers' contextual factors in the PD design to influence changes in teachers' classroom practices to enhance student learning (Guskey, 2000; Desimone, 2009).

The existing survey instruments on TPACK were designed for the educational context of the Western, developed countries that have different sociocultural factors from Indonesia and they did not attempt to tap teachers' perceptions on their ICT-related learning experience. Besides, there is a lack of data on how the principles of quality ICT-related teacher PD work in the Indonesian educational context. Therefore, it is important to design an instrument that can measure the level of TPACK of Indonesian pre-service teachers and their perceptions concerning the quality of their ICT-related learning experiences.

Considering the existing instruments are usually written for school subjects such as Math, Science, and Social Studies, the present study modifies the work of Schmidt et al. (2009/2010) and Sahin (2011) on the TPACK survey by incorporating Indonesian English language teachers' pedagogical content knowledge into the teachers' TPACK measurement instruments. Since the TPACK level of Indonesian EFL pre-service teachers and their learning experience that shape the current development of their TPACK have not been studied yet, this study attempts to bridge this gap. Thus, the question addressed in this study is whether the survey instrument developed in this study valid and reliable to measure the TPACK levels of the English language pre-service teachers at a teacher training institution in Yogyakarta, Indonesia.

The questionnaire may become a basis in evaluating the outcome of pre-service education institutions in Indonesia, particularly their graduates' readiness to use ICT in their pedagogical practices. The questionnaire may also be useful to inform the development of effective interventions to assist the Indonesian English language pre-service teachers in developing their TPACK.

FOREIGN LANGUAGE TEACHERS' TPACK

The idea of TPACK has been built on Shulman's notion of pedagogical content knowledge (1986, 1987). Shulman (1987), as cited in Mishra and Koehler (2006), argues that teacher's knowledge consists of "content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts and knowledge of educational ends, purposes, and values, and their philosophical and historical grounds" (p. 8). He went further by stating that content knowledge and pedagogical knowledge intersected in the minds of the teachers (Figure 1);

thus, making the pedagogical content knowledge (PCK) central in the body of knowledge of teaching.

Mishra and Koehler (2006) propose a framework that includes the integration of technological knowledge into the pedagogical content knowledge. They stated that in order to realize the potential of ICT in the teaching and learning process, teachers needed to develop a knowledge that showed a connection and interaction among technological knowledge, content knowledge and pedagogical knowledge (Figure 1). In addition to Shulman's categorization of teacher's knowledge, Mishra & Koehler's framework yields to the development of technology knowledge, technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge.

Technology Knowledge (TK) refers to the skills to use the technology. Teachers need to show the ability to use the standard technology like the black/white board, textbooks, visual aids, or the new technology like the Internet and digital video. Including in this knowledge are teachers' skills to operate computer system and hardware, and use software tools like word processors, PowerPoint, spreadsheet, web browsers, e-mail, and instant messaging. Digital technology is continuously changing. It is imperative for teachers to have the ability to keep up and adapt with the changes in technology. In addition, teachers should also need to decide whether the technology supports or hinders the attainment of the purpose of the lesson (Mishra & Koehler, 2008).

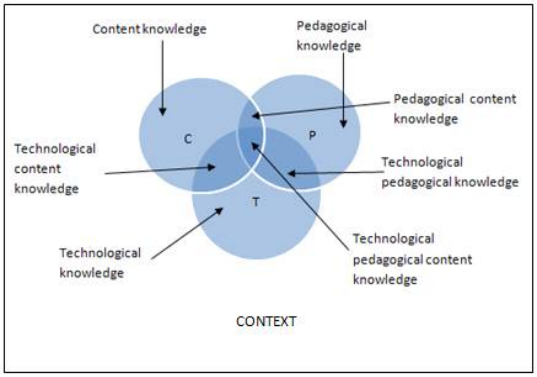

FIGURE 1: TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE AS A RESULT OF THE BLENDING OF TECHNOLOGY KNOWLEDGE, CONTENT KNOWLEDGE AND PEDAGOGICAL KNOWLEDGE (KOEHLER & MISHRA, 2008, P. 12).

Technological Content Knowledge (TCK) includes the ability to select the appropriate technology tool to deliver the subject matter since technology can support or impede the learning of the subject matter. The nature of the ideas in the subject matter drives the selection process. This is a combination of content knowledge and technology knowledge. Richards (1998), as cited in van Olphen (2008), argues that language teachers' content knowledge includes an understanding of linguistics components (phonetics, phonology, morphology, semantics, syntax, socio-linguistics, pragmatics), second language acquisition, cross-cultural awareness, and the development of language proficiency skills (reading, writing, speaking, and listening). TCK for foreign language teachers can be defined as "the body of knowledge that teachers have about their target language and its culture and how technology is used to represent this knowledge" (van Olphen, 2008, p. 113).

Technological Pedagogical Knowledge (TPK) is the interaction between technology and pedagogy. Teachers have a repertoire of teaching strategies and they should be able to skillfully select the one that best represents the idea in the subject matter

and suits the students' context or characteristics such as age, fluency/mastery level of the topic, learning style, or background knowledge. With technology, the complexity increases. Teachers need to understand how technology can change the teaching and learning. There are different technology tools that can be used for a task. The selection of the appropriate tool is

> *"based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. This includes knowledge of tools for maintaining class records, attendance, and grading, and knowledge of generic technology-based ideas such as WebQuests, discussion boards, and chat rooms" (Mishra & Koehler, 2006, p. 1028).*

Technological Pedagogical Content Knowledge (TPACK) is the heart of effective teaching using technology. It requires

> *"an understanding of how to represent concepts with technologies, pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help students learn; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones" (Mishra & Koehler, 2008, p. 10).*

According to the American Council of Teachers of Foreign Languages (ACTFL, 2002) Program Standards for the Preparation of Foreign Language Teachers, the knowledge that foreign language teachers should be able to demonstrate consists of the following six content standards: (1) language, linguistics, comparisons; (2) Cultures, literatures, cross-disciplinary concepts; (3) Language acquisition theories and instructional practices; (4) Integration of standards into curriculum and instruction; (5) Assessment of languages and cultures; (6) Professionalism. The Teacher of English to Speakers of Other Languages (TESOL) also released a document containing a set of standards that need to be made in preparing foreign language teachers. Briefly, teacher candidates are expected to show proficiency in the following five domains, each is divided into a number of standards: (1) language; (2) culture; (3) instruction; (4) assessment; (5) professionalism. Explanations, rubrics, and performance indicators of the standards and domains are provided in these two documents. The knowledge that is covered in these documents incorporate the notion of pedagogical content knowledge proposed by Shulman (1986; 1987).

Using Mishra & Koehler's concept of TPACK, van Olphen (2008, p. 117) states that meaningful technology integration in language teaching entails the following condition:

a) An understanding of how linguistic and cultural concepts can be represented using technology
b) Educational approaches to language teaching that draw from socio-constructivist philosophies to develop students' language and cultural competence
c) An awareness of what facilitates or hinders the acquisition of language and the development of language competence and how technology, specifically CALL or CMC, can revamp common problems that students ordinarily face
d) An awareness of students' previous knowledge, and particularly knowledge of second language acquisition and cognitive development theories

e) An understanding of how current and emerging technologies can be used to advance present knowledge and to develop new epistemologies and sustain previous ones.

QUALITY LEARNING IN DEVELOPING FOREIGN LANGUAGE TEACHERS' TPACK

Learning for teachers is an ongoing and continuous process which also includes activities that are embedded in their daily lives (Desimone, 2009). Reflecting, reading journal or magazine, group discussion, teacher network or study group, self- or observer examination of the teachers' practice, teachers' individual activities, such as engagement in educative online venues are examples of teacher learning activities (Desimone, 2009). Thus, there are different forms of learning that can be performed by teachers to improve their knowledge on ICT integration. Technology related teacher professional development shows a movement from one-size-fits-all type of training or workshops that focus on showing teachers how to use the technology hardware and software (Denning & Selinger, 1999) to those that are conducted over time with the element of follow-up learning and feedback (Cole, Simkins & Penuel, 2002; Kariuki, Franklin, & Duran, 2001; Mulqueen, 2001).

Studies on teachers' learning should focus on the critical features of teachers' learning experiences (Desimone, 2009). Several studies (Campbell, McNamara, and Gilroy, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001) conclude that teachers' learning models can impact student achievement if they have the following features:

1. longer in duration in terms of contact hours plus follow-up in order to be sustainable
2. actively engage teachers in meaningful and relevant activities for their individual contexts
3. school-based
4. provide a degree of autonomy for teachers to design and choose the topics and types of PD that suit their need and contexts
5. promote peer collaboration and community building
6. have a clear goal toward student achievement
7. provide access to new technologies for teaching and learning

TPACK framework has been used recently to underline models of professional development. Learning-by-design approach is an example where the TPACK framework and the critical features of teacher learning are used. In this model of teacher learning, teachers need to construct artifacts (such as online courses, digital video, podcasts, and so on) based on the content of the subjects taught by the teachers to be used in their own classroom (Angeli & Valanides, 2009; Beckett et al., 2003; Cole, Simkins & Penuel, 2002; Keller, Hixon, Bonk, & Ehman, 2004; Koehler, Mishra, & Yahya, 2007; Mulqueen, 2001). Koehler and Mishra (2005) mention that learning by design approach focuses teachers' attention on a problem they might encounter in their practice; then they work collaboratively with other participants to investigate the ways in which technology can be used to address the problem. This approach is informed by the principles of social constructivism or constructionism with the participants actively construct their knowledge on a particular topic with the help of their peers by creating artifacts that meet their teaching goals. Design projects lead to sustained inquiry and revision of ideas (Koehler & Mishra, 2005). Learning in this kind of environment hap-

pens informally and within the immediate context of the participants which results in deeper understanding of the topic. Problem-based learning also influences this approach since the length of the program is extended than the traditional one-shot type of training, the activities to solve the 'real-world' problems are learner centered, interdisciplinary, and 'ill-structured' where there can be more than one solution to the problem (Koehler & Mishra, 2005). This kind of learning environment required a pedagogical shift on the role of the learners and the teacher/instructor. The learners have to be like an 'apprentice' who investigate the problem and find solutions with the help of their peers (who might have more or less knowledge on the topic under investigation) in the actual context of practice. The teachers/instructors assist learners to understand the content, provide them with feedback, mentor and coach, and manage the learning context and setting. They no longer become the main source of information who transmit their knowledge to their students.

Hence, learning by design approach reflects the principles of transformational adult learning. It allows the participants to exercise self-directedness (Brookfield, 1991), provides more learners' engagement, and builds connections with their real need and context (Eraut, 2007; Borko, 2004). There are also opportunities to critically reflect on their experiences in learning and teaching as well as building a learning community. The whole process results in the ownership of the program, a sense of agency. This kind of learning environment creates meaningful learning experiences that will highly likely make the learning sustained even after the program has finished (Lawless & Pellegrino, 2007).

METHOD

The purpose of this study is to develop an instrument that can be used to examine the relationship between the technology-related learning experiences of the English language pre-service teachers at a teacher training institution in Yogyakarta, Indonesia, and their current level of Technological Pedagogical Content Knowledge (TPACK). In line with this purpose, the Survey of Technology Use, Teaching, and Technology-Related Learning Experiences among Pre-Service English Language Teachers was constructed.

Survey design is the appropriate method underlying this study. According to Creswell (2011), survey research design is a quantitative research procedure where a sample or the entire population of people complete a set of questions (questionnaire) to describe the opinions, attitude, behaviours, or characteristics of the population. In order to investigate the validity and reliability of this instrument, it needs to be tested by sending the instrument to a sample of English language pre-service teachers in Yogyakarta, Indonesia and asking them to complete it. Since the population of English language pre-service teachers in Yogyakarta is quite large and geographically dispersed, survey design enables this study to collect information from a few respondents to describe the characteristics of the whole population, which is cost effective and time efficient (Salant & Dillman, 1994).

Since survey design does not rely on observation and long, structured or semi-structured interview that utilise open-ended questions to collect data, survey design cannot provide the depth of understanding that interview and observational techniques provide (Salant & Dillman, 1994). In order to address this issue, the instrument designed

in this study included two essay (open-ended) questions and two semi-closed-ended questions to elicit qualitative information from the respondents.

INSTRUMENT DEVELOPMENT

Reviewing the literature around the existing surveys used to measure teachers' TPACK was the first step conducted in the development of the instrument in this study.

The instrument used was adapted from Schmidt et al. (2009/2010) and Sahin (2011) to measure Technological Pedagogical Content Knowledge of Indonesian English language pre-service teachers at a teacher training institution in Indonesia. This study's instrument focused on the specific content and pedagogical knowledge related to learning and teaching foreign language, i.e. the English language. The literature around teacher learning was also consulted in order to develop the items about the ICT-related learning experiences of the English language pre-service teachers.

There are five domains in the questionnaire. Four domains measure TPACK perceptions on Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). One domain measures the pre-service teachers' perceptions on their ICT-related learning experiences. Demographic questions are included to identify the characteristics of the respondents in order to understand gender differences or relationships between teachers who have access to technologies at home and those who do not.

The TK domain collects information on English language pre-service teachers' skills in operating technological hardware and software, which are generally available in the context of these teachers. The TCK domain covers questions about the teachers' use of technology in enhancing their knowledge on the non-teaching topics they have enrolled at the English language and education study program. The TPK domain aims to collect information on the teachers' use of technology to improve their knowledge and skills in teaching. The TPACK domain contains questions about the interrelationship among technology, content and pedagogical knowledge that influence the teachers' English language and teaching skills. The questions in the ICT-related learning experiences domain are designed to collect information on the teachers' perceptions on their learning experiences that might inform their level of TPACK.

This questionnaire uses multiple types of questions and response formats which are carefully constructed to minimize common responses or common method variance which can cause measurement error and mislead conclusions (Podsakoff, MacKenzie, & Lee, 2003). Unlike the instruments designed by Schmidt et al. (2009/2010) and Sahin (2011) where they used the same question and response format which raise an issue concerning 'consistency motif' of the respondents (Podsakoff, MacKenzie, & Lee, 2003), this questionnaire also incorporates different types of questions that require the use of different response formats.

Initially, there was a total of 64 items in this instrument. Most of the items (36 items) used five-point Likert-type response scale ranging from 'strongly disagree' to 'strongly agree' with the inclusion of 'neutral' option. 18 other items were also based on five-point Likert-type scale, but the options were labelled differently (from 'very competent' to 'not competent' with the addition of 'not

applicable' option). Research surrounding the number of options in response scale has been inconclusive (Lietz, 2008). For example, Nagata, Ido, Shimizu, Misao, and Matsuura study's (1996) showed that the 5-point scale was the easiest of the other types of response scales to complete when applied to instruments for assessing health status. Finn and Peng's study (2009), however, showed that seven category responses outperformed five category responses for both Likert and semantic differential item formats when scaling marketing stimuli. Cook, Cella, Boespflug, and Amtmann (2010) argued that four to five response categories were better than two to three. However, their study also found that more than five categories did not necessarily improve the reliability, person separation, or validity of scores. Thus, five-point response categories were adopted in the initial development of this study's questionnaire on TPACK and technology related learning experiences among pre-service English language teachers in Indonesia. In the questionnaires, two items adopt ordering and ranking type of question, two items are written in multiple choice/selection, and 1 item is written in open-ended question. Respondents was also informed that their answers would be anonymous, there were no right or wrong answer, and their answers would not be used for any marking purposes to reduce 'mood state' effect (Podsakoff, MacKenzie, & Lee, 2003).

RESEARCH SITE AND PARTICIPANTS

The survey was created online by using SurveyGizmo 14-day trial program. The link of this survey was sent to 133 English language pre-service teachers of a teacher training institution in Yogyakarta, Indonesia, who were listed on the researcher's Facebook friend list. The 133 pre-service teachers made up this study's target population. Their response indicated their informed consent. The first reminder to participate on the survey was sent two days after the survey was launched, followed by the second reminder two days later. The reminders were posted on the researcher's Facebook wall and sent to the participants' inbox messages. Thirty-seven responses were received. Out of this number, fifteen responses were partial (incomplete). A number of respondents sent the researcher personal messages through Facebook regarding technical problems they encountered when trying to complete the survey. It appeared that some of the respondents were not familiar with this kind of online survey and stopped completing the survey after they clicked the first 'next' button, which explained the high occurrence of partial responses. Thus, there were only 22 respondents who were selected as the sample of this study. As for the language that was used in the questionnaire, it was decided to use English since the respondents of this study are pre-service English language teachers who understand English well.

The procedure of the survey development in this study is illustrated in Figure 2.

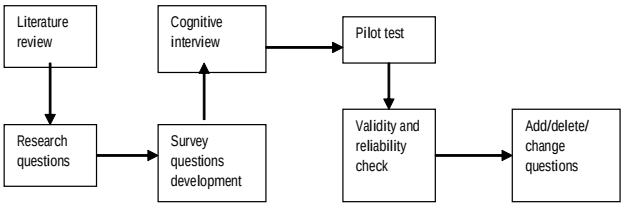

FIGURE 2: THE MODEL OF SURVEY PROCEDURE OF THIS STUDY

DELIMITATION AND LIMITATION OF THE STUDY

In order to provide a good estimate of the population characteristics, there are several factors that

need to be considered in conducting survey research (Salant & Dillman, 1994; Creswell, 2011). The number of sample needs to be as large as possible to ensure that the sample represents the target population. Every member of the population also has the same chance of being selected for the sample. The non-responsive respondents in the sample should have similar characteristics with the people who give responses in the sample. The instrument needs to be well-constructed to avoid any ambiguity both in the questions and in the responses and rigorous administration procedure needs to be implemented to obtain as large a return rate as possible. Due to the limited time under which this study needs to be completed, rigorous sampling technique is not possible.

It is the instrument development that is emphasized in this study. Expert review as an evidence of validity was unlikely to be conducted due to the funding limitation of this study. Thus, the effort to achieve a degree of validity and reliability was performed by implementing cognitive interviewing procedure (Desimone & Le Floch, 2004) and by carrying out statistical tests on the responses (i.e. Cronbach Alpha and Factor analysis). To achieve stronger reliability and validity, the initial survey items of this study were modified by the deletion of several items based on the result of the validity and reliability tests. According to Field (2009, p. 681), a second run of factor analysis is essential if the survey items undergoes a number of changes as a result of the statistical tests. With the limited scope of the paper, a second run of factor analysis was not conducted. Moreover, the limited sample size of this study made the application of factor analysis to the whole items not viable.

DATA ANALYSIS

Qualitative and quantitative research methods were used to analyse the degree of the reliability and validity of the instrument. A cognitive interview was applied after the first construction of the survey items. The internal consistency of each domain in this instrument was analysed by using Cronbach's alpha reliability technique. Factor analysis was implemented to examine the construct validity of each domain. The two essay (open-ended) questions and two semi-closed-ended questions were not included in this analysis.

RESULTS ON THE COGNITIVE INTERVIEWS

After the initial survey was completed, cognitive interviews were conducted to 5 participants. Cognitive interviews is a method to contribute to increase reliability and validity of surveys (Desimone & Le Floch, 2004). Based on the feedback gathered during the cognitive interviews, some items were revised (refer to Appendix 1 for the cognitive interview results). The revision included the following:

1) Removal of negative items, which were modified into positive statements,
2) Removal of the adjective 'appropriate,'
3) Addition of information to clarify meaning of the statements, such as 'school work' instead of 'work' only and an example of 'difficult concept in English language,'
4) Removal of examples from some statements in TK section to avoid double barrel statement,
5) Emphasis on the instruction of certain items (e.g. the ranking-type question) by formatting the sentence in the instruction with italic, bold, and colour,

6) Simplification on the length of several statements,
7) Addition of information to make the meaning of the statement clear (e.g. from 'I do not know how to use technology to assess students' performance' into 'When I teach later, I will know how to use technologies to assess students' performance'),
8) Change one of the ranking-type items to a semi-closed-ended type item,
9) Addition of one open-ended item, and
10) Removal of the neutral option from the response scale.

Research on the omission and inclusion of neutral option has been inconclusive (Lietz, 2008). The decision to remove neutral option from the response scale in this survey was based on the result of the cognitive interview which appeared to support the findings that the introduction of neutral option would attract respondents to select this option when they were not completely sure about their answers (Garland 1991; Kalton et al. 1980; Krosnick & Helic 2000; O'Muircheartaigh 2000; Schumann & Presser 1996, as cited in Lietz, 2004).

RESULTS ON THE FACTOR ANALYSIS AND CRONBACH'S ALPHA

Survey items need to be checked whether they relate to the construct that the study intended to measure (Field, 2009). Factor analysis is a technique for identifying groups or clusters of variables. Each domain in this survey item was analysed by using factor analysis. After the application of factor analysis to validate this survey items, the reliability of the scale was examined using the Cronbach's Alpha.

TECHNOLOGY KNOWLEDGE DOMAIN

The construct of this domain is about teachers' skills to use technology. The factor analysis on the 22 items representing TK resulted in 7 components underlying this construct. These components may, or may not, relate to genuine sub-components of TK. Special attention was given to the items with factor loadings below 0.40 (Field, 2009). These items are presented in Table 1.

The result shows that each of these items has a much bigger factor loading in another component. Having closely examined the items of variable TUTTEA3, TUTTEA5, TUTTEA6, TUTTEA7, TUTTEA 9, AND TUTTEA12, it turned out that these items represent the same concept (i.e. ability in operating technologies). Since there were 22 items in this scale (which represented the answers from the 22 sample of this study), it is suspected that the limited sample of this study may result in the low factor loading of these items. The decision

was then made that all items that asked the pre-service teachers' ability in operating technologies (i.e. TUTTEA1 to TUTTEA17) were dropped since these items had a similarity to TUTTEA20 ('I play around with different technologies') which had much greater factor loading (.771). TUTTEEA18 and TUTTEEA19 item were also deleted since they appeared to have resemblance with TUTTEA20 item as well.

TECHNOLOGICAL CONTENT KNOWLEDGE (TCK)

TCK includes the ability to select the appropriate technology tool to deliver the subject matter. It is the relationship between content and technology. Based on the factor analysis, two components had the eigenvalues over 1 and in combination

explained the 64.06% of the variance. It means that the 10 items reflected two constructs. The factor loadings were above.40 for each item (i.e..44 to.83). Thus, all items were retained.

TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE (TPK)

The factor analysis extracted 2 components for this domain. Since TPK is the interaction between technology and pedagogy, the 6 items in this domain may reflect these two concepts (technology and pedagogy). Factor loadings were between.51 to.86. This result showed that the factor loadings were considered as good and accepted. No item was changed or deleted.

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK)

TPACK is where technology, pedagogy, and content merge to create a unique notion of effective teaching using technologies. Only one factor emerged as the underlying construct of this scale based on the factor analysis. The 6 items within this domain were built around one coherent construct. The factor loadings were between.64 to.90. All items were then retained.

TEACHERS' TECHNOLOGY-RELATED LEARNING EXPERIENCE (TLE)

This refers to the quality of learning experiences that can influence teachers' development of TPACK. It is predicted from the literature around effective teacher professional learning that teachers with positive or high-quality learning experiences will have a higher level of TPACK and teachers' with negative or poor learning experiences will have a lower level of TPACK. The factor analysis extracted 2 components underlying this construct, each component has the eigenvalue over 1 which account for the 71.20% of the variance. This means that there are two constructs underlying the 6 items in TLE domain. Two items (TUTTEE53 'When technologies are used in my classroom, it is the lecturers who use technologies most of the time' and TUTTEE54 'I am allowed to use any technology software/hardware I am familiar with in the classrooms') needed special attention since their factor loadings were.267 and.003 respectively. TUTTEE53 item was then deleted since the question might be redundant with TUTTEE49 ('My lecturers use technologies in the classrooms') and the information asked was in fact implied in TUTTEE52 ('When technologies are used in my classroom, it is the students who use technologies most of the time'). Item TUTTEE54 was eliminated by considering its irrelevancy with the construct.

The internal consistency of the set of items under each domain was investigated using Cronbach's alpha technique. Table 2 illustrates the internal consistency from each domain.

DOMAIN NAME	CRONBACH ALPHA
Technological Knowledge (TK)	.82
Technological Content Knowledge (TCK)	.86
Technological Pedagogical Knowledge (TPK)	.82
Technological Pedagogical Content Knowledge (TPCK)	.87
Technology-related Learning Experience (TLE)	.67

TABLE 2: CRONBACH ALPHA FOR EACH DOMAIN

The result in Table 1 indicates that the internal consistency reliability for Technology-related Learning Experience was low while the other domains had satisfactory scale. The questionable items

VARIABLE NAME	ITEM LABEL	COMPONENT						
		1	2	3	4	5	6	7
TUTTEA3	Ability in operating Instant Message	.291	.255	-.218	.619	-.406	-.252	-.337
TUTTEA5	Ability in operating Weblog	.310	.628	-.332	.058	-.400	-.352	-.057
TUTTEA6	Ability in operating Electronic mailing list	.081	.219	.191	.676	.245	.008	.513
TUTTEA7	Ability in operating Podcast	.341	.447	.638	.163	-.137	-.134	.074
TUTTEA9	Ability in operating scanner	.037	.185	.838	.193	-.050	.131	.055
TUTTEA12	Ability in operating Tablet computer	.026	.536	.602	-.178	.038	-.316	-.214

TABLE 1: COMPONENT MATRIX OF PROBLEMATIC ITEMS UNDER THE TK DOMAIN

within the Technology-related Learning Experience domain were examined. In line with the result of the factor analysis for this construct, items TUTTEE53 and TUTTEE54 needed to be dropped to increase the reliability of this domain. The Cronbach's alpha increased to.78 when these two items were dropped. As a result, a total of 21 items were eliminated from the survey, including 19 TK items and 2 TLE items.

CONCLUSION

Efforts toward building the validity and reliability of the instrument had been performed by this study. The results suggest that this instrument is considered acceptable to be used in a larger scale of work that aims to investigate the role of pre-service teachers' experiences in learning to use ICT in their pedagogical practice in influencing the development of their TPACK. However, much work needs to be done with regards to further validating and revising the instrument. Stronger validity and reliability should be the focus of future studies. This can be done by conducting expert review to build content validity, applying rigorous sampling techniques, and conducting validity and reliability tests on the qualitative types of the items in this instrument. A valid and reliable instrument will be beneficial in providing accurate feedback on ICT-related teacher professional learning programs.

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