

# EXPLORING TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE (TPK) OF FILIPINO TEACHERS OF MANDARIN

**CAVIN F. PAMINTUAN**

Professor at the Graduate School of Angeles University Foundation, Philippines.

E-mail: pamintuan.cavin@auf.edu.ph

## Abstract

Anchored on the TPACK framework, this mixed-methods sequential explanatory research focused on the technological-pedagogical knowledge of the Filipino secondary school teachers of Chinese Mandarin. The technological-pedagogical knowledge refers to the teachers' ability to choose appropriate technological tools to support teaching practices. This study employed questionnaires, classroom observations, and semi-structured interview to capture teachers' TPK. The questionnaire data revealed that the teachers have a high level of awareness of their TPK as reflected in the computed mean score of their responses. In addition to that, the classroom observation data showed that teachers' TPK was reflected in the use of varied technologies that have supported the implementation of the different components of their teaching, starting from the introduction until the assessment. Furthermore, teachers' TPK was reflected their cognitions which uncovered their awareness of the available applications to support teaching (CTPK-Application) and the significance of TPK (CTCK-Sig) to teaching. Lastly, the study provided recommendations for crafting professional development programs to further enhance teachers' TPK.

**Index Terms:** Local Chinese Mandarin Teachers, Chinese as a Foreign Language (CFL), Technological Pedagogical Knowledge (TPK), TPACK, Chinese Language Teaching, Educational Technology, Educational Innovations

## 1. INTRODUCTION

The computer technologies became widely used in the field of education due to the pandemic. The health crisis caused by the novel coronavirus disease known as COVID-19 has resulted in the broadest disturbance of all time in education systems [32]. Among the most affected by the pandemic is the education sector. Schools were mandated to abruptly close, hence affecting billions of students across all countries of the world [30]. The Philippines was not spared from the impacts of the pandemic; the disruption of classes has forced nearly twenty-eight million Filipino students to continue their schooling from home. The health crisis resulted in the shift in the instructional delivery model from the orthodox way of delivering instruction to online instruction [21]. The online instruction, which was implemented through the help of online educational technology, ensured that learning will continue amid school closures, regardless of students' and teachers' different geographic locations. The use of educational technology was noticeably more amid pandemic when teachers and students worldwide started utilizing educational technologies to support remote teaching and learning [29]. The sudden migration of both students and teachers from physical classrooms to virtual classrooms was made possible with the help of the available educational technology. In the Philippine context, online distance learning (ODL) is among the learning delivery modalities adopted by the Department of Education during the COVID-19 pandemic. The ODL is the learning delivery modality adopted by the public secondary school

teachers in teaching Chinese Mandarin during the school year 2020-2021. It can be also paired with other learning delivery modalities for blended learning.

Although previous studies claimed that online instruction is advantageous in teaching of a particular subject, its swift implementation resulted in different challenges for stakeholders in education. The most prominent challenge is teachers' lack of preparation to adopt the online modality of instruction delivery. The stakeholders are not technologically competent to cope with the unexpected changes in the education system [21]. This concurs with the observations of Kalinga [14] that one of the challenges of utilizing technology in education is the scarcity of qualified online teachers due to a lack of appropriate training in utilizing educational technology. Many teachers have no experience teaching in virtual classrooms and are unaware of the needed competencies to fully deliver the role of a virtual teacher [28]. Most teachers lack confidence in utilizing online tools such as learning management systems, online collaboration, and online discussion [12]. Considering the differences between teaching in the physical classroom and online classroom, the roles of an online teacher also differ from that of a physical classroom teacher [33]. Therefore, teachers should have support and training to equip them with relevant competencies that would capacitate them to perform a task using relevant educational technology for online learning technology [23].

One of the most prominent models for utilizing technology in teaching is the model or framework developed by Koehler and Mishra [22] called TPACK. The TPACK model showcases three types of knowledge which include knowledge in technology, pedagogy, and content. The interplay among the three types of knowledge in the TPACK model resulted in seven (7) constructs that may directly or indirectly influence teachers' competence to utilize technology in teaching. The constructs include the three essential components (TK, PK, CK) and the four constructs, which is the interplay between the essential components (TPK, TCK, PCK, TPACK). Koehler and Mishra [15] claimed that the given variables of the framework have significant roles to play both individually and collectively in utilizing technology in teaching.

Guided by the TPACK model, previous studies measured the teachers' competence in technology using different instruments. The widely used instrument in measuring teachers' TPACK is the self-assessment report [3], [4], [7], [26], [31]. Consolidating the issues of the existing TPACK self-assessment reports, Schmidt et al. [27] have developed a short-scale questionnaire that can be used to assess and describe teachers' competencies in teaching with technology. However, the issue with self-assessment reports is their low correlation with the direct assessment of participants' knowledge or performance. This was due to the Dunning–Kruger Effect or the failure to be aware of one's deficiency [9]. Thus, this study also gathered qualitative data through the use of performance-based assessment. Performance-based assessment refers to the evaluation of the actual performance of the teachers in teaching with technology [34]. This study utilized classroom observations to determine the TPK evident in teachers' performance. To further verify the results of the classroom observations, a semi-structured interview was administered. The data extracted from the three sources were triangulated.

Previously, no study exploring the Technological-Pedagogical Knowledge (TPK) among Filipino public secondary school teachers of Mandarin in the Philippines has been published. The existing literature has assessed the TPK of teachers in other countries, but only limited studies have explored secondary school teachers' TPK. Furthermore, previous studies focused solely on the data from self-assessment reports, which are being questioned for validity and accuracy. Guided by these reasons, the present study explored the TPK of Filipino public secondary school teachers of Mandarin using qualitative data from classroom observations, semi-structured interviews, and questionnaires. Subsequently, the researcher of this study attempted to formulate the following specific objectives:

1. How may the teachers' Technological Pedagogical Knowledge (TPK) be described in terms of:

- 1.1. Self-Assessment Report
- 1.2. Classroom Practices
- 1.3. Cognition

2. What are the implications of the findings of this study for educational management?

The findings of this study provided valuable inputs concerning the development of teachers' TPK to effectively implement online teaching to policy-making units of different educational institutions, including the Department of Education. Thus, this study could function as the point of reference in crafting professional development programs that would further enhance the TPK of Filipino public secondary teachers of Mandarin.

## **2. METHODOLOGY**

### **2.1 Research Design**

To fully describe the participants' Technological Pedagogical Knowledge (TPK), the researcher employed Mixed-Methods Sequential Explanatory Design. This two-phase approach uses the qualitative data gathered from the second phase to further explain the quantitative data collected from the first phase [11]. This study first collected quantitative data from self-assessment reports, followed by the collection of qualitative data from classroom observations and semi-structured interviews. The central focus of this study was the gathering of quantitative and qualitative data regarding the participants' technological pedagogical knowledge. The quantitative data were treated using descriptive data which include percentage, frequencies, mean, and standard deviation. On the other hand, thematic analysis of Braun and Clarke [5] was used to analyze the qualitative data. To further establish the validity of the results, the results from the multiple varied sources were triangulated.

### **2.2 Theoretical Framework**

The conduct of this study is guided by the Technological Pedagogical and Content Knowledge (TPACK) framework developed by Koehler and Mishra [22]. Among the

knowledge domain of the TPACK framework is the Technological Pedagogical Knowledge which is a synthetic knowledge resulted from the interplay between the Technological and Pedagogical Knowledge. The Technological Pedagogical Knowledge (TPK) describes the knowledge of the teacher in choosing an appropriate technology to support a particular teaching approach. It answers the question “What technology is the most appropriate technology to support teaching and learning?”

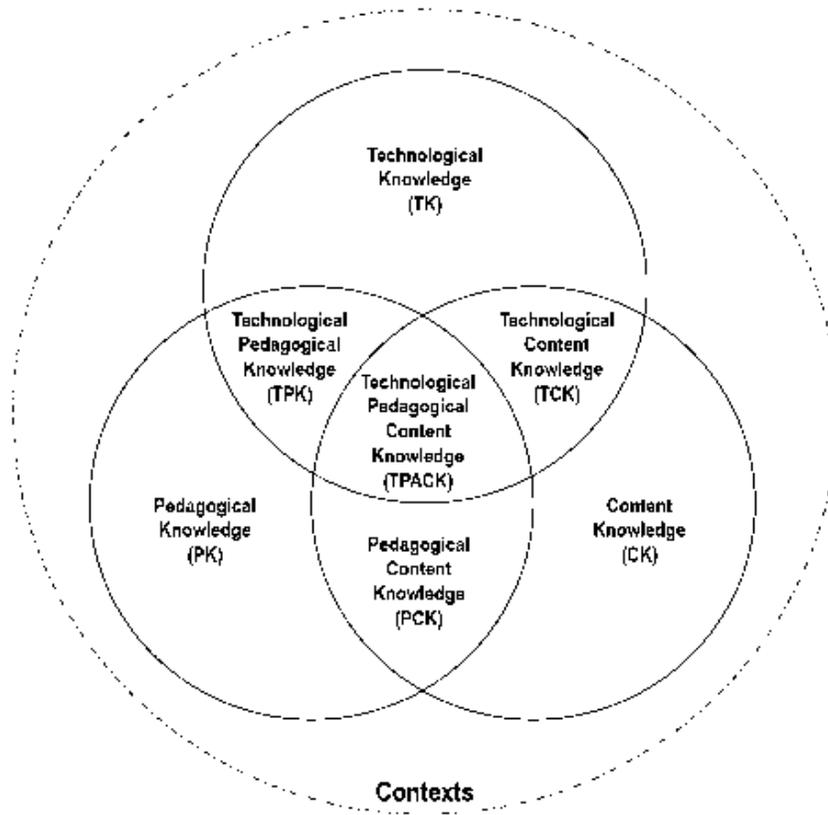


Figure 1: TPACK Framework (Mishra & Koehler, 2006)

### 2.3 Study Participants

The participants of this study were Filipino teachers who are teaching Chinese Mandarin as a foreign language in the Philippine public secondary schools. Participants were from the three public secondary schools identified as Centre of Excellence in the implementation of the Chinese Language program. The participants were chosen to be included in this study because they have completed the prescribed training program for Chinese as a foreign language teacher; they were from the identified centers of excellence; and they were teaching online during the conduct of this study. Other teachers who did not meet any of the mentioned criteria were excluded from the study. **All tables and figures will be processed as images. You need to embed the images in the paper itself. Please don't send the images as separate files.**

## 2.4 Study Instrument

To fully capture teachers' knowledge on the use of technology to support pedagogical practices, this study gathered data through (a) self-assessment questionnaire, (b) classroom observations, and (c) semi-structured interviews. The self-assessment questionnaire consists of four statements about Technological Pedagogical Knowledge (TPK). The four items in the questionnaire were adopted from the TPACK questionnaire developed by Schmidt et al. [27]. The same instrument was used as an interview guide in the semi-structured interview, where the researcher converted the statements into questions. On the other hand, classroom observations were recorded, transcribed, and coded.

The data collected from the self-assessment report were analyzed using mean and standard deviation. On the other hand, data gathered from the classroom observations and semi-structured interviews were analyzed using NVivo 12, a qualitative data analysis software. To ensure the validity of the results of the analysis, the data gathering and analysis procedures were documented accordingly using an audit trail. The aim of using an audit trail is to enhance the acceptability and credibility of the findings by recording the processes implemented in the completion of the study, including the procedures of gathering and analyzing data [10]. **The participants of this study were Filipino teachers who are teaching Chinese Mandarin as a foreign language in the Philippine public secondary schools. Participants were from the three public secondary schools identified as Centre of Excellence in the implementation of the Chinese Language program. The participants were chosen to be included in this study because they have completed the prescribed training program for Chinese as a foreign language teacher; they were from the identified centers of excellence; and they were teaching online during the conduct of this study. Other teachers who did not meet any of the mentioned criteria were excluded from the study. All tables and figures will be processed as images. You need to embed the images in the paper itself. Please don't send the images as separate files.**

## 2.5 Study Protocol

The researcher strictly adhered to the protocols of the university ethics review committee in the conduct of this study. The consent of the participants and their employer was sought using a written consent form. The study collected quantitative data from self-assessment report. On the other hand, qualitative data were gathered from classroom observations and semi-structured interviews.

First, the participants were asked to answer a self-assessment report to investigate their perceptions of their TPK. Second, the researcher further explored the participants' TPK through classroom observations. The participants recorded their online classes for (3) consecutive meetings. The recorded online classes were transcribed, checked, and coded. Lastly, the semi-structured interviews were conducted where questions were asked to explore the participants' cognition of their TPK. The audio recordings of the interviews were transcribed, checked, and coded. The data from the three sources were

triangulated.

### 3. RESULTS

#### 3.1 Participants' Perceptions of their Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) describes the teacher's knowledge on choosing appropriate technology to support a particular teaching approach [22]. As a result of the interplay between technological and pedagogical knowledge, TPK means knowing both technology and pedagogy and understanding how technological integration influences teaching, resulting in new pedagogical affordances. It involves knowing the available technological resources to enhance the teaching and learning experience. In the context of this study, technological pedagogical knowledge (TPK) refers to the participants' knowledge of using technology to enhance their language teaching. The participants' ratings on statements describing their technological pedagogical knowledge generated an average of 4.72 (strongly agree), demonstrating a high confidence level in their TPK. Table 1 below shows the participants' perceptions towards their TPK and other domains of the TPACK framework.

**Table 1: Participants' Mean Scores of their TPACK**

Professional Knowledge	Mean Scores	Standard Deviations
Pedagogical Knowledge	4.72	0.38
Content Knowledge	4.28	0.58
Technological Knowledge	4.50	0.45
Pedagogical Content Knowledge	4.53	0.44
Technological Pedagogical Knowledge	4.72	0.34
Technological Content Knowledge	4.31	0.76
Technological Pedagogical & Content Knowledge	4.58	0.43

Legend: 1-1.80 (SDA), 1.81-2.60 (DA), 2.61-3.40 (N), 3.41-4.20 (A), 4.21-5.00 (SA)

Among the TPK statements, the participants expressed their strongest agreement to knowing how to adapt the use of technologies to implement different teaching activities (4.89). This was followed by statements indicating their ability to choose technology to enhance students' learning (4.78) and think critically about using technology in the classroom (4.78). Moreover, surprisingly, participants' ability to choose technology that enhances teaching approaches garnered the lowest rating (4.44). The participants' rating of each statement related to technological pedagogical knowledge was shown in 2.

**Table 2: Participants’ Perceptions of their Technological Pedagogical Knowledge**

Technological Pedagogical Knowledge Items	Mean Scores	Standard Deviations
I can choose technologies that enhance the teaching approaches for a lesson.	4.44	0.50
I can choose technologies that enhance students' learning for a lesson.	4.78	0.38
I can adapt the use of the technologies to different teaching activities.	4.89	0.38
I am thinking critically about how to use technology in my classroom.	4.78	0.38
Mean score for Technological Pedagogical Knowledge	4.72	

Legend: 1-1.80 (SDA), 1.81-2.60 (DA), 2.61-3.40 (N), 3.41-4.20 (A), 4.21-5.00 (SA)

### 3.2 Participants’ Classroom Practices Demonstrating Technological Pedagogical Knowledge (TPK)

It is also worth noting that participants’ TPK, along with PK, garnered the highest mean score among the knowledge domains of TPACK, indicating their consciousness of their ability to choose appropriate technological resources for their teaching. This can be further supported by the teaching episodes that exemplified TPK during the classroom observations. The researcher collated the varied practices that clearly demonstrated the participants’ TPK in each component of the instructional model or structure of the lesson prescribed by the Department of Education. The focus of this part was how did technological tools and resources support or enhance teaching. The TPK practices in each part of the lesson is shown in Table 3 below.

**Table 3: Participants’ TPK Practices**

PEDAGOGY	TECHNOLOGY	TPK PRACTICES	CODES
<b>Introduction</b>	Slide Presentation	The use of slide presentation to provide an overview of the lesson’s content (topic, vocabulary, sentence pattern, learning objectives).	PCK-Plan
<b>Pretest/Review/Motivation</b>	Game Software (Bambozzle), Slide Presentation	The use of slide presentation or game software to arouse the interest of the students or to review the previous lesson.	TPACK-Game, TPACK-Review Previous Lesson
<b>Lesson Presentation</b>	Slide Presentation, Video, Picture,	The use of slide presentation (text), digital images, and videos to support the presentation of the vocabulary and grammar contents of the lesson.	TPACK-Word-Video, TPACK-Word-Translation, TPACK-Word-Picture,

			TPACK-Word-Comparison, TPACK-Watch Video Presentation, TPACK-Sentence-Translation, TPACK-Sentence-Formula, TPACK-Production Practice, TPACK-Modelling
<b>Generalization</b>	Slide Presentation, Image, Animation, Digitized Textbook	Use of visual-prompt (image/animation) or text-based material (flashcard/word card) placed in a slide presentation or digitized textbook to let students' recall and summarize the newly learned vocabulary and sentence patterns.	TPACK-Word-Review, TPACK-Sentence-Review
<b>Application</b>	Slide Presentation, Image, Animation, Digitized Textbook	Use of slide presentation or digitized textbook to ask the students to use the newly learned sentence patterns through a dialogue activity, visual-prompt or text-based prompt may be included in the slide presentation as basis for the dialogue.	TPACK-Dialogue Activity
	Slide Presentation, Image, Animation, Digitized Textbook	Use of visual-prompt (image/animation) or text-based material (flashcard/word card) placed in a slide presentation or digitized textbook to test students' comprehension of the newly learned vocabulary and sentence patterns.	TPACK-Visual Identification
	Slide Presentation, Image, Animation, Digitized Textbook	Use of visual-prompt (image/animation) or text-based material (flashcard/word card) placed in a slide presentation or digitized	TPACK-Kinesthetic

		textbook and let the students say the newly learned word accompanied with a body movement	
<b>Assessment</b>	Nearpod, Google Form, Slide presentation	The use of slide presentation or online application for the test/evaluation of the students.	TPACK-Online Test
	Game Software (Kahoot), Slide Presentation	The use of slide presentation or game software to test students' knowledge of the vocabulary and sentence patterns.	TPACK-Game
<b>Additional/Other Activities</b>	Name Selection Software	The use of a software to randomly pick name of the student who will recite or do a particular activity/task.	TPK-Name Pick
	Video, Slide presentation	The use of video or slide presentation for the enrichment activity such as making a card, writing Chinese characters, etc.	TPACK-Enrichment Activity

Table 3 reveals that the participants employed varied technological tools and resources to support or enhance every teaching component. The lesson usually begins with an introduction, wherein the teacher will provide students with an overview of the lesson by sharing the lesson's topic and target learning objectives. Instead of simply narrating these information pieces, the participants encoded them in a slide presentation, making it visually available to the students. The lesson's introduction was followed by the review/motivation part wherein the participants employed learning games to arouse the students' interest or review their previous learnings. The learning games became more interesting and engaging with game software and slide presentation. Following the motivation is the presentation of the lesson's content. The use of technology in presenting the lesson's content was previously discussed in the TCK part. The TCK resulted in the new content representation and afforded new teaching activities. The succeeding part is the generalization wherein teachers summarize the presented content. The participants asked questions to let students recall or enumerate what has been discussed. However, this was further enhanced with visual-prompt or text-based material placed in a slide presentation, which guided the students to recall or review the newly learned vocabulary and sentence patterns. The use of technology provided the students with an easier way to consolidate and remember the knowledge gained from the lesson.

After consolidating the knowledge gained, it is essential to let the students practice its application through different activities. Instead of the usual question and answer activity, the participants used visual-prompt (image/animation) or text-based material (flashcard/word card) placed in a slide presentation or digitized textbook to elicit

students' comprehension of the newly learned vocabulary and sentence patterns. Furthermore, the participants employed Total Physical Response to promote physical interaction in learning Chinese Mandarin. However, instead of simply dictating the word to be translated, the participants used visual-prompt (image/animation) or text-based material (flashcard/word card), wherein the students' response to the prompt is saying the newly learned word accompanied with a body movement. Lastly, the functions of the vocabulary and sentence pattern were practiced using the dialogue activity, in which they were asked to complete the given dialogue based on the given visual-prompt or text-based prompt. It allows the students to recall the newly learned vocabulary and sentence patterns and analyze the given context and respond accordingly. The students were randomly called during these activities using a name selection software called Duck Race.

Following the activities for application was the assessment part, wherein the participants have digitized their paper-and-pencil type of tests through technological tools such as slide presentation, Nearpod, and Google Form. Though the use of these tools was not directly observed during the classroom observation, the instructions were explicitly explained to the students, thus, allowing the researcher to have an idea of their assessment activities. The assessment strategies employed by the participants adhered to the suggested strategies under the distance learning delivery modalities issued by the Department of Education (DM-CI-2020-00162). The said document recommended the use of online platforms of applications in the conduct of both formative and summative assessment, which was clearly reflected in the participants' classrooms. In addition to assessment activities, the participants also provided enrichment activities such as making greeting cards and writing Chinese characters, supported by slide presentations, Canva, and video presentations.

### **3.3 Participants' Cognition of Technological Pedagogical Knowledge**

Aside from the participants' observed techniques of employing technological tools to support their teaching, their TPK was also manifested in their interview and open-ended questionnaire responses. The participants' responses were grouped into two themes: using applications to support teaching (CTPK-Application) and the importance of TPK (CTPK-Sig).

The participants mentioned using varied technological applications and how they helped enhance their teaching. Teacher Chan and Teacher Ong used social media and online classrooms to ensure that students can conveniently access non-print materials, even before or after the synchronous session, allowing the students to preview and review the lesson.

Teacher Chan: We have different social media platforms like our Facebook group page where I post some videos or materials related to Mandarin even before the lesson. In that way, students can asynchronously go over with the topic that we're going to discuss for the next meeting. So, ahead of time, I see to it that the lesson is already posted in our group page or even in our messenger so that the neophyte learners will be able to adjust as well as participate in the discussion. I did different applications. I'm really

happy and satisfied of the outcome, and to see the learners' feedback is really a good price for me and with the support of our teachers and head teacher.

Teacher Ong: Technology is very important for me, and for my students because nowadays it is hard to teach using voice alone, so if they will not see what I am talking about in a PowerPoint presentation or in other platform, it is really going to be difficult to learn this Chinese Mandarin as I and they are not native speakers. Nevertheless, even though they do not have laptop, we usually capture the video and send it to them through Messenger because it is the most accessible for them. For example, their assignment is about five characters, so I capture a video on how to write the specific character and send it to them through Google classroom or on Messenger which is really the most accessible for them.

Teacher Ong emphasized his intervention to ensure that all students will be catered to regardless of their technological resources. Considering the fact that some students do not have the needed laptop or software to view a particular material, he made sure to video record it and still make it available through the use of other technological applications. Teacher Uy encountered the same challenge and said, "Some students do not have the same opportunity to explore the lessons due to limited access to internet connectivity, and the gadgets they use are not suited with the activities prepared by the teacher." Thus, it is important to be knowledgeable of the alternative technological applications that these students can use. Teacher Ong also mentioned how the slide presentation made the content visually available to the students, allowing them to follow the discussion easily. In addition to this, it was mentioned by Teacher Nan that technological tools promoted active participation among the students, contributing to students' mastery of the lesson.

Teacher Nan: Technology is actually a big factor for the students to reach the mastery of the lesson. It is hard for us teachers if we are just kept on discussing. It is also engaging when it comes to using technology in teaching. We have, just like what I have mentioned earlier, game-based instruction or gamification.

Teacher Nan maximized technological applications by designing instructional games to support his teaching and further engage students in the discussion. On the other hand, Teacher Fan, Teacher Uy, and Teacher Sy shared the conference applications they are using, which have been instrumental in the successful delivery of their classes during the pandemic.

Teacher Fan: Like the Google Meet, because definitely in this situation, we could not meet them personally. So, with this particular means of delivery, like the use of the Google meet the zoom and the like, that's the way, that's the avenue for us to discuss the lesson for them.

Teacher Uy: We need use online platforms at this time to ensure the learning of the students because we are in this new normal, new set up that is why there is no other way but to study these and explore others to ensure students' learning.

Teacher Sy: I'm using the Google slide I think from the very start up to the end of my

lesson, I find it to be very accessible if I use these Google slides because I discovered that it's easy to input different videos there. I use the Google slides to make my lesson easier. And usually, I share this with my students and that's the thing that they also study.

In addition to mentioning the technological applications used to support teaching, the participants also recognized the significance of TPK to their teaching. The participants believed that technology significantly impacts the teaching and learning process, especially during the pandemic or new normal setup of education. The technology served as an essential instrument to support teacher-initiated activities designed to arouse students' enthusiasm, promote engagement, and encourage interaction. Moreover, technologically-supported teaching provides both teachers and students a platform for an easier way of sharing materials and communicating, regardless of their geographical locations.

Teacher Chan: The use of technology has a great impact in the teaching-learning process. It has been observed that the use of technology makes the teaching-learning process more interactive and more effective.

Teacher Ong: I feel the importance of technology in teaching learning process.

Teacher Nan: Technology is an important tool in bridging teaching and learning in the new normal of education.

Teacher Uy: The use of technology is a great way to support my teaching, especially this time of pandemic.

Teacher Sy: Technology incites a great deal of enthusiasm since we are dealing with technological learners.

Teacher Ing: Technologies are helpful in teaching mandarin.

Teacher Chu: I use technology by means of engaging my students to fully enjoy their online class.

Teacher Un: I think technology helps a lot in teaching. It aids teachers to make their ppt's, search appropriate activities for the lesson on the internet, communicate with the students frequently with regards to the lesson concerned and so on.

Though the participants recognized the significance of TPK on their teaching, they also acknowledged the presence of the challenges in using technology to support their teaching. The issues raised in the use of technology in the TK part were echoed in this part. Below are the participants' responses when asked about the challenges of using technology in their teaching.

Teacher Chan: Accessibility of learners due to poor internet connect, no gadgets, no load, home disturbance. Suitability of the technology applications to their age as well as their skills in performing or doing it.

Teacher Ong: Some of the students were not able to utilize the technology because of insufficient memory being used in their gadget.

Teacher Nan: However, not all students have the luxury to enjoy the benefits of it which sometimes leads to poor performance in class.

Teacher Fan: Poor Internet connection.

Teacher Uy: The limited access of internet connection is a great challenge. For instance, you are in the middle of creating an activity using gform/quizziz then all of a sudden, the internet will disconnect. Definitely, the momentum will be lower in that scenario.

Teacher Chu: Some challenges that I encountered in choosing technology is that some students are having internet connection problems that are affecting their use of technology.

Teacher Un: Lack of sufficient knowledge with the use of some applications are the challenges I have encountered.

The success of technological integration in teaching depends on both the teachers and students; thus, it is vital to analyze the students' technological resources, access to the internet connection, and technological fluency to ensure the feasibility of a particular technology. Furthermore, as previously mentioned by Teacher Ong, it is essential to check for alternative technologies that the students can use.

In summary, data gathered from the self-assessment questionnaire, classroom observations, and interview revealed the following regarding the participants' technological pedagogical knowledge (TPK): First, the participants have a high level of awareness of their TPK as reflected in the computed mean score of their responses in the questionnaire, in which TPK garnered the highest rating among the knowledge domains of TPACK. Second, the participant's technological pedagogical knowledge was reflected in the use of varied technologies that have supported the implementation of the different components of their teaching, starting from the introduction until the assessment. The teaching episodes wherein the participants clearly demonstrated their TPK were coded using 20 unique codes. Third, participants' cognitions reflected their awareness and experience using applications to support teaching (CTPK-Application). Lastly, the participants recognized the significance of TPK (CTCK-Sig) and its significant impact on their teaching.

#### **4. DISCUSSION**

The technological-pedagogical knowledge garnered the highest rating among the knowledge domains of TPACK with a computed average of 4.72, the same rating as that PK. Contrary to the findings of previous studies [8], [18], [2], which claimed that teachers were less confident of their TPK compared to other knowledge domains. The self-assessment report indicated that the participants were more confident in their TPK than TCK and PCK. This was further reflected in participants' use of varied technologies that supported the implementation of the different components of their teaching, starting from the introduction until the assessment. This supports previous study which claimed that technology can be used in a purposeful way to improve teaching and learning [6].

This was further reflected in the participants' responses wherein they mentioned the varied applications they use to support their teaching, thus, further exemplifying their TPK. This observation aligns with [16], which explained that TPK requires seeking technological tools to advance student learning & deepen understanding. The participants' use of multiple varied technologies demonstrated their ability to adapt a technological tool suited to a particular component of their teaching. The same was emphasized by [15], which indicated that different technologies have their potentials that contribute to their suitability for a particular task. It simply means that TPK is the ability to choose a particular technology that will support or enhance a teaching task, resulting in better learning outcomes.

However, to successfully judge the technology's suitability, the teachers should have an in-depth understanding of their teaching. Lachner et al. [19] emphasized that TPK requires teachers to have pedagogical knowledge that would enable them to evaluate the affordances of technologies in varying teaching scenarios. This was further confirmed by [1] which found that pedagogical knowledge has a positive effect on TPK, which on the other hand, influences TPACK development. The TPK, along with PCK or PK, contributes to the teachers' TPACK development [20], [24], [25]. Therefore, professional development training may also focus on further enhancing the teachers' pedagogical knowledge, which plays a vital role in TPK & PCK and contributes to their TPACK development.

## 5. CONCLUSION

Utilizing multiple varied data sources, this study provided educators, school heads, policymakers, and other education stakeholders with a relatively detailed vignette of the participants' Technological-Pedagogical Knowledge, which is crucial in the development of teachers' technology-related professional development programs. Understanding the participants' current professional knowledge is vital in developing professional development programs [27]. Based on the gathered data, the following are the findings and recommendations of this study:

First, the participants have a high level of awareness of their TPK as reflected in the computed mean score of their responses in the questionnaire, in which TPK garnered the highest rating among the knowledge domains of TPACK. Considering that TPK is the result of the interplay between technological knowledge (TK) and pedagogical knowledge (PK), it is necessary that the emphasis of the professional development programs should be placed in developing their TK and PK independently and interdependently. Professional development program providers shall design TPACK-based trainings that will equip teachers the capability to plan a technology-supported teaching;

Second, the participant's technological pedagogical knowledge was reflected in the use of varied technologies that have supported the implementation of the different components of their teaching, starting from the introduction until the assessment. The teaching episodes wherein the participants clearly demonstrated their TPK were coded using 20 unique codes. However, the extent of the participants' use of technology to

support teaching was not established. Thus, the conduct of TPK needs assessment is recommended to establish the current status of the teachers' professional knowledge, given the fact that novice and experienced teachers have different technological knowledge as reflected in [13]. Furthermore, professional development programs should also look into innovative approaches in Chinese language teaching, especially for experienced teachers who are prone in routinely using teaching strategies, limiting them from exploring more effective techniques;

Third, participants' cognitions reflected their awareness and experience using applications to support teaching (CTPK-Application). The participants recognized the significance of TPK (CTCK-Sig) and its significant impact on their teaching. Thus, it is necessary for the school heads to further explore the different factors that may contribute to the teachers' TPK development and provide necessary training or support for the successful enactment of TPK in their classrooms.

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