Technological Pedagogical Content Knowledge (TPACK) and Emergency Remote Teaching (ERT): Understanding teacher decisions and challenges with integrating technology in planning lessons and instruction

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Abstract: This paper explores how senior high school teachers integrated technology with the shift to emergency remote teaching (ERT) during the pandemic. Seven teachers from 2 private high schools were asked to describe the considerations, challenges, and modifications related to lesson planning and actual online teaching. Quantitative results show that teachers rated themselves highly in the following TPACK components: content, pedagogy, pedagogical content, technological content, and technological pedagogical content knowledge. On the other hand, qualitative results include descriptions about: considerations and challenges related to ERT (in relation to preparation and readiness for lesson planning and technology use; challenges and opportunities related to online assessment and teaching; and insights about ERT experiences. The study concludes that technology integration should not only be promoted as a response to the pandemic, but more as a process for supporting to teacher development and student learning beyond the pandemic.

Key Words: TPACK, curriculum planning, ERT, online teaching

1. INTRODUCTION

The COVID-19 pandemic disrupted education around world, causing schools to lockdown and utilize alternative delivery systems. The immediate response for most school was to engage in emergency remote teaching (ERT), a temporary shift from classroom teaching to online learning (Bawa, 2020; Hodges, Moore, Lockee, Trust, & Bond, 2020). The approach in ERT is not to create robust online learning system, but to establish quick set-up to immediately deliver learning (Hodges, Moore, Lockee, Trust & Bond, 2020). In the Philippines, the government policy underscores multiple delivery systems, which include blended learning, distance learning (online, modular, TV/radio-based instruction), and even face-to-face learning in low-risk areas (DepEd, 2020).

In 2020, school opening was delayed as the government tried to mitigate the situation and address the emerging challenges faced by educational institutions (Baizas, 2020). As schools start the transition, they faced a number of challenges related to technology (connectivity, access to equipment), teacher preparedness for online learning, availability of resource materials to support teaching and learning, and readiness of K-12 students and their parents for online learning (DepEd, 2020; Ferri, Grifoni, & Guzzo, 2020).

Pedagogical challenges related to online learning include: lack or limited knowledge and skills among teachers in using technology; the need for professional development training for teachers; students' familiarity with online learning tools; lack

of interactive multimedia teaching resources; and the difficulty in designing assessment and evaluation strategies to support learning (Ferri, Grifoni, & Guzzo, 2020). In most local schools, teachers were caught in a predicament as they were asked to prepare to move learning from their classroom to an online environment, while the system for providing resources, training and support are also being simultaneously being established or simulated (Luz, 2020).

Teachers were at the forefront in addressing the disruption caused by the pandemic on curriculum planning and delivery. Curriculum planning refers to "making decisions about what students need to learn and why, and as well as, how to organize teaching and learning process taking into account existing curriculum requirements and resources available" (UNESCO IBE, n.d.). Teachers had to determine what students need to learn and how learning should be facilitated. The curriculum planning challenges faced by teachers involved organizing learning units, preparing individual lessons, and harmonizing lesson sequences using an online platform, which they have not trained for or extensively used before the pandemic. Teachers had to fast-track lesson planning for their virtual classrooms. They needed to immediately figure out how they can adapt their classroom-based practices into emergency remote teaching. They had to devise ways to integrate technology with their teaching in order to deliver learning.

Technological Pedagogical and Content Knowledge (TPACK)

TPACK is a widely researched and utilized framework for understanding how teachers integrate technology. TPACK describes technology integration in terms of primary teacher knowledge forms (content, pedagogy, technology) and their interactions (Koehler & Mishra, 2009):

Pedagogical Knowledge (PK) pertains to teachers' deep knowledge about the processes and practices or methods of teaching and learning.

Content Knowledge (CK) pertains to the teachers' knowledge about the subject matter to be learned or taught.

Technological Knowledge (TK) refers to the understanding of information technology and applying it productively to work and in everyday lives. It is also the ability to recognize information technology to assist or impede the achievement of a goal and continually adapt to changes in information technology.

Pedagogical Content Knowledge (PCK) covers the core business of teaching, learning, curriculum, assessment and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy.

Technological Pedagogical Knowledge (TPK) refers to the understanding of how teaching and learning can change when particular technologies are used in particular ways.

Technological Content Knowledge (TCK) refers to the understanding of the manner in which technology and content influence and constrain one another

Technological Pedagogical Content Knowledge (TPCK) refers to meaningful and skillful teaching with technology, and entails the integration of the content, pedagogy, and technology.

Technology typically encompass the new digital tools and applications that tend to change and evolve rapidly, which makes their adoption and use in the classroom challenging for teachers. But technology integration is more than just knowledge and use of latest technology. What is critical in facilitating effective integration of technology is an understanding of how teachers' pedagogical and technological beliefs affect technology adoption, teaching decision and classroom practices (Koh, Chai, & Tay, 2014). The TPACK framework provides a conceptual structure to explore teachers' decision-making processes, particularly how they can assess classroom realities and maximize available resources to facilitate learning. Using TPACK, the current study explores how Filipino senior high school teachers make decisions about technology integration in lesson planning and instruction. Specifically, the study addresses the following questions:

1. What is the profile of the participants in terms of TPACK?
2. What modifications in lesson planning and instructions were considered to integrate technology with the shift to ERT?
3. What are the considerations and challenges in selecting technologies to be used in lesson planning and instruction?
4. What are the teacher beliefs related to online learning and ERT?

2. METHODOLOGY

The study employed a concurrent mixed methods design to measure TPACK levels, qualitatively describe teaching practices, and define how teachers integrate technology in ERT. Participants were 7 senior high school teachers from

2 private schools in Manila as participants. The respondents currently teach different core subjects such as: Personal Development, Research Methods, Earth and Life Science, Understanding Culture, Society and Politics, Contemporary Philippine Arts, and 21st Century Literature from the Philippines. In terms of educational attainment, the participants were distributed as follows: Bachelor's degree (n=4), Master's degree (n=2), and Doctoral degree (n=1). The average age is 33.16 years (range 25-59); and years of teaching, 6.40 years (range 4-12). They typically handle class sizes have 25-35, and conducts4-5 hours of online teaching per week since the start of the pandemic.

TPACK Survey

The study used 28-item *TPACK.xs*, which was developed as a shorter alternative to existing TPACK measures that have more items, unequal number of items per subscale, and refers to specific subject matters or technologies (Schmid, Brianza, & Petko, 2020). The study samples for the instrument development were pre-service upper secondary school teachers. Cronbach alphas for the subscales were as follows: PK=.84; CK=.77; TK=.90; PCK=.79; TPK=.81; TCK=.91; and TPCK=.87 (Schmid, Brianza, & Petko, 2020). The items were rated on a 5-point scale (1-strong disagree, 5-strongly agree).

The researchers choose to use *TPACK.xs* primarily because: (1) it has equal number of items for each TPACK domain; (2) it is well suited for general use as it does not pertain to specific subjects or specific technologies (given the study participants do not teach common subjects).

Qualitative Questionnaire

An open-ended questionnaire was used to further obtain information: (1) preparations and challenges related to lesson planning and instruction in the context of ERT; (2) considerations for selecting and use of technology; (3) beliefs about online learning and ERT.

Procedure and Data Analysis

The researchers distributed the *TPACK.xs* self-assessment questionnaire to all seven participants through Google Forms. The survey also collected demographics data such as age, gender, educational attainment, and years of teaching experience. All seven respondents completed the self-assessment questionnaire and the initial responses were collected and tabulated. After completing the self-assessment questionnaire, the participants received a follow-up qualitative questionnaire to provide details to the TPACK survey.

Descriptive statistics were computed for the quantitative data, while qualitative data were content analyzed descriptively to describe teaching practices. Quantitative and qualitative data were then compared to relate TPACK with actual teaching practices during ERT, following general guidelines in mixed methods data analysis (Creswell, 2014)

3. RESULTS AND DISCUSSION

The quantitative results are presented under TPACK Profile, while the section on considerations and challenges to ERT discusses the qualitative results.

TPACK Profile

In Table 1, the participants rated themselves positively across all TPACK components, but they rated themselves as highly knowledgeable about the following: (1) subject matter to be taught: (CK, M=4.61, SD=.57); (2) processes and practices of teaching and learning (PK, M=4.32, SD=.61); (3) knowing which teaching approaches is most appropriate for the content (PCK, M=4.50, SD=.58); (4) knowing how the subject matter can be changed by the technology used (TCK, M=4.21, SD=.74), and knowledge of good teaching with technology (TPCK, M=4.36, SD=.62).

Table 1. Descriptive Statistics for the TPACK Profile

TPACK Components	M	SD
Content Knowledge (CK)	4.61	.57
Pedagogical Knowledge (PK)	4.32	.61
Technology Knowledge (TK)	3.96	.79
Pedagogical Content Knowledge (PCK)	4.50	.58
Technological Pedagogical Knowledge (TPK)	4.21	.74
Technological Content Knowledge (TCK)	3.86	.93
Technological Pedagogical Content Knowledge (TPCK)	4.36	.62

Considerations and Challenges Related to ERT

Responses are presented in relation to instructional phases (lesson planning, online

teaching and assessment), and descriptions of ERT experiences. Interview narratives describe modifications related to pedagogy, content, and technology use as part of ERT:

Lesson Planning

Preparation and Readiness. With just a short time before the start of the school year, teacher preparations included training on how to navigate and use learning management systems (LMS), and online communication platforms such as *Google Meet* and *Zoom*. These tools were used as the primary method for synchronous and asynchronous classes. They were also provided with online applications and websites as resources for their lesson plans. Others had to do their own additional research on effective online teaching. They also had to prepare for content and coverage revisions, following the *Most Essential Learning Competencies* (MELCs) from the Department of Education (see DepEd, n.d.).

The MELCs streamlined target competencies and content coverage. They became the fundamental guide for curriculum planning, content teaching, learning episodes, and assessments. However, most of the teachers still opted to retain their classroom-based teaching and instruction strategies (i.e., lectures, discussions, games and student recitations), while others facilitated group activities and actively used student feedback through online communication.

Technology Considerations. The primary consideration for choosing and integrating technological tools was ease of access. Teachers chose to use online resources that can be readily accessed given the poor quality of Internet connection in the country. The most commonly used online tools were: *YouTube* (for lesson plan integration), *Google Suite* (for online collaboration), *Kahoot* and *Mentimeter* (for interactive student group activities). These technologies are usually free, familiar, and easy to navigate that most teachers are able to use them without additional training provided.

Another consideration for selecting technology use is the appropriateness and alignment of content standards with both MELCs and the Senior High School curriculum. For instance, science related topics such as the nervous system and microscopes can be taught by using tutorial videos as an alternative to an actual laboratory class. Most teachers incorporated online tools into their lessons but are often limited to what were introduced to during trainings and webinars like *Google Suite, Zoom, Kahoot, Slido* and *Mentimeter*.

Online Teaching and Assessment

Challenges. In spite of the preparation and modifications made on lesson plans, there were still unexpected complications during actual instruction. Some teachers had to adjust the use of technology in classroom instruction, revise student evaluation and assessment, and adjust instructional strategies to address emerging student needs.

Due to unstable Internet connection, teachers experienced limitations on implementing their planned learning activities, demonstrating technical concepts and methods, and even holding lectures and discussion sessions. Not being able to maximize online tools due to connectivity issues caused emotional stress and frustration among the teachers. Likewise, student participation also became limited. Changes in learning activities were characterized by the use of less authentic learning strategies. For instance, a few teachers reported shifting from actual online scientific experiments to video tutorials as Internet connection became intermittent.

Assessment was also another main challenge for online teaching. As they aligned with the minimum content standards, they ended up giving lenient assessment. The teachers felt that they needed to compromise between what should be considered minimum competency standards from their understanding of the subject matter and what should be reasonably assessed given the pandemic situation. Application of authentic assessments was also limited, especially in specific subject areas (like science) where knowledge and skills are easier to evaluate in a face-to-face classroom setting. Concerns about how to handle academic dishonesty and inattentiveness among students were also reported by the teachers.

In relation to technology, all respondents agreed that they need further training required to

improve how they conduct online teaching. Two respondents acknowledged that they only have the basic knowledge and skills in integrating technologies in their lesson plans and instruction. They recognize the lack of training compounded their adjustment to the shift to the online learning environment.

Opportunities. Participants agreed that there were opportunities in ERT. ERT made them realized the importance of online learning and professional development training in technology integration, not only to respond to current needs but also ensure to create effective learning environments.

TPACK Used in
Integrating Technology During ERT

Table 2 describes how the specific teaching practices during ERT are related to TPACK components. The results highlight how content, pedagogy, and technology are interdependently related in technology integration. Although quantitative results indicate moderate to high ratings across all components, qualitative results show that majority of the teaching practices were largely related to technology knowledge (TK), technological pedagogical knowledge (TPK), content knowledge (CK), and pedagogical content knowledge (PCK). There was no teaching practices reported related to technological pedagogical content knowledge (TPCK). The results support findings in earlier studies that highlight a holistic and multifactor approach to technology integration in teaching (Koehler & Mishra, 2009; Koh, Chai, & Tay, 2014)

Table 2. TPACK Component related to Teaching Practices

TPACK Components	Teaching Practices
Content Knowledge (CK) (M=4.61, SD=.57)	*Lesson Planning* - Streamlined target competencies and content coverage - Modified lesson plans to align with minimum content standards - Aligned assessment with minimum content standards
Pedagogical Knowledge (PK) (M=4.32, SD=.79)	*Lessson Planning* - Modified lesson plans to respond to student needs
Technology Knowledge (TK) (M=3.96, SD =.61)	*Lesson Planning* - Needed additional training on online teaching - Used LMS and online tools to aid teaching - Did additional research on useful online teaching and learning tools *Technology Consideration* - Chose and integrated technology based on what is accessible and available - Preferred to use online tools that are free, familiar, and easy to navigate
Pedagogical Content Knowledge (PCK) (M=4.50, SD=.58)	*Online Teaching and Assessment* - Adjusted instruction and assessment to address emerging student needs - Modified assessment standards to align with minimum target competencies and content coverage
Technological Pedagogical Knowledge (TPK) (M=4.21, SD=.74)	*Lesson Planning* - Did additional research on effective online teaching - Adapted face-to-face classroom teaching practices for online learning *Online Teaching and Assessment* - Modified instructional delivery and learning activities to respond to unstable internet connection - Adjusted assessment strategies for online learning - Learned to how effective handle academic dishonesty and manage student disengagement - Recognized the need to learn how to conduct effective online teaching
Technological Content Knowledge (TCK) (M=3.86, SD=.93)	*Online Teaching and Assessment* - Recognized the need to upgrade competencies to integrate technology in their lesson plans and instruction

Teachers' ERT Experiences

The participants were optimistic despite the limitations and drawbacks in ERT, citing that the introduction and use of the LMS (i.e., Google Suite, Blackboard) offered the convenience of providing a platform for teachers to remain connected to their students. They described their LMS as user-friendly, accessible, and content-heavy. For those without LMS, they use creative online platforms to engage and motivate their students. They appreciated the implementation of self-paced learning, considering that senior high school students were expected to practice self-regulated learning and self-discipline. Teachers observed that the students invested more for their learning progress.

On the other hand, teachers believed that they need further training in relation to: (1) identify appropriate technological tools for their subject matter and planning instructional activities, (2) how

to effectively utilize technological tools to address the needs of their students. They also realized that the training received at the start of the school year was insufficient to ensure effective lesson planning and instruction. Some even believed that both teachers and students were not also fully prepared for ERT. Other hindrances to ERT included poor Internet connection and limited resources. Teachers could not deliver their lessons properly without stable Internet connection. Connectivity issues affected the overall quality of education and effective communication in ERT – which is a common concern that emerged across schools (DepEd, 2020; Ferri, Grifoni, & Guzzo, 2020).

4. CONCLUSIONS

In shifting to emergency remote teaching, senior high school teachers made necessary adjustments on what they teach, how they teach, and what tools they used to facilitate learning. Their limited knowledge of online teaching and access to online resources made planning content, assessment, and learning activities, and as well as, the actual virtual teaching more challenging for all, and daunting, for some. Curriculum planning for classroom teaching was even more disrupted by technological concerns related to connectivity and access. Even if they faced challenging situations, the teachers were able to maximize the use of available tools, accommodate modifications to curriculum plans, respond to student needs, and reflect on their professional development needs. They also recognized the need to recalibrate current practices, retool themselves, and upgrade their competencies in integrating technology -not only to respond to ERT but to support teacher development and student learning beyond the pandemic.

To help teachers integrate technology within and beyond ERT, the following are recommended: (1) provide regular professional development activities related to technology integration using a research-based framework like TPACK; (2) provide teacher support for developing TPACK competencies; (3) conduct more research on teacher decision-making based on TPACK to inform policies and programs for in-service training, particularly in curriculum planning and instruction; (4) make interactive multimedia resources available for curriculum planning; and (5) address technological challenges (connectivity and access) at least at the school level;

Limitations and future research

Due to pandemic-related restrictions, data collection was limited to the use of a series of online survey questionnaires. Future studies can focus on using TPACK as a framework for technology integration, and provide more in-depth investigation of TPACK transformation by elaborating teacher descriptions with class observations, document analysis, and more detailed interviews.

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