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Research Article

Appropriating Technological Pedagogical Content Knowledge of Basic Education Teacher Using Online Learning Instruction

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ABSTRACT

The digitalization of the world community and the advent of Covid-19 pandemic have created impact to the lives of the teachers and other stakeholders. This study provide knowledge on the teachers in terms of, pedagogical, content and technological knowledge in using technology as means of instruction and learning of the students. Findings have showed that teachers were knowledgeable in terms of technology as means of their pedagogical application, content matters and best practices in technology integration. Data further implied that teachers were knowledgeable with tech-ed either online or in the classroom settings. However, data suggests that there were some technical issues were perceived in technology integration.

Keywords: *TPACK*, *Technology integration*, *technical Issues.*

Introduction

Technology has become an increasingly vital part of students' lives outside school, and even within the classroom it can also help increase their sympathetic of complex concepts or encourage collaboration among peers. Although instructors should employ technology in their classrooms because of these advantages, many are hesitant to do so for several reasons (Berge and Collins, 1995; Hwang et al, 2015; Lau, 2003; Maor, 2003). Cost, accessibility, and implementation time are typically significant obstacles in the classroom, but a lack of information about how technology may best be used to help students in various subject areas is also a barrier (Kurt, 2019). Information and communication technology (ICT) in the twenty-first century has opened up new avenues for accessing and processing knowledge across all disciplines. In addition, ICT is altering teaching by offering new methods for involving students (TTF, 2018; Noor-Ul-Amin, 2013; Benton-Borghi, 2013).

In educational programs, for example, new and developing digital technologies are more easily included due to increasing availability and social applications in routine daily activities (Merchant, 2012; Sefton-green, 2004). When it comes to incorporating new technology into the classroom for teaching and

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learning, teachers face several obstacles and issues about how and when to do so. Students' thinking, curricular content, and pedagogical techniques in the context of learning with new technology have taken precedence over the characteristics, affordances, and restrictions of specific technologies (Niess, 2011).

In order to effectively educate and engage students with technology, instructors should evaluate how their knowledge domains interact with TPACK, or Technological Pedagogical Content Knowledge. Content (CK), Pedagogy (PK), and Technology (T) are the three major types of knowledge that play an important role within the TPACK framework (TK). The TPACK strategy looks at all three knowledge bases as part of a whole. By emphasizing knowledge at the junction of three basic forms: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Know-How, the TPACK paradigm takes a step further (TPACK). Developing attention to the dynamic, transactional interaction between various components of knowledge located in specific settings is required for effective technology integration for pedagogy around specific subject matter. Every scenario is unique, and no one mix of material, technology, and pedagogy will apply to every teacher, every course, or every approach of teaching. Individual teachers, grade levels, school specific characteristics, demography, culture, and other aspects (Mkoehler, 2012).

Technological Pedagogical Content Knowledge

Punya Mishra and Matthew J. Koehler's "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," published in 2006, is considered a foundational book on the TPACK paradigm. They explain that their hypothesis is the result of five years of research involving design experiments in which they observed how instructors of various grade levels ran their classes (Wang, 2019). It was Lee S. Shulman's 1986 book "Those Who Understand: Knowledge Growth in Teaching" that gave them their inspiration. A common conception of teacher knowledge is that there are two types: one is called content knowledge, and the other is called pedagogical knowledge, which includes information about how to instruct and includes particular teaching techniques. Shulman argues the opposite, stating that good instructors use these two sets of information to form a comprehensive understanding of how to instruct their subject matter effectively. This is what he refers to as PCK, or pedagogical content knowledge. When Mishra and Koehler looked back twenty years later, they realized that the use of technology in the classroom was the most significant shift in education. They discovered that technological knowledge was regarded as though it was in a separate category from PCK and was unrelated. These researchers spent five years developing a new framework known as TPACK, which incorporates technology into teaching subject knowledge while emphasizing the linkages, interactions, and restrictions that instructors face across all three domains of knowledge (Mouza et al., 2014).

Table 1. Content, Pedagogical and Technological Knowledge

TPACK	Outcomes
Content Knowledge (CK)	This refers to knowledge regarding concepts, theories, facts, and organizational frameworks within a certain academic area; it may also include best practices and established means of delivering this material to students in the field . As an example, the amount of depth and scope required in middle school science and history classes is less than that required in college or graduate courses, therefore the CK of their various professors or the CK that each class imparts to its pupils may vary. (Mkwawa, 2020; Harris et al. 2009; Ball et al., 2008).

Pedagogical Knowledge (PK)	This is a description of what instructors know about teaching and learning techniques, procedures, and approaches. To be more particular, PK may be used to areas such as recognizing student learning styles, classroom management abilities, lesson preparation, and assessments as a general type of knowledge. (Mishra and koeler, 2008; Graham, 2011; Harris et al. 2009).
Technological Knowledge (TK)	This refers to how well instructors understand and can put to use a wide range of technology resources and tools. Learning to detect when edtech helps or hinders learning is at the heart of TK, as is staying abreast of new technology and adapting to it as it becomes available. (Mouza et al, 2014; Koeler @ Mishra, 2009; Niess, et al., 2009).

Even while teacher preparation programs have failed to engage instructors in actively incorporating suitable technology, a new paradigm has evolved for imagining teacher knowhow. Numerous academics have advocated thinking about the integration of technology, content, and pedagogy in the same manner Shulman (1987) did when he developed PCK, recognizing the necessity for a larger viewpoint. There has been an attempt to integrate and intersect the fields of content, pedagogy (teaching and learning), and technology (TPCK) with the concept of technological pedagogical content knowledge (Margerum-Leys & Marx, 2002; Mishra & Koehler, 2006). Over time, the abbreviation TPCK was renamed to TPACK (pronounced "tee-pack") in order to draw emphasis to the entire teaching package, which includes technology, pedagogy, and subject knowledge as components (Niess, 2008b; Thompson & Mishra, 2007). While using digital technology to guide their students' thinking and learning in many topics, TPACK is seen as a dynamic framework that describes the information that instructors must rely on.

TPACK Key Attributes

TPACK's essential characteristics have been deduced from the pictures and viewpoints used to create them. When new technologies are introduced for integration into specific topic areas, TPACK evolves and multi-faceted (rather than static) representations of teacher knowledge are created. Two critical discoveries were offered by Angeli and Valanides (2009). Because they felt the name "technology" was deceptive, they rephrased it as Information and Communication Technologies (ICTs) (ICT). Another way to put it is that they depicted TPACK as "a tool used by its users to rebuild subject matter from teacher knowledge into the substance of teaching" (pp. 8-9). They stated that "just developing one or more of its knowledge bases does not guarantee or imply that ICT-TPCK is also being developed simultaneously" (p. 14). The term "technology pedagogical content knowledge" was intentionally used to highlight TPACK as a PCK extension with the inclusion of the intersection of the technology domain with the PCK content and pedagogy intersection (Niess, 2005). This term, rather than using the word "pedagogy," underlined the range and magnitude of the various pedagogical factors (Niess, 2005). A wide range of models centered on the educational setting in which instructors are required to integrate technological innovations (Angeli & Valanides, 2009; Doering et al., 2009; Koehler & Mishra, 2008). In the accounts of the encounters, instructors' thinking was seen as simultaneously drawing on various construct domains, which attracted attention. Strategic thinking in TPACK has been defined by Niess (2008a) as understanding when, when, and how to utilize domain-specific knowledge and techniques (Shavelson, Ruiz-Primo, Li, and Ayala, 2003) while directing student learning using suitable information and communication technologies (as cited by Niess, 2011).

Research Method

The research strategy used in the study was a descriptive method research design using quantitative techniques. Descriptive statistics use data collecting and analysis techniques to provide reports that summarize significant facts. The input of the study provide data on the relevant information relating to the Technological Content Knowledge of the respondents. The respondents of the study were the elementary teachers of identifies school in the province of Cebu City. With the 5-point likert0-scale the instrument was adopted from the study was adopted from the study of Schmidt et al. (2009) and Valtonen et al. (2017) relating to TPACK framework for the teachers. This includes, technology, pedagoy, content and knowledge. This study addressed the pedagogical, content, and technological knowledge of teachers in this time of pandemic.

Results and Discussion

Pedagogical Knowledge

Knowledge of the processes and practices of teaching, including classroom management, lesson plan development and delivery, student evaluation, and an understanding of cognitive, social and developmental theories.

Table 2. Pedagogical Knowledge

Pedagogical Knowledge	Mean	VD
Guiding students' discussions during group work	4.42	SK
Promoting critical thinking in students	4.68	SK
Assisting students in the planning of their own learning	4.84	SK
Assisting pupils with their reflective thinking	4.65	SK
Encouraging pupils to utilize one other's opinions and ideas throughout group projects.	4.62	SK
Aiding kids' problem-solving abilities	4.54	SK
Fostering pupils' inventiveness	4.52	SK
Weighted mean	4.61	SK

Table 2, shows the teachers knowledge in terms of pedagogical knowledge. Guiding students in planning their own learning got the highest weighted Guiding students' discussions during group work got the lowest weighted mean of 4.42 which also verbally described as strongly knowledgeable. Overall, the knowledge of pedagogical knowledge got an overall mean score of 4.61 which verbally described as strongly knowledgeable. Persaud (2019) has stated that having a well-thought-out pedagogy can improve the quality of your teaching and the way students learn, helping them gain a deeper grasp of fundamental material. Being mindful of the way you teach can help you better understand how help students achieve deeper learning. And it can, in turn, impact student perception, resulting in cooperative learning environments that utilizes technology. This indicates that pedagogical knowledge integrating technology is fundamental in 21st century classroom. Moreover, pedagogy requires meaningful classroom interactions and respect between educators and learners. The goal is to help students build on prior learning and develop skills and attitudes and for educators to devise and present curriculum in a way that is relevant to students, aligning with their needs and cultures.

Technological knowledge (TK)

Knowledge of digital technologies and the skills required to operate them. They include knowledge of operating systems, computer hardware, software, and the ability to learn and adapt to new technologies.

Table 3. Technological knowledge (TK)

Technological knowledge (TK)	Mean	VD
I am capable at resolving ICT-related issues.	4.16	K
I am well-versed in new technologies and their features.	4.12	K
I am capable at utilizing modern technology.	4.11	K
I am familiar with a number of new technology websites.	4.08	K
I know how to troubleshot ICT problem.	3.48	K
It's easy for me to incorporate technological aspects in my class.	3.88	K
I can solve ICT related problems.	4.12	K
Weighted mean	3.99	K

Table 3, shows the teachers knowledge in terms of technological knowledge. The statement I can solve ICT related problems got the highest weighted mean of 4.16 which verbally described as knowledgeable. While, the statement I know how to troubleshot ICT problem" got the lowest weighted mean of 3.88 which also verbally described as knowledgeable. Overall, the knowledge of technological knowledge got an overall mean score of 3.99 which verbally described as knowledgeable. Recent reports shows that technical skills are important for a number of reasons. They can help you work more efficiently, boost your confidence and make you a more valuable candidate for employers. Candidates who have a technical skill are often more confident when applying to certain industries than those who don't (WikiJob, 2020). Hence, this indicates that technological knowledge of the teachers is important to help students in this digital world.

Content knowledge (CK)

Content Knowledge (CK) is knowledge of the subject matter to be taught, including information of essential facts, concepts, theories, and procedures within the discipline.

Table 4. Content knowledge (CK)

Content knowledge (CK)	Mean	VD
I have sufficient knowledge in developing contents in my lessons	4.84	SK
I know the basic theories and concepts of my lessons	4.83	SK
I know the history and development of important theories in my lessons	4.86	SK
I am familiar with recent research in my lessons	4.55	SK
Weighted mean	4.77	SK

Table 4, shows the teachers knowledge in terms of content knowledge. the statement "I know the history and development of important theories in my lessons" got the highest weighted mean of 4.86 which verbally described as strongly knowledgeable. While, the statement "I am familiar with recent research in my lessons" got the lowest weighted mean of 4.55 which also verbally described as knowledgeable. Overall, the knowledge of content knowledge got an overall mean score of 4.77 which verbally described as knowledgeable. Our own content knowledge affects how we interpret the content goals we are expected to reach with our students. It affects the way we hear and respond to our students and their questions. It affects our ability to explain clearly and to ask good questions. It affects our ability to approach a mathematical idea flexibly with our students and to make connections. It affects our ability to push each student at that special moment when he or she is ready or curious. And it affects our ability to make those moments happen more often for our students (Lappan, 2000). Moreover, teacher content knowledge is crucially important to the improvement of teaching and learning, attention to its development (Ball et al., 2008).

Interaction between technological and pedagogical knowledge (TPK)

Knowledge of technological tools for specific classroom tasks such as record keeping, grade books, data analysis, and content organization, as well as how technological tools change the nature of teaching and the learning environment.

Table 5. Interaction between technological and pedagogical knowledge (TPK)

Interaction between technological and pedagogical knowledge	Mean	VD
I understand how to utilize ICT in the classroom as a tool for students' reflective thinking.	3.82	K
I understand how to utilize ICT in the classroom as a tool for students to design their own learning.	3.34	K
I understand how to utilize ICT in the classroom as a tool for exchanging ideas and thinking together.	4.06	K
I also understand how to use ICT in the classroom as a tool for students' creative thinking.	4.16	K
I understand how to use ICT in the classroom as a tool for group problem solving among students.	3.84	K
Weighted mean	3.84	K

Table 5, shows the teachers knowledge in terms of Interaction between technological and pedagogical knowledge. The statement "I know how to use ICT in teaching as a tool for students' creative thinking" got the highest weighted mean of 4.16 which verbally described as knowledgeable. While, the statement "I know how to use ICT in teaching as a tool for students to plan their own learning" got the lowest weighted mean of 3.34 which also verbally described as knowledgeable. Overall, the knowledge of interaction between technological and pedagogical knowledge got an overall mean score of 3.84 which verbally described as knowledgeable. This describes teachers' understanding of how technology and content can both influence and push against each other. Kurt (2019) has stated that TCK involves understanding how the subject matter can be communicated via different edtech offerings, and considering which specific edtech tools might be best suited for specific subject matters or classrooms.

Interaction between content and technological knowledge (TCK)

Knowledge of what technologies are suitable for specific content, as well as how technology influences and changes the nature of content.

Table 6. Interaction between content and technological knowledge

Interaction between content and technological knowledge (TCK)	Mean	VD
I know websites with online materials for my study.	4.63	SK
Professionals utilize ICT apps that I am familiar with.	4.48	SK
I am familiar with ICT-applications that I may utilize to better grasp the topics.	4.12	K
I am familiar with technology that can be used to demonstrate challenging concepts.	4.25	SK
Weighted mean	4.37	SK

Table 6, shows the teachers knowledge in terms of interaction between content and technological knowledge. The statement "I know websites with online materials for my study" got the highest weighted mean of 4.63 which verbally described as strongly knowledgeable. While, the statement "I know ICT-applications which I can use to better understand the contents" got the lowest weighted mean of 4.12 which also verbally described as

knowledgeable. Overall, the knowledge of interaction between content and technological knowledge got an overall mean score of 4.37 which verbally described as strongly knowledgeable. Thus, understanding of how technology and content can both influence and push against each other.

Interaction between pedagogical and content knowledge (PCK)

Knowledge what teaching approaches fit the content, and likewise, knowing how content can be arranged for better teaching.

Table 7. Interaction between pedagogical and content knowledge (PCK)

Interaction between pedagogical and content knowledge (PCK)	Mean	VD
I know how to help students solve content-related problems in groups.	4.84	SK
I understand how to direct pupils' critical thinking.	4.64	SK
I know how to encourage students to use one other's opinions and ideas in group projects.	4.88	SK
I also know how to encourage students' reflective thinking.	4.82	SK
I know how to assist pupils in developing their own learning plans.	4.85	SK
Weighted mean	4.81	SK

Table 7, shows the teachers knowledge in terms of interaction between pedagogical and content knowledge. The statement "I know how to guide students in planning their own learning" got the highest weighted mean of 4.88 which verbally described as strongly knowledgeable. While, the statement "I know how to guide students' critical thinking" got the lowest weighted mean of 4.64 which also verbally described as strongly knowledgeable. Overall, the knowledge of interaction between pedagogical and content knowledge got an overall mean score of 4.81 which verbally described as strongly knowledgeable. According to Solis (2009) pedagogical content knowledge is a special combination of content and pedagogy that is uniquely constructed by teachers and thus is the "special" form of an educator's professional knowing and understanding.

Interaction between pedagogical, technological, and content knowledge

Knowledge of how technology, pedagogy and content interact in different contexts.

Table 8. Interaction between pedagogical, technological, and content knowledge (TPACK)

Interaction between pedagogical, technological, and content knowledge	Mean	VD
I know how to utilize ICT as a tool for exchanging ideas and collaborative thinking when teaching natural sciences.	3.81	K
I know how to utilize ICT as a tool for students' reflective thinking when teaching natural sciences.	3.64	K
I know how to utilize ICT as a tool for students to design their own learning when teaching natural sciences.	4.12	K
I know how to use ICT as a tool for group problem solving in natural sciences classes.	4.06	K
I know how to use ICT as a tool for students' creative thinking when teaching natural sciences.	3.86	K
Weighted mean	3.90	K

Table 8, shows the teachers knowledge in interaction between pedagogical, technological, and content knowledge. The statement " In teaching natural sciences, I know how to use ICT as a tool for students to plan their own learning" got the highest weighted mean of

4.12 which verbally described as knowledgeable. While, the statement "In teaching natural sciences, I know how to use ICT as a tool for sharing ideas and thinking together" got the lowest weighted mean of 3.64 which also verbally described as knowledgeable. Overall, the knowledge of interaction between pedagogical, technological, and content knowledge got an overall mean score of 3.90 which verbally described as knowledgeable. Teaching with technology is complicated further considering the challenges newer technologies present to teachers. Technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy, and technology knowledge. Underlying truly meaningful and deeply skilled teaching with technology, TPACK is different from knowledge of all three concepts individually. Teaching with technology is a difficult thing to do well. The TPACK framework suggests that content, pedagogy, technology, and teaching/learning contexts have roles to play individually and together. Teaching successfully with technology requires continually creating, maintaining, and re-establishing a dynamic equilibrium among all components. It is worth noting that a range of factors influences how this equilibrium is reached (Harris et al. 2009)

Summary of Teachers Knowledge on Tpack

Table 9. Summary teachers' knowledge on TPACK

TPACK	Mean	V
Pedagogical Knowledge	4.61	SK
Technological knowledge	3.99	K
Content knowledge (CK)	4.77	SK
Interaction between technological and pedagogical knowledge	3.84	K
Interaction between content and technological knowledge	4.37	SK
Interaction between pedagogical and content knowledge	4.81	SK
Interaction between pedagogical, technological, and content knowledge	3.90	K

Table 9 shows the summary of the teacher's knowledge on TPACK. Result shows that majority of the of the elements which consider critical in the teaching and learning process were rated as strongly knowledgeable. Moreover, it can be seen that interaction between pedagogical and content knowledge got the highest weighted mean of 4.81 which verbally described as strongly agree, while interaction between technological and pedagogical knowledge got the lowest weighted mean of 3.84 which verbally described as knowledgeable. This implied that teachers have the knowledge and skills in terms technological pedagogical and content knowledge. Overall, the findings shows that teachers were fully equipped with the knowledge and skills in this digital era in education.

Conclusion

Based on the findings, teachers have shown the knowledge in using technology across the curriculum. This indicates that teachers were fully guided on the best practices in terms of integrating technology in the classroom and through online learning. Major findings also suggest that through technology integration, teachers and students were able to meet the objectives of department of education under the new normal and teachers were able to provide quality learning to the students. However, findings also suggest that there were some technical issues when using technology as means of instruction and learning. By recognizing the impact of this results, it is very important to provide alternative means of learning and instruction in order to provide quality education.

Recommendation

The main goal of this study is to gain empirical knowledge on the teacher's knowledge in terms technology, content, and technological knowledge as means of instruction and learning.

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Authors Contribution

All authors discuss the results and contributed from the start to final manuscript.

Conflict of Interests

The authors declare that they have no competing interests.

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