# TPCK Assessment of Pre-service Teachers toward Enhancing Teacher Educators' Modeling

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**ABSTRACT—*This study explored the pre-service teachers' perceived Technological Pedagogical Content Knowledge (TPCK) level and its relationship to teacher educators' TPCK modeling through a descriptive-correlation method. Data were gathered among 47 graduating pre-service teachers who turned in self-report Liker-type instruments. Findings reveal that the graduating pre-service teachers felt very good about their TPCK levels. Nonetheless, they would benefit from intensive training on upgrading their Technology Knowledge (TK) level to reach balance with Content Knowledge (CK) and Pedagogical Knowledge (PK) levels. Participants likewise perceived that their university-based teacher educators have high competence and oftentimes model TPCK, while cooperating or supervising teachers have shown some competence and sometimes demonstrate TPCK in their student teaching program. Through Pearson r, it is established that significantly strong positive relationship exists between TPCK levels of pre-service teachers and their university-based teacher educators' TPCK modeling. Implications germane toward enhancing the teacher educators' instruction toward the 21st century education paradigm are forwarded.***

**Keywords—** TPCK, TPACK, Pre-service Literacy Teachers, Teacher Education

## 1. INTRODUCTION

Educating today's pre-service teachers to be future teachers can be a daunting job. Teacher trainers or models are challenged to craft learning that meaningfully integrates content and pedagogy to foster the development of twenty-first century skills using current and emerging technologies to prepare teachers for a technology-driven, knowledge society (Lock and Redmond 2010). Hence, the environment, which these future teachers will create, will largely depend on the training and/or preparation they receive.

Teacher educators or trainers face the challenges on how to ensure that pre-service teachers have the necessary combination of skills and pedagogical knowledge that will enable them to both effectively use today's technologies in the classroom as well as continue to develop and adapt to new technologies that emerge in the future (Gill and Dalgarno 2008; Marino, Sameshima, and Beecher 2009). Those who have received professional development in pre-service years may not feel fully comfortable with their technology skills and knowledge; thus the feeling of unpreparedness for technology integration in teaching content becomes apparent (Ponessa 1996; Loveless 1996). Will this case be the same with the graduating pre-service teachers in a certain university in the Philippines? How will they [graduating pre-service teachers] assess themselves and their teacher educators' modeling? Hence, these questions motivated the researcher to study the teacher pre-service teachers' assessment of their knowledge levels along the TPCK domains and their perception on their teacher educators' modeling into the 21st century learning environment. Both research and practice in teacher education may benefit from an assessment of pre-service teachers' Technological Pedagogical Content Knowledge levels.

### *1.1 Technological Pedagogical Content Knowledge*

Many teacher preparation programs are failing to provide pre-service teachers with the knowledge, skills, and dispositions necessary to adapt and utilize technology effectively (Marino, Sameshima, and Beecher 2009). As education institutions continue to recognize the pivotal role of educational technology in preparing student teachers or teacher candidates for their future classroom works, Mishra and Koehler (2008) proposed the Technological Pedagogical Content Knowledge (TPACK or TPCK) as a way of thinking about the knowledge teachers need to understand to integrate technology effectively in their classrooms. They argue that TPCK includes knowledge of content, pedagogy, and technology, as well as understanding the complex interaction among these knowledge components. At the onset of Schmidt et al. (2009) development and validation of an assessment instrument for pre-service teachers, TPCK was introduced to the educational research field as a theoretical framework for comprehending teacher knowledge required for effective technology integration (Mishra and Koehler 2006).

The TPCK grows from Shulman's (1986) idea of Pedagogical Content Knowledge (PCK) which consists of a crucial aspect of teacher's knowledge on their subject matter and their knowledge of the particular form of content teachability. Pedagogical Content Knowledge also covers the understanding of what makes the learning of a specific topic or area simple or complicated. Even though the TPCK construct is a novel approach to ICT knowledge integration, the idea has intrigued

experts with its various equivalent names as they continue to define the characteristics, skills and knowledge of teachers who could drive the complexities, advantages and connections of its domains (Schmidt et al. 2009).

Enriching Shulman's landmark model, Mishra and Koehler (2006, 2008) explained that at the helm of good teaching are three core components: namely, Content, Pedagogy and Technology. TPCK application in the classroom requires a profound, sensible, and fine understanding of teaching with technology and the other domains. It must be fathomed that the separation of teaching into content, pedagogy and technology is not necessarily straightforward, or even something that good teachers do. To attain the so-called dynamic *equilibrium*, integration should work well (Mishra & Koehler, 2008); otherwise compensatory characteristic of each component should address any conflict or constraints.

The TPCK domains by Mishra and Khoeler (2006, 2008) and Shulman (1986) served as the scaffold of this study. In addition, TPCK enables teachers to use their knowledge about technology, pedagogy, content, learners, and context to provide transformative teaching and learning experiences (Angeli and Valanides 2008). Mishra and Koehler (2006) described TPCK, in general, as support to recognize the important components of teacher knowledge that are germane to the sound fusion of technology in education.

Looking into a beginning approach to measure TPCK level of teachers, Archambault and Crippen (2009) investigated the knowledge level of K-12 online teachers with respect to the domains described by the TPCK frameworks. The result of the online self-assessment survey which they employed indicates that teachers' knowledge ratings are highest among the domains of pedagogy, content, and pedagogical content showing that the responding online teachers felt very good about the said domains but they were less confident when it comes to technology. Although there revealed a weak correlation between technology and pedagogy, as well as technology and content (.289 and .323, respectively), there was a large correlation between pedagogy and content (.690).

Delving into the distinctiveness of the TPCK domains, Schmidt et al (2009) further developed and validated a Likert-type instrument designed to measure pre-service teachers' self-assessment of their TPCK and related knowledge domains included in the framework. The instrument was piloted on 124 elementary pre-service teachers. High Cronbach alpha of 0.80 were obtained for each TPCK constructs. Hence, the survey is a reliable and valid instrument that will help educators design longitudinal studies to assess pre-service teachers' development of TPCK.

Chai, Koh, and Tsai (2010) examined the perceived development of pre-service teachers in terms of their technological knowledge, pedagogical knowledge, content knowledge and the synthesis of such knowledge by adapting the questionnaire developed by Schmidt et al (2009). Factor analyses and the 889 pre-service teachers' TPCK perceptions before and after their ICT course were examined in Singapore. Results reveal that Technological Knowledge and Pedagogical Knowledge are all significant predictors of pre-service teachers TPCK, with pedagogical knowledge having the largest impact. As a result of the initial studies presented herein, the researcher was moved to conduct additional investigation on the TPCK domains but on a different context and method.

### *1.2 Pre-service Teachers' TPCK*

Pre-service teachers' levels of technology use are influenced by their lack of self-confidence in their ability to use technology in instruction (Albion 1996). Furthermore, Albion put forward that the most significant factor influencing student teachers' use of computers with children was found to be the cooperating teachers' use of computers with children. Jong (2010) justified how supervising teachers could become effective models for technology integration considering the Technological, Pedagogical, and Content Knowledge development of pre-service teachers. He concludes that observing experienced science teachers helps pre-service teachers imitate and apply instructional strategies and use of emerging technologies (computer, video, film…) in their teaching. A pre-service teacher noted in an interview **"**I created a multimedia video-recording to illustrate the concept of density and its applications**."** (p.139). This notion was inspired from an observation with a mentor teacher's modeling. This only proves that supervising or cooperating teachers have their fair share in developing innovative teachers. Educators providing pre-service teachers the opportunity to reflect on and evaluate their knowledge of computer integration and sound ICT-enhanced learning experience could lead pre-service teachers to self-identify their conflicting ideas; thus it could result in the development of deeper and more thoughtful insights, models and practices concerning computer integration in instruction (Mims 2004).

As teacher education improves, change in pre-service teachers' use of technology is inevitable. Albion (2003) described in his study on the graduating teachers' disposition toward teaching with ICT at University of Southern Queensland. It could be concluded that, compared to their predecessors, 2003 graduating teachers at the University of Southern Queensland are better prepared for, and more positively disposed towards integrating ICTs into their teaching. Nonetheless, a follow-up study is needed to see how far those improved characteristics played out in the classroom where the teachers are. Furthermore, whether the observed differences are a consequence of changes made to the teacher preparation program or are related to the arrival of a new generation of ICT natives is not known with certainty so far. Further studies of students entering the teacher preparation programs may help to answer that question (Albion 2003).

Beginning pre-service teachers' perceptions in their integration of computers with the processes of teaching and learning are naïve and demonstrated very little development (Mims 2004). In this study, the participants' responses were often repetitive and lacked depth. In fact, the individuals interviewed in the study sometimes made contradictory statements about their perceptions of integrating computers with teaching and learning. On the same note, Whetstone and Carr-Chellman (2001) argued that pre-service teachers did not appear to see the importance of their own pedagogical roles in integrating

computers in classrooms at the onset. They showed concern and a lack of enthusiasm toward the use of computers, in spite of the importance they placed on computers in changing schools.

Teacher preparation programs necessitate providing pre-service teachers with a variety of effective experiences in literacy with computer integration that can be adopted for use in their future classrooms. Purposeful efforts should be made to encourage pre-service teachers to frequently reflect on and evaluate their perceptions about technology integration in the classroom (Mims 2004). Hence, the nature and composition of teacher preparation and training programs do impact considerably on pre-service teachers' knowledge, beliefs and attitudes, and consequently their preparedness to use ICTs in classrooms (Gill and Dalgarno, 2008). It is within the realms of teacher educators, in-service teachers, and pre-service teachers to explore and address effective practices using technology to enhance learning. By understanding the TPCK, pre-service teachers may discern using ICT for classroom teaching as an act of integrating TK, PK and CK to form TPCK for a particular lesson (Lock and Redmond 2010).

The studies mentioned here presented initiatives toward assessing TPCK among pre-service teachers. Anchored on the TPCK in assessing the teachers' competence in integrating ICT in instruction, this study provides additional baseline information on the graduating pre-service teachers' levels of TPCK toward enhancing teacher educators modeling. The researcher, then, hypothesized that relationship exists between pre-service teachers' knowledge levels—in navigating the affordances and constraints in infusing emerging technologies with literacy content and pedagogy—and their teacher educators' TPCK modeling which covers the university-based teacher educators and cooperating or supervising teachers in the field.

### *1.3 Research Questions*

In this report, three research questions are addressed:

1. What is the perceived knowledge level of graduating pre-service teachers in the areas of technology, pedagogy, and content, including combinations of these TPCK domains?
2. To what extent do pre-service teachers perceive their teacher educators' TPCK modeling?
3. What is the relationship between the pre-service teachers' TPCK levels and the teacher educators' TPCK modeling?

## 2. METHODS

The descriptive survey is generally the most suitable method to use in this investigation because this method treats information collected from a group of people in order to describe some aspects of characteristics which include but are not limited to their abilities, opinions, attitudes, beliefs, and/or *knowledge* of the population. Furthermore, this research also examined the relationship of a scale or subscales in a survey to other, or of score based on another set of scale. For that purpose, correlation research is commonly paired in a descriptive survey method as well as in this study (Fraenkel and Wallen 2007).

Adapting, constructing and modifying self-report Likert scale instruments with expert validation were done. The survey items covered several components which were knowledge levels along the Technological Pedagogical Content Knowledge domains and the TPCK modeling of their teacher educators as perceived by the pre-service teachers. Although self-report is inclined to certain degree of bias, it should be made clear, however, that the instruments in the study aimed to measure the aforementioned variables, not the pre-service attitude toward the domains. It should also be noted that this method may be used to measure teachers' perception of a program (Fraenkel and Wallen 2007; Wiersma 1995). Thus, the survey included respondents' perception of teacher educators' TPCK modeling.

### *2.1 Respondents*

The respondents are primarily the graduating pre-service teachers taking the Bachelor of Elementary Education from the Philippine Normal University Quezon Campus, Philippines, during the school year 2011-2012. Simple random sampling was made for the selection of the sample. For this procedure, the lottery sampling or the fish bowl technique was utilized. Numbers were assigned for the pre-service teachers in the list. These numbers were marked on pieces of paper and drawn from a bowl; the procedure was repeated until the target sample size was completed (Schutt 2006). The same probability sampling strategy has been employed for the selection of samples for pilot testing and field testing of instruments for the graduating pre-service teachers.

### *2.2 Instruments*

Two (2) self-report Likert-type questionnaires instruments were used to investigate the pre-service teachers' perceived levels of TPCK which includes Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK) scales, and the pre-service teachers' perception of their teacher educators' TPCK modeling. The researcher developed two self-report Likert-type questionnaires by adapting and modifying the instruments used in the previous studies. Experts' panel review composed of two (2) knowledgeable literacy experts

and one (1) research professor to critique the draft instruments was tapped. Finally, the instruments were piloted and field tested accordingly to enhance validity and reliability of the scales.

### *2.3 Pilot, Field Testing and Data Gathering*

The two (2) instruments were administered for pilot testing at the Philippine Normal University, Quezon Campus. The researcher personally distributed the instruments to the 10 lottery-selected pre-service teachers. He verbally clarified to them the objectives of the instruments and the study taking into consideration that the results would be treated with utmost confidentiality and that their honest and well-thought responses would not in any way affect their course grades. He also timed how long the respondents completed the survey questionnaires. Then, he also shed light on items not clear enough to the respondents.

For instruments 1 and 2, two of the respondents cited that it would be better if the numerical response scale and its interpretation or even abbreviation were placed on top of each page of the instruments. After going through the directions and items of the instruments, they all agreed that the instruments *per se* were ready for actual data gathering with the target respondents. Fair enough, three of them suggested that it would be convenient if the researcher would administer the instruments during an assembly called for such purpose. On the pilot testing, instruments were retrieved minutes after the respondents completed the materials. The ten respondents completed the instruments within 14 minutes on the average.

The remaining members of the population composed of ninety-seven (97) respondents were selected to participate in the field testing. Because of occurrences beyond the researcher's and invited respondents' control, only eighty-seven (87) out of 97 respondents participated in the field testing. The researcher personally distributed the survey questionnaires to the 87 respondents and the same instructions were explained as what had been done during the pilot testing. All the instruments were administered and, immediately, retrieved by the researcher. No instruments were allowed to be brought home for it would only take approximately 8 minutes for an individual to respond to the instruments as observed in the pilot testing.

The data gathered in the field test were right away subjected to computer analysis using the Statistical Package for Social Sciences, more commonly known as SPSS. The two instruments obtain high Cronbach Alphas of 0.80 and up in all the scales. This indicates considerable internal reliability on their field testing results.

The instruments were finally administered to the sampled respondents a week before their graduation. A special assembly was convened for this purpose in coordination with the University officials. To encourage full attendance of the 50 sampled respondents, special prizes were given to 10 lucky participants in a raffle draw. Forty-seven respondents came and completed the instruments. Like the field testing, same instructions were given to the respondents before, during, and after the instruments' administration.

## 3. RESULTS AND DISCUSSIONS

### *3.1 Levels of TPCK*

The sample consisted of 47 graduating pre-service teachers from the Philippine Normal University, Quezon Campus. The pre-service teachers rated their knowledge at the highest level for the scales of Pedagogy (4.06), Technological Pedagogical (3.86), and Pedagogical Content (3.83). These average mean scores indicate that pre-service teachers believe that their knowledge is very good in connection with their ability to monitor student performance, to adjust teaching styles, to assess student learning, combined with their TPK and PCK which include but are not limited to their ability to use appropriate technologies that enhance teaching and learning process, to assist students in connecting concepts across the curriculum, to design integrated, balanced literacy lesson plans, and to select effective approaches to guide student thinking and learning for literacy content (Table 1).

**Table 1:** Overall self-reported levels of TPCK

| TPCK Domains/Scales | Number of items | Mean | SD |
|---|---|---|---|
| Technology Knowledge | 5 | 3.62 | 0.52 |
| Content Knowledge-Literacy | 7 | 3.78 | 0.41 |
| Pedagogical Knowledge | 7 | 4.06 | 0.42 |
| Pedagogical Content Knowledge | 5 | 3.83 | 0.46 |
| Technological Content Knowledge | 4 | 3.73 | 0.57 |
| Technological Pedagogical Knowledge | 4 | 3.86 | 0.5 |
| Technological Pedagogical Content Knowledge | 4 | 3.80 | 0.55 |

The data on the aforementioned scales reveal that these pre-service teachers can comfortably navigate with the rudiments, methods, strategies, and processes of literacy instruction enhanced by educational technologies that enable them

to create endless opportunities for students to grasp specific concepts in literacy. Lagging behind PK, TPK and PCK scales are the scales in Content-Literacy (3.78), Technological Content (3.73), and Technology Knowledge (3.62). These three average means are still interpreted at the boundary of 'very good' within the range of 3.40 to 4.19. This, however, suggests that pre-service teachers are more knowledgeable in pedagogy than their CK and TK combined because of the 0.26 and 0.44 mean differences respectively. The participants similarly felt that their CK associated with understanding of literacy, reading and writing development, reading across elementary years, explaining literacy research and theory, using multiple sources of information, and other literacy-related foundation knowledge was not as strong as their knowledge related to PK and TPK.

Obviously, the lowest individually scored item fell within the area of TK. It was particularly observed in the item rating 'about my knowledge in playing around with technology,' in particular, with the mean of 3.38 which is interpreted to a rating of *Good*. However, the rest of the items under technology were all classified as 'Very Good'. With this result, it could be inferred that pre-service teachers may have favorable know-how to solve their technical problems, to recognize, and to use a lot of different technologies.

When technology was combined with content and pedagogy, scores scaled to 3.73 and 3.86, respectively. These ratings are not as high as those associated with pedagogy and content combined, but not as low as the domain of technology *per se*. In examining all three domains together and the interplay existing within the domains or scales, pre-service teachers, as a whole, rated their skills at 3.80 along the TPCK, interpreted as very satisfactory.

In exploring the perceived knowledge levels of pre-service teachers within the TPCK domains, it becomes apparent that these teachers felt competent about their abilities to perform more than just traditional teachers. They seemed very much certain of themselves when it came to their skills associated with pedagogy combining it with technology to convey literacy content to students. If compared to the work of Archambault and Crippen (2009) who investigated the knowledge level of K-12 online teachers, this study confirms their findings that teachers' knowledge ratings are also highest among the domains of pedagogy and content but not that high on technology. This suggests that the technology area remains to be a domain to seriously deal with because it covers various technologies not only present in the mainstream but also the emerging ones.

The results do not, however, communicate that the respondents' teacher education institution has failed to provide pre-service teachers with the knowledge, skills and disposition required to adopt and to utilize technology effectively as what Marino, Sameshina, and Beecher (2009) assert for many teacher preparation programs. Instead, the results provide important component levels of pre-service teachers' knowledge that are germane to the sound fusion of technology in education to enhance the teacher preparation programs. Nonetheless, this has yet to be observed in practice.

According to Mims (2004) purposeful efforts should be made to encourage pre-service teachers to reflect on and evaluate their perceptions about technology integration. Training pre-service teachers in this study could no longer be a daunting task. With considerable levels of TPCK, the pre-service teachers in this study may not be anymore the kind of pre-service teachers who have poor self-esteem about their ability to use technology in instruction. Thus, enhancement of the teacher preparation program where there is a balanced and comprehensive development of pre-service teachers' knowledge in pedagogy, content, and technology is now finding a niche in this 21st century teaching and learning world.

### *3.2 Perceived Teacher Educators' TPCK Modeling*

**Table 2:** Overall of pre-service teachers' self-perception of their teacher educators' TPCK modeling

| Teacher Educators | Number of items | Mean | SD |
|---|---|---|---|
| Literacy Education Professors | **3** | **3.85** | 0.60 |
| Instructional Technology Professors | **3** | **3.99** | 0.63 |
| Education Foundation Professors | **3** | **3.86** | 0.72 |
| Professors Outside Literacy Education | **3** | **3.75** | 0.65 |
| Grade 1 to 6 Cooperating Teachers | **3** | **3.36** | 0.74 |

Table 2 shows the overall perception of the pre-service teachers on their university-based professors and Grade 1 to 6 Cooperating Teachers. The pre-service teachers reported that their teacher educators have high competence and they oftentimes model TPCK in the classroom. Arranged from the highest ratings, teacher educators obtaining very favorable assessments within the rating range of 3.40 to 4.19 are the instructional technology professors (3.99), education foundation professors (3.86), literacy education professors (3.85), and professors outside literacy education (3.75). As expected and very much apparent, the instructional technology professors got the highest average mean. The results also show that except for the Grade 1 to 6 cooperating teachers, all the rest of the teacher educators were rated by the pre-service teachers to possess considerable skills to demonstrate frequently the tasks in using technologies in the classroom, in applying strategies that combine the domains and in providing leadership that helps their student-teachers coordinate the use of content, technologies and teaching approaches.

With the average mean of 3.36, the Grade 1 to 6 cooperating teachers were perceived by the pre-service teachers to have some competence and sometimes demonstrate TPCK in the classroom. Albion (1996) put forward that the most significant factor influencing student teachers' use of technologies is the cooperating teachers' use of technologies with children. The result seemed contradictory to aforementioned notion because pre-service teachers regarded their university-based professors higher in this area compared with their cooperating teachers. It appears that what the elementary cooperating teachers lack to provide in TPCK modeling in the classroom, the university-based teacher educators complement. The pre-service teachers through this assessment were able to reflect on conflicting ideas and to develop deeper and more thoughtful insights on the teacher educators' TPCK modeling and practices concerning technology integration; hence, their [pre-service teachers] levels and future implementation of TPCK in a working and learning environment are formed and/or changed through the combination of various experiences they have had with their teacher educators.

These results have provided additional baseline information on the way teacher educators perform their functions outside and inside the university. The lowest mean falling to the side of grade 1 to 6 cooperating teachers (3.36) could mean that there could be a need to look into and to improve the practice teaching program of the university and pre-service experiences with their cooperating or supervising teachers. Thorough investigation on the student teaching experience in the field remains to be a fertile ground for future studies.

### *3.3 Relationship of Pre-service Teachers' TPCK and Teacher Educators' Modeling*

**Table 3:** Matrix of correlations between pre-service teachers' TPCK levels and teacher educators' modeling

| | TK | CK | PK | PCK | TCK | TPK | TPCK |
|---|---|---|---|---|---|---|---|
| Literacy Education Professors | .335* | .438* | .365* | .390* | .326* | .338* | **.548*** |
| Instructional Technology Professors | .350* | .397* | .321* | .338* | .365* | .326* | **.516*** |
| Education Foundation Professors | .407* | .461* | .311* | .407* | .383* | .561* | **.547*** |
| Professors Outside Literacy Education | .493* | .465* | .354* | .446* | .394* | .446* | **.501*** |
| Grade 1 to 6 Cooperating Teachers | .232 | .361* | .136 | .031 | .109 | .149 | .152 |

** Significant at .05 level*

Table 3 all boils down to the correlation values existing between pre-service teachers' TPCK level (combination of all the domains) and their perceived TPCK modeling of their teacher educators. The value on this scale confirmed the findings of all the scales in the TPCK domains. Hence, it is safe to deduce that all the teacher education institution professors or instructors, except for the Grade 1 to 6 Cooperating Teachers, may have exerted significantly strong influence on the development of pre-service teachers' TPCK level or the knowledge required by teachers for integrating technology into their teaching of literacy content.

The assumption that the pre-service teachers show some extent of TPCK levels in relation to their perceived favorable teacher educators' TPCK modeling is held true as results revealed. In a related study Jong (2010) validated how supervising teachers could become effective model for technology integration considering the TPCK development of pre-service teachers. Data found in this study, however, shows that Grade 1 to 6 cooperating or supervising teachers' TPCK modeling is found to have weak or low correlation between pre-service teachers TPCK knowledge levels.

Pre-service teachers' not so very good assessment (low mean = 3.36) of their cooperating teachers and the homogeneity of the group could be attributed to the unrelatedness or weak correlation. In addition, contact or engagement time could be another issue; pre-service teachers spent most of their learning time with their teacher trainers in the university compared to their supervising teachers in the field. Their rating of their cooperating teachers, which is interpreted as having some competence and sometimes modeling of TPCK, is an indication that their cooperating teachers do not regularly show what are expected of them as models. It could be inferred largely that the pre-service teachers' experiences with their cooperating or supervising teachers in the field were not so very favorable for the development of their [pre-service teachers] TPCK compared to their university-based teacher educators' modeling. Nevertheless, further study is needed to explicate the distinct connection and/or influence, if there is any, cooperating teachers have for the development or enrichment of pre-service teachers' TPCK.

## 4. CONCLUSION

Granted that the TPCK levels of the pre-service teachers are in the positive territory, a balance of TPCK development however has yet to be attained by the pre-service teachers, particularly on enhancing their TK vis-à-vis PK and CK levels. A balanced TPCK development could mean stability of teachers to navigate the affordances and constraints in infusing emerging technologies with literacy content and pedagogy. Thus, integrating mainstream and emerging educational technologies in the teacher preparation program will always remain to be beneficial.

The grade 1 to 6 cooperating teachers like the university-based teacher educator counterparts are also the models of pre-service teachers in the real classroom setting. They [cooperating teachers] are required, often if not always, to demonstrate appropriate TPCK in their classroom. Inability to provide such experience may be drawn from their lack of training and/or technologies to use in the classroom. It may have been the same case for some professors or instructors. Pre-service teachers' very favorable assessment of the teacher educators' modeling of TPCK may be equated on their considerable levels of TPCK or vice versa. Indeed, the nature and curricula of teacher preparation and program being implemented by teacher educators influence to a certain extent the pre-service teachers' development of TPCK.

This study has provided significant implications particularly in the field of teacher education. On the other hand, investigating deeply the affordances and constraints of literacy program and technology-enhanced instruction under the roof of TPCK with emphasis in the rigorous validation of instruments and models is encouraged to cover also the different phases of pre-service teachers (beginning pre-service teachers and graduating pre-service teachers) and in-service teachers (beginning teachers and master teachers). The impact of teacher educators especially cooperating teachers' TPCK modeling to the pre-service teachers' beliefs and knowledge in other content areas using varied research designs and methodologies is also a goldmine for future inquiries.

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