Development of a TPACK-Based Professional Development Framework for the New Normal in Education

Anania B. Aquino, Aleli A. Dadayan, Marvin E. Rosel, and Michael John V. Francisco

***Abstract*—The role of technology in the delivery of education in this time of pandemic help teachers in the delivery of lessons and student learning. This study examined the competence on online technological pedagogical content knowledge (TPACK) of a sample of faculty members and their online teaching attitude and ability and develop a professional development framework for teachers under the new normal in education. This quantitative research used a questionnaire to collect data from 501 faculty members from Batangas State University as respondents. Findings indicate that pedagogical knowledge, technological knowledge and technological content knowledge are the predictors of faculty members. Online attitude and ability were also considered very important by most faculty members. Thus, a professional development framework in the new normal based on technological pedagogical content knowledge of teachers was prepared.**

***Index Terms*—TPACK, content knowledge, pedagogical knowledge, technological knowledge, university faculty.**

I. Introduction

The latest outbreak of coronavirus 2019 n-CoV in Wuhan has spread all over the globe and the Philippines is not spared. The Philippine government implemented community quarantine to mitigate its effect but the Philippines' confirmed COVID cases continued to escalate. With the terrifying effect of COVID-19 on the health and wellness of the people, the economy, and all other aspects of our daily existence, the Philippines is shifting to the "new normal". In the educational sector, this means shifting to a flexible and alternative delivery of instruction while observing social distancing.

This flexible instruction may include face-to-face meetings with only 20 students per class to observe social distancing, online instruction and other alternative modality. It is then a necessity for teachers to be prepared for this new normal in education.

In addition, problems were reported on the skills and knowledge of teachers in teaching during the era of technology in different countries [1]. Moreover, the development of these 21st century skills is a means of improving teacher instructional quality [2], and among these skills, ICT skills pose challenges for teachers.

Technology plays a major role in the 21st century as it is used as a tool in helping the teachers in the delivery of lessons and students in learning which completes the model of Technology, Pedagogy Content Knowledge (TPACK). The TPACK framework focuses on the integration of technology to enhance student learning in a classroom. It becomes a productive way to consider how teachers could integrate educational technology into the classroom. TPACK can serve as a measurement of instructor knowledge and can be used potentially for both training and professional development offerings for teachers at all levels of experience [3].

In this time of COVID-19 pandemic, as the education sector sees it fit to shift to the new normal of teaching, faculty members must adapt to the demand of the situation. Their teaching competencies and attitude are challenged. Thus, the College of Teacher Education deems it necessary to analyze the TPACK competence of the faculty members of Batangas State University. The assessment will identify both their strengths and weaknesses, which will be used as baseline data in designing a TPACK professional development framework for the new normal in education. The TPACK professional development framework, in turn, will be used to promote better learning among students in this time of new normal in education and after.

II. Review of Related Literature

The Technological Pedagogical and Content Knowledge (TPACK) is a framework for the integration of technology in the teaching and learning process that is based on Shulman's Pedagogical Content Knowledge [4]. Fig. 1 is a TPACK Framework where the image has been copyrighted in 2012 by tpack.org. TPACK aims to provide a sound basis for identifying and assessing teachers' professional competence relevant to technology integration in their teaching [4]. The framework shows that the heart of good teaching is an interplay of knowledge of content (field of specialization), pedagogy, and technology [5]. Further, it puts emphasis on the relationships of these three primary knowledge forming Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK).

Content knowledge (CK) covers the teacher's mastery about her/his specialization [6]. Pedagogical Knowledge (PK) deals with the teachers' expertise in designing effective

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learning experiences for students [7].

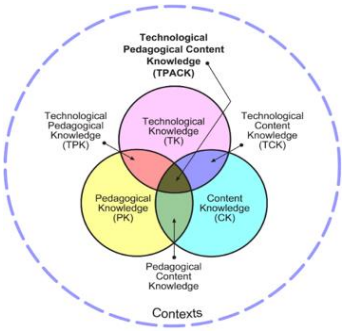

Fig. 1. TPACK Framework: An image copyrighted in 2012 by tpack.org.

Technological knowledge (TK) is the knowledge and skills of using technology efficiently in the context of education [7]. Pedagogical Content Knowledge (PCK) pertains to the application of appropriate pedagogy to the subject matter. Technological Content Knowledge (TCK) focusses on the interactions between content knowledge and technology and Technological Pedagogical Knowledge (TPK) as the interactions and relationship between of the teaching and learning process and the use of technology [7].

The relationship and interaction of TCK, PCK and TPK constitutes the Technological pedagogical content knowledge (TPACK). TPACK describes how the effective teaching of a content can be carried out with the integration of appropriate technology [5].

Durak [8] studied teachers' TPACK levels and their self-efficacy in integrating technology, technology literacy, and social network usage goals. He found that encouraging teachers' own beliefs and focusing on building their own beliefs in technology integration techniques are beneficial for attaining effective technology integration.

Additionally, Santos and Castro [6] investigated the implementation of TPACK based on context and how TPACK may be implemented in different situations using multiple regression analysis. The findings show that one of the aspects that need evaluation is TPACK performance.

Moreover, Othman and Maat [9] identified research methods have been used to conduct studies on the TPACK framework in mathematics education. The findings also show that technology integration in teaching fraction and algebra is the most frequently studied.

Agustini, Santyasa, and Ratminingsih [10] also assessed the TPACK capacity among Education technology graduates using the mixed-method approach. As a result, the graduates have a strong command of material and pedagogical knowledge, but their ability to use technology is still limited.

A. Online Teaching Attitude and Ability

Online teaching involves activities and opportunities that will expand the learning environment for diverse student. Since the use online teaching increases, many teachers are asked to consider the use of online teaching. [11]. In addition, online learning is defined as a learning experience in which students connect with instructors and work with other students in either synchronous or asynchronous contexts utilizing various technologies [12]. It can enhance the teaching-learning process and make it more student-centered, innovative, and adaptable [13].

Gururaja [14] investigated the attitudes of teachers regarding online instruction. The findings revealed that men teachers have a considerably more favorable attitude toward online teaching than female teachers, and urban teachers are more interested in online teaching than rural teachers.

III. Materials and Methods

This study utilized the quantitative method of research. It employed a questionnaire uploaded to an online Google Form, which were sent to as many respondents as possible. The questionnaire asked about the teachers' profile that covers sex, age, highest educational attainment, and years of teaching. It also assessed the participants' Technological Pedagogical Content Knowledge using the questionnaire of Archambault and Crippen [15]. This is intended for online teaching with 24 items; the response to each item is scaled from 1-5 (5=excellent, 4=good, 3=average, 2=fair, and 1=poor). The questionnaire tested reliable with Cronbach's alpha coefficient of alpha = 0.699 for the technology content domain to alpha = 0.888 for the technology domain. The third part requested participants to report their attitude and ability on online teaching using the 31-items Faculty Readiness to Teach Online (FRTO) instrument of Martin, Budhrani, and Wang [16].

The study collected data from faculty members of different constituent campuses of Batangas State University, whereby a total of 501 faculty members (184 males and 317 females) answered the questionnaire.

The collected data were organized and analyzed by employing descriptive and inferential statistical tests. For the test of significant difference comparing the responses of faculty, z-test and ANOVA were used. Regression analysis was done to determine which kind of knowledge predicts TPACK of faculty members. A p =0.05 was used as the significance level for all data analysis.

Ethical Concerns. The researchers addressed all ethical concerns relevant to the study. They obtained approval from the campus chancellors before they sent questionnaire to the respondents. They also assured the respondents' privacy and confidentiality and their participation in this research was voluntary and still free to withdraw at any time without giving a reason. They were then requested to fill out the questionnaires after taking their consent.

IV. Results and Discussion

Faculty members who responded to the survey represented different constituent campuses of Batangas State University. Of these campuses, most responses came from Alangilan Campus (32.14%), followed by ARASOF-Nasugbu (20.36%), Pablo Borbon (17.17%); Malvar (16.57%), and Lipa (69=13.77%).

To test for the reliability of data obtained in this study, Cronbach's alpha coefficient [17] was determined for each of the subscales to determine the level of internal consistency. Cronbach's alpha levels were acceptable with alpha = 0.7632 for TCK, 0.8025 for CK, 0.8232 for PK, 0.8574 for TK, 0.8727 for PCK, 0.8694 for TPCK/TPACK, 0.8924 for the

domain of Technological Pedagogical knowledge.

A. Faculty Members' Self-reported Online TPACK as Indicative of Their Competencies for Online Teaching

The online technological pedagogical content knowledge of faculty members was investigated using mean, which are shown in Table I. Knowledge of all the domains of TPACK was rated above 3.99, indicating that faculty members possess good knowledge and a good level of competencies for online teaching in general. Among all domains of online TPACK, the highest mean value was obtained by pedagogical content knowledge, i.e., 4.09, while TK obtained the least mean value of 3.78. The domains of content knowledge and pedagogical knowledge have both the same mean value of 4.08, TPK with a mean of 4.04, technological pedagogical content knowledge (TPCK) with a mean of 3.99, and technological content knowledge (TCK) with 3.87.

For the domain of pedagogical knowledge, which received the highest mean, there are three items. Faculty were very confident of item no. 3 "*ability to distinguish between correct and incorrect problem-solving attempts by students"* as it received the highest mean of 4.14 among the three items while faculty rated item no. 2 "*ability to assist students in noticing connections between various concepts in a curriculum"* as the lowest in this domain with the mean of 4.05.

For technological knowledge (TK) that obtained the least mean value of 3.78, faculty might feel slightly less confident of this domain as each item recorded a mean of slightly lower than 4.0 that of 3.72, 3.76, and 3.85 for "*Ability to assist students with troubleshooting technical problems with their personal computers", "Ability to address various computer issues related to software",* and *"Ability to troubleshoot technical problems associated with hardware"* respectively. It should be noted that these ratings are still equated to good knowledge, although faculty might feel somewhat less confident among the TPACK domains.

TABLE I: ONLINE TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE OF FACULTY MEMBERS

TPACK Domains	Mean	Verbal Interpretation
Technological Knowledge (TK)	3.78	Good
Content Knowledge (CK)	4.08	Good
Pedagogical Knowledge (PK)	4.08	Good
Pedagogical Content Knowledge (PCK)	4.09	Good
Technological Pedagogical Knowledge (TPK)	4.04	Good
Technological Content Knowledge (TCK	3.87	Good
Technological Pedagogical Content Knowledge (TPCK/TPACK)	3.99	Good

Although content knowledge is only one of the second domains with the highest rating, one of its items received the highest rating of 4.18 among all 24 items of TPACK and this is the "*Ability to plan the sequence of concepts taught within my class".*

The item that faculty demonstrated the least confidence among all 24 items fell under the domain of technological content knowledge. This item receiving a mean of 3.52 is about the "*Ability to use various courseware programs to deliver instruction*".

B. Online TPACK Comparison by Sex, Highest Educational Attainment, and Years of Service/ Teaching

Table II discloses that he PK and PCK for male and female were found to be similar as specified by the p-values obtained (0.215 and 0.150). In contrast, the p-values obtained for technological knowledge (8.29×10^{-8}), content knowledge (8.29×10^{-8}), technological pedagogical knowledge (0.0475), technological content knowledge (0.00288), and technological pedagogical content knowledge (0.00639) specify a significant difference between the responses of male and female respondents. Male perceived themselves in these domains to have a higher competence than females.

TABLE II: TPACK COMPARISON BY SEX, HIGHEST EDUCATIONAL ATTAINMENT AND YEARS OF SERVICE/TEACHING

TPACK Domains	*p*-values		
	TPACK by Sex	TPACK by Highest Educational Attainment	TPACK by Years of Service/ Teaching
TK	8.29×10^{-8}*	0.012*	0.0022*
CK	8.29×10^{-8}*	0.018*	0.996
PK	0.215	0.067	0.790
PCK	0.150	0.045*	0.79
TPK	0.0475*	0.083	0.45
TCK	0.00288*	0.100	0.416
TPCK/TPACK	0.00639	0.097	0.280

** Significant Difference*

With respect to highest educational attainment, F-test identified significant difference in three domains only - those of TK, CK, and PK, with *p*-values below the significance level of 0.05. Therefore, H_1 is accepted. Tukey HSD / Tukey Kramer test reveals that faculty with units in master's degree and those with Post-doctorate Degree have different means. In contrast, the difference in terms of content knowledge arises from the combined mean of more than one group compared with the mean of one group or from the mean of other combined mean.

Statistical analysis of TPACK responses by years of service/teaching identified that there are only small differences between groups as conformed by F-test except on the domain of TK with a *p*-value (0.0022) $<\alpha$. Tukey HSD / Tukey Kramer test identifies the group of faculty members with 16 years and above teaching service to be different from the group with 0-5 years.

C. Extents by Which Primary and Secondary Knowledge Contribute to the Development of Faculty's TPACK

Table III reveals strong correlation between the primary knowledge of TK, CK and PK and secondary knowledge of PCK, TCK, and TPK and TPACK. The values ranging from 0.70 for TK and TPACK to 0.90 for TCK and TPACK support this correlation.

Multiple regression analysis as disclosed in Table IV shows that the primary knowledge of TK and PK and the secondary knowledge of TCK are the predictors of faculty's TPACK. Results from the MRA revealed that the overall association was statistically significant, $F(3, 497) = 427.254$, $p = 0.000$. These three predictors of TK, PK, and TCK explain 83.6% of the variance of TPACK. The coefficient of multiple correlation (R) equals 0.915470, which means that there is a very strong direct relationship between the faculty's TPACK and their TK, PK, and TCK.

TABLE III: TPACK CORRELATION

	TPACK	TK	CK	PK	PCK	TPK	TCK
TPACK	1.00000	0.70	0.75	0.82	0.81	0.86	0.90
TK		1.00000	0.50	0.56	0.51	0.61	0.65
CK			1.00000	0.86	0.83	0.78	0.83
PK				1.00000	0.86	0.82	0.88
PCK					1.00000	0.83	0.92
TPK						1.00000	0.96
TCK							1.00000

TABLE IV: MULTIPLE REGRESSION ANALYSIS MODEL SUMMARY

Variable	B	SE B	β	Significance	Adjusted R^2	R
Constant	0.153	0.0821	0.000	*		
TK	0.148	0.0203	0.189	***		
CK	-0.00739	0.0385	-0.00708	*		
PK	0.184	0.0435	0.181	***	83.6%	0.916
PCK	-0.0504	0.0616	-0.0495	*		
TPK	-0.00103	0.0722	-0.00108	*		
TCK	0.694	0.123	0.671	***		

R = Coefficient of multiple correlation *p >0.05 ***$p \leq 0.05$

D. Faculty's Online Teaching Attitude and Ability as Indicative of Their Competencies for Online Teaching

Generally, Table V bares that faculty members regarded all four areas of online teaching in terms of course design, course communication, time management, and technical competence as very important as depicted by the mean ranging from 4.51- 4.70. Course design was rated the highest (4.70) and technical competence got the lowest rating of 4.51 among the four areas but still regarded as very important. The high ratings indicate faculty has a very good attitude when it comes to online teaching, which could mean faculty members regarded themselves as very competent.

Meanwhile, faculty also rated their online teaching ability as very high with mean ranges of 4.89 – 4.98 verbally interpreted as they can do all four aspects of course design, course communication, time management, and technical competence well. They can do course communication well receiving the highest mean of 4.98. They rated course design as the second highest with a mean of 4.97 followed by time management with a mean of 4.96. Although they believe they can also do well in the aspect of technical competence, this receives the lowest rating of 4.89 among the four aspects.

TABLE V: FACULTY'S ONLINE TEACHING ABILITY AND ATTITUDE

Item Indicators	Attitude	V.I.	Ability	V.I.
Course Design	4.70	Very Important	4.97	Can do it well
Course Communication	4.69	Very Important	4.98	Can do it well
Time Management	4.63	Very Important	4.96	Can do it well
Technical Competence	4.51	Very Important	4.89	Can do it well

**Legend: V. I. – Verbal Interpretation*

E. Correlation of Online Teaching Attitude and Online Teaching Attitude and TPACK

The values obtained for online teaching attitude and ability are lower than 0.5 indicating there exist a very, very weak to no correlation at all between teaching attitude and teaching ability and TPACK.

F. TPACK-Based Professional Development Framework in the New Normal

The researchers used the findings of the study to prepare the TPACK-Based Professional Development Framework in the New Normal, which was subjected to validation. The framework envisions to support the school administration in the further development of the TPACK of faculty members while at the same time providing faculty a new perspective on how to enhance and develop their TPACK. It articulates the Guiding Beliefs, Key Principles, Framework Areas, and TPACK Professional Development Framework Areas. Each area contains suggested professional development activities as well as the evidence of competency to assess faculty members' TPACK enhancement.

The researchers believe the Framework is also applicable to all university educators using the flexible delivery of learning in the new normal as well as HEIs to guide best practice and to further enhance their skills in their role as educators and supervisors.

V. CONCLUSIONS

The study surveyed the TPACK and the online teaching attitude and ability of 501 faculty members of one state university in the Philippines using survey questionnaire and attempted to develop a TPACK – based professional development framework. The study found faculty members have good knowledge in all domains of TPACK. Technological knowledge differs across all groups by sex, educational qualifications, and years of service. Content knowledge varies by sex and educational background. All groups of respondents have similar pedagogical knowledge. PCK varies by educational background only while TPK, TCK, and TPCK varies by sex only with female having higher means than male. Primary knowledge of TK, CK and PK and secondary knowledge of PCK, TCK, and TPK are strongly correlated with TPACK.

Faculty members have very good teaching attitude and very high teaching ability on all four areas of course design, course. Despite these findings, online teaching attitude and ability are not correlated with the faculty members' TPACK.

Faculty members' TK, PK, and TCK influence faculty their TPACK. Thus, a TPACK-based Professional Development Framework in the New Normal was prepared. The framework could prove to be valuable in professional development.

VI. RECOMMENDATIONS

This study unveils significant aspects of the integration of technology in teaching of faculty members of Batangas State University. It adds to the existing literature on TPACK because it identified the predictors of TPACK of faculty members, which can be used in developing the TPACK of faculty members in other educational institutions.

In as much as the output framework of the study utilizes the findings of the study on faculty members' TPACK and their online teaching attitude and ability, the TPACK-based Professional Development framework may be considered as a basis in the organization's professional development plan especially relating to TPACK development of faculty.

A future research goal that can be explored is the study of the TPACK progress and development of faculty as they face the challenges of the flexible teaching and learning modality using the qualitative approach. The present study is quantitative in nature and the researchers believe it would serve as a relevant feeder to a qualitative study to further clarify the TPACK development of faculty. This might lead to the detection of valuable faculty learning episodes with respect to TPACK development, which may subsequently add to the existing literature on TPACK development in the new normal.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

A.B. Aquino prepared the research proposal, conducted the statistical treatment and interpretation of data, and oversaw the development of output based on the findings of the study. A.A. Dadayan prepared the letter of request to conduct the study, distributed and retrieved questionnaire, contributed in data interpretation and analysis and the development of the output of the study. She was also responsible in enhancing the research write-up and research literature. Both M.E. Rosel and M.J.V. Francisco distributed and retrieved the questionnaire and contributed in data interpretation and analysis, the development of the output of the study and the preparation of the final write-up.

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