A Concise Inquiry of College Teacher's Technological, Pedagogical and Content Knowledge (TPACK) During the Post Pandemic

Ferdinand G. Varilla
Quezon City University
Quezon City, Philippines
ferdinand.varilla@qcu.edu.ph

Nelson M. Lazare
Quezon City University
Quezon City, Philippines
nelson.lazare@qcu.edu.ph

Michelle S. Gregorious
Quezon City University
Quezon City, Philippines
michelle.gregorious@qcu.edu.ph

Abstract. This research focused to inquire and compare the assessed Technological, Pedagogical and Content Knowledge (TPACK) competence level of college teachers based on the variables of sex, educational attainment, specialization, age and years in teaching. The participants of the study consist of 42 College of Education faculty teaching at the Quezon City University. TPACK Competence Scale was used to collect research data. The results revealed that most of the teachers were male, finished a master's degree and specialized in Social Science and Humanities subjects. Furthermore, the majority of the respondents' age was from 41 to 55 years old and have long years of teaching experience ranging from 11 to 20 years. Meanwhile, findings of the research showed that teacher's competence on content knowledge, pedagogical knowledge, pedagogical-content knowledge, and technological-pedagogical knowledge were very high while participant's competence on technological knowledge and technological-content knowledge were high. Participants' overall TPACK competence was very high. In addition, participants' competence on all TPACK domains do not differ based on above-mentioned variables. However, there was a difference found in the competence level of participants' technological knowledge when grouped according to their field of specialization.

Keywords: *College teachers; Technological knowledge; Pedagogical knowledge; Content knowledge; TPACK level*

INTRODUCTION

In a policy brief released by the United Nations (2020), 94% of the world's student population, and up to 99% in lower-middle and low-income countries are affected by school closures that were brought about by the Covid-19 pandemic. This education system disruption created wider disparities in educational opportunities for the most vulnerable youth and children, particularly girls, displaced individuals, persons with disabilities, refugees, and those living in poor communities. An estimated 23.8 million students worldwide from pre-primary to tertiary level are expected to drop out because of Covid-19's impact on the economy.

With these recent changes in the education system, the demand for technology used in the teaching and learning process also accelerated.

Technology has become an increasingly important part of students' lives beyond school, and even within the classroom, it can also help increase their understanding of complex concepts or encourage collaboration among peers. Because of these benefits, current educational practice suggests that teachers implement some form of technology in their classrooms – but many teachers face difficulties in doing so. Cost, access, and time often form considerable barriers to classroom implementation, but another obstacle is a lack of knowledge regarding how technology can best be used to benefit students across diverse subject matter.

Punya Mishra and Matthew J. Koehler's 2006 TPACK framework, which focuses on technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), offers a productive approach to many of the dilemmas that teachers face in implementing educational technology (edtech) in their classrooms. By differentiating among these three types of knowledge, the TPACK framework outlines how content (what is being taught) and pedagogy (how the teacher imparts that content) must form the foundation for any effective edtech integration. This order is important because the technology being implemented must communicate the content and support the pedagogy to enhance students' learning experience.

According to the TPACK framework, specific technological tools (hardware, software, applications, associated information literacy practices, etc.) are best used to instruct and guide students toward a better, more robust understanding of the subject matter. The three types of knowledge – TK, PK, and CK – are thus combined and recombined in various ways within the TPACK framework. Technological pedagogical knowledge (TPK) describes relationships and interactions between technological tools and specific pedagogical practices, while pedagogical content knowledge (PCK) describes

the same between pedagogical practices and specific learning objectives; finally, technological content knowledge (TCK) describes relationships and intersections among technologies and learning objectives. These triangulated areas then constitute TPACK, which considers the relationships among all three areas and acknowledges that educators are acting within this complex space.

This pandemic compelled educational systems all over the world to shift from classroom set-up to mainly online classes and other modes of learning. In the Philippines, Higher Education Institutions implemented flexible learning as mandated by the Commission on Higher Education through a Memorandum Order No. 4 Series of 2020. The Quezon City University is currently in its second year of imposing flexible learning to continue its mission of delivering comprehensive education to its students. The faculty members were trained to use Google Classroom as means of delivering the lessons in both synchronous and asynchronous classes. Through video tutorials, they learned by themselves how to utilize some Google Applications such as Google Form, Google Meet, Google Mail, Google Slides, etc. They also learned by themselves some Google Application's extensions like Google Meet Attendance, Form Limiter, Hypatia Create, Form Builder and Mail Merge. Creation of modules was made by the college teachers of their assigned subjects. Technology was no longer regarded only as an integrated tool to enhance the quality of teaching but has been given a crucial role in the success of the teaching and learning process. It is equally important to the mastery of the content of the teachers as well as the pedagogy to be employed to learn the lesson in a meaningful way.

The migration in education becomes more challenging as it demands more technological infrastructure and the needed skills of teachers and students to navigate the numerous educational tools and applications. The inexperienced educational institutions in the sudden shift to online learning revealed the gaps in the system of education that could be turned into opportunities to improve. In the study conducted by Todd in 2020, the teacher's perception of the sudden shift from the classroom to online was tested. It revealed problems in technology, such as the ability to utilize a platform or application, which can be addressed through webinars and training. In the same study, employing a strategy in an online class also becomes a challenge as activities should be suitable and stimulating to be successful in transferring learning.

The challenges or problems experienced by educators in the new normal of education and together with their own solutions conceived the idea of conducting this study on the competence level of technological, pedagogical, and content knowledge of the faculty members of the College of Education. Furthermore, it will attempt to identify the issues that educators are encountering in their use of technology but also to

propose a capacity-building strategy to address the issues in teaching instruction. As a result, the necessary skills required by teachers will enable and keep them up to date with rapid technological advancement. This is also in response to the objective of Quezon City University of accelerating human capital development. One of the areas in which the school would want to deal with is the challenges in the educational dimension. Faculty development is required to keep up with new trends in teaching methods and thrive in a fast-paced environment. But beyond all the benefits of conducting faculty development, the most essential one is the welfare of the students. The professional development of faculty members will have an impact on students' acquisition of knowledge and skills, allowing Quezon City University to achieve its goal of being recognized as a local university producing employable graduates.

The study manifests one of the university's research agendas on Faculty Development - the process of giving professional development training to individuals to enhance their teaching abilities and mentoring faculty members to assist them in improving their job performance, especially in specialized areas such as teaching, research, course content, and design. Identifying teachers' Technological, Pedagogical, and Content Knowledge (TPACK), assessing their levels of development, and designing an intervention plan to further address the needs of teachers in their TPACK competencies, all lead to faculty betterment.

Hypothesis of the Study

There is no significant difference between the level of TPACK of the College of Education teachers and their demographic variables.

Objectives of the Study

The purpose of the study is to have a brief but comprehensive inquiry into the Technological, Pedagogical, and Content Knowledge (TPACK) of the College of Education's faculty of Quezon City University during the second semester of the school year 2021-2022.

Specifically, the study sought to answer the following questions:

1. What is the profile of the College of Education teachers in terms of:
    - 1.1 Sex;
    - 1.2 Specialization;
    - 1.3 Educational Attainment;
    - 1.4 Age; and
    - 1.5. Years of Teaching?

2. What is the level of TPACK of the College of Education teachers?
3. What significant difference exists between the level of TPACK of the College of Education teachers and in terms of the following:
    2.1 Sex;
    2.2 Specialization;
    2.3 Educational Attainment;
    2.4. Age; and
    2.5 Years in Teaching?

METHODOLOGY

The approval of the author to use the research instrument was made on April 23, 2022, and the Research Load - Notice to Proceed from the Office of the Vice President for Research was signed on May 25, 2022. After these events, the researchers prepared for the collection of data. The researchers employed stratified random sampling. Jackson (2009) defined stratified random sampling as a kind of probability sampling designed to ensure that subgroups or strata are fairly represented. There are a total of 65 faculty members in the College of Education. With the use of a table for determining sample size for a finite population (Krejcie & Morgan, 1970), 56 faculty were chosen to be the respondents of our study - 25 from the Social Sciences and Humanities, 10 from the Physical Education, 11 from the Mathematics and Science, and 10 from the Language Department. The teachers were given a survey questionnaire using Google Forms to determine their demographic profile and TPACK level, which also includes informed consent. The data collection period is from July 7, 2022, to July 28 of the same year. Out of 56 faculty, only 42 answered the survey questionnaire, data collected from 1 faculty was not included due to biased responses. After collection, data were recorded, tabulated, analyzed, and presented

Respondents

The respondents of the study were teachers from various departments of the College of Education at Quezon City University, teaching their assigned subjects for the 2nd semester of the Academic Year 2021-2022. The faculty respondents are employed at the institution regardless of their status, including those on contract, permanent, full-time, or part-time, as well as faculty members with administrative roles.

Instrumentation

The data-gathering instrument employed in this study is a survey questionnaire. In utilizing the survey questionnaire, the researchers sent the questionnaires to the target

respondents. The study employed the Likert-type Survey Questionnaire on TPACK Instrument developed by Schmid (2020).

There are two sets of questionnaires. The first set is for the profile of the respondents according to sex, specialization, educational attainment, age, and years in teaching. The second set is for the TPACK level of the respondents consisting of 28 items designed to measure all 7 competencies of TPACK using a 5-point Likert-scale (5 = strongly agree, 1 = strongly disagree).

This study adopted the TPACK.xs questionnaire (Schmid, 2020). The researchers asked permission from the author to use the whole questionnaire without any modifications on it. The said instrument is suitable for the current study which is useful to measure the level of TPACK of faculty members of the College of Education. The TPACK.xs questionnaire emphasized every component of TPACK. It provides indicators for the following components: Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, and Technological, Pedagogical, and Content Knowledge. The indicators were assessed and it established a good measure for every component that constitutes the TPACK. The adoption of the TPACK.xs questionnaire was deemed to be advantageous since it went through an extensive evaluation process in terms of validity and reliability when an instrument was first used (Hyman, et al., 2006). The words used in the instrument were easy to understand and direct to the point. No words particularly in the domain of technological knowledge would hinder the respondent to answer as indicators presented the use of technology in general.

Statistical Treatment of Data

The gathered data was analyzed and interpreted with the help of different statistical tools. Frequency count and percentage was used to present the profile of the respondents. Weighted mean and standard deviation was utilized and analyzed to determine the College of Education faculty TPACK level. The following ranges were used to determine the TPACK level: 1.00-1.79 Very low, 1.80-2.59 Low, 2.60-3.40 Moderate, 3.41-4.20 High, 4.21-5.00 Very high. In addition, a t-test and analysis of variance was utilized to determine the significant difference between the TPACK levels of the respondents and in terms of their demographic profile.

Ethical Considerations

All the participants in this study were asked for their informed consent. They were informed of the entire process of their participation and were allowed access to the results of the study. Participation was voluntary, and respondents were free to

withdraw from the study at any time. Participants were assured that this study would cause them no harm, whether physical, psychological, emotional, or verbal. Confidentiality regarding the respondents' identities and the data they provided was also assured. Their names would not be mentioned unless they agreed to it and it was necessary, and all data were for the study only and would be used as references for other studies. The study focused solely on relevant components, and respondents should not feel that they are being experimented on. The data collected were used exclusively for this study. Data will be saved in Google Drive, and only the researchers will have access to it. Lastly, upon completion of this study and after successfully publishing it, all gathered data will be deleted.

RESULTS

Profile of the Respondents

Table 1 shows the profile of the faculty members under the College of Education. It revealed that most of the teachers were male (N=24, 57.14%), and a large number of the respondents came from the Social Science and Humanities unit (N=18, 44.86%). In terms of educational attainment, the majority of the respondents completed a master's degree (N=19, 45.24%). Most of the respondents' age range from 41 to 55 years old (N=22, 52.38%) and majority of them have long years of teaching experience ranging from 11 to 20 years (N=16, 38.10%).

Table 1.
Teacher's Profile of the College of Education

Profile Variables	f	%
Sex		
Male	24	57.14
Female	18	42.86
Total	42	100
Specialization		
Social Science and Humanities	18	42.86
Language	9	21.43
Mathematics and Science	9	21.43
Physical Education	6	14.29
Total	42	100

Educational Attainment		
College Graduate	15	35.71
Master Graduate	19	45.24
Doctorate Graduate	8	19.05
Total	42	100
Age		
25 and below	3	7.14
26-40	11	26.19
41-55	22	52.38
56-70	7	14.29
Total	42	100
Years in Teaching		
1-10	15	35.71
11-20	16	38.10
21-30	8	19.05
31-40	2	4.76
41-50	1	2.38
Total	42	100

Level of TPACK

Technological Knowledge (TK)

In this part, the findings highlight the research subjects' levels of technology knowledge. The first statement concerns keeping up with important new technologies, and the results showed that it got the highest weighted mean of 4.33 and was most consistent among the four statements on Technological Knowledge (TK) since it obtained the lowest standard deviation of 0.65. Participants agreed that they were keeping up with important new technologies. The second statement asks whether respondents frequently play around with technology, and findings showed that it got a weighted mean of 4.12 and a standard deviation of 0.71. Teachers participating in this study agree that they frequently play around with technology. The third statement interrogates knowing about a lot of different technologies. Findings showed that it got a weighted average of 3.79. Subjects agreed that they recognized different kinds of technologies. The last statement covers whether respondents know how to solve technical problems, and the results showed that it got a weighted mean of 3.93.

Respondents agreed that they have much knowledge of solving technical problems in technology.

The overall research subjects' levels of technology knowledge obtained a weighted mean of 4.04 with the verbal interpretation "Agree."

Pedagogical Knowledge (PK)

In this section, the research subjects were questioned about their knowledge of pedagogical approaches to teaching. The first statement assessed the participants' ability to adapt their teaching based on what students currently understand or do not understand, and findings indicated that it received the highest weighted average of 4.36. Respondents agreed that they can adjust their teaching based on their understanding of the students' levels. The second statement addressed teachers' ability to adapt their teaching style to different learners. Results showed that this statement achieved a weighted mean of 4.31. Respondents concurred that they can modify their teaching style depending on the learners they are instructing. The third statement examined respondents' ability to use a wide range of teaching approaches in the classroom. Findings revealed that this statement received a weighted average of 4.26 and was also the most consistent among the four statements on Pedagogical Knowledge (PK), as it had the lowest standard deviation of 0.80. Participants agreed that they can employ a diverse range of teaching methods in the classroom. The final statement addressed teachers' ability to assess student learning in multiple ways. Results indicated that this statement received a weighted average of 4.19 and a standard deviation of 0.86. Respondents agreed that they can evaluate their students' learning through various methods.

The overall level of knowledge among the research subjects regarding pedagogical approaches to teaching obtained a weighted mean of 4.28, with a verbal interpretation of "Agree."

Content Knowledge (CK)

The survey on content knowledge addresses four research questions. The first statement asked respondents about their sufficiency of knowledge regarding their teaching subject. Findings indicated that this statement received a weighted mean of 4.57 and a standard deviation of 0.74. This statement had the highest weighted mean and was one of the most consistent among the four statements on Content Knowledge (CK). Respondents agreed that they possess sufficient knowledge of the subjects they teach.

The second statement pertained to the respondents' subject-specific approach to thinking about their teaching content. The findings illustrated that it attained a weighted

average of 4.57, with a verbal interpretation of “Agree.” The third statement questioned the participants’ understanding of the basic theories and concepts related to their teaching subject. Results demonstrated that it had a weighted mean of 4.52, a standard deviation of 0.74, and a verbal interpretation of “Agree.” Together, this statement and the first statement were the most consistent.

The final statement addressed teachers' knowledge of the history and development of significant theories in their teaching subject. Findings indicated that it had a weighted mean of 4.45, a standard deviation of 0.77, and a verbal interpretation of “Agree.”

Overall, the participants’ levels of Content Knowledge (CK) within the TPACK framework obtained a weighted mean of 4.49, a standard deviation of 0.75, and a verbal interpretation of "Agree.".

Technological Pedagogical Knowledge (TPK)

The survey on Technological Pedagogical knowledge (TPK) covers four research questions. The first statement asked the respondents’ ability to choose technologies that enhance their teaching approaches for a lesson, and findings showed that this statement got a weighted mean of 4.29, standard deviation of 0.71 and verbal interpretation “Agree”. The second statement questioned the participants’ knowledge to choose technologies that enhance students’ learning for a lesson. Results illustrated that this statement obtained a weighted average of 4.24 and standard deviation of 0.66. This statement is the most consistent among the four statements on the Technological Pedagogical knowledge (TPK) domain of TPACK. Teachers’ agreed that they have the knowledge to choose technologies that enhance students’ learning for a lesson. The third statement concerned the research subjects’ knowledge to adapt the use of the technologies that they are learning in relation to different teaching activities, and results showed that this statement got the highest weighted average of 4.31 with a verbal interpretation of “Agree”. The last statement deals with respondents’ critical thinking on how to use technology in their classroom. Results illustrated that this statement obtained a weighted mean of 4.26, standard deviation of 0.77 and a verbal interpretation of “Agree”.

The overall research subjects’ levels of Technological Pedagogical Knowledge (TPK) domain of TPACK obtained a weighted mean of 4.27, a standard deviation of 0.71, and with verbal interpretation “Agree”.

Pedagogical Content Knowledge (PCK)

The survey on the Pedagogical Content Knowledge (PCK) domain of TPACK covers four research questions. The first statement deals with participants' knowledge on the selection of effective teaching approaches to guide student thinking and learning in their teaching subject, and findings revealed that it obtained a weighted mean of 4.26, the standard deviation of 0.83, and a verbal interpretation of "Agree". The second statement questioned the respondents' knowledge of developing appropriate tasks to promote students' complex thinking about their teaching subject. Results showed that this statement got a weighted average of 4.26, the standard deviation of 0.86, and verbal interpretation of "Agree". The third statement asked about the respondents' knowledge on developing exercises with which students can consolidate their knowledge of their teaching subject, and results illustrated that it got a weighted mean of 4.40,the standard deviation of 0.83, and verbal interpretation "Agree". The last statement deals with research subjects' knowledge of evaluation of students' performance in their teaching subject. The findings revealed that this statement obtained a weighted mean of 4.45, the standard deviation of 0.74, and a verbal interpretation of "Agree". In addition, the fourth statement got the highest weighted mean and the most consistent among other statements on the Pedagogical Content Knowledge (PCK) domain of TPACK.

The overall research subjects' levels of Pedagogical Content Knowledge (PCK) domain of TPACK obtained a weighted mean of 4.85, a standard deviation of 0.81, and verbal interpretation of "Agree".

Technological Content Knowledge (TCK)

The survey on Technological Content Knowledge (TCK) has four research questions. The first statement asked about the respondents' knowledge of how technological developments changed the field of their subject, and findings showed that this statement got the highest weighted mean of 4.33, a standard deviation of 0.72, and verbal interpretation "Agree". In addition, the first statement is one of the most consistent among the four research questions on the Technological Content Knowledge (TCK) domain of TPACK. The second statement questioned the participants' knowledge to explain which technologies have been utilized in research in their field. Results illustrated that this statement obtained a weighted average of 4.14 and a standard deviation of 0.75. Participants agreed to this statement when it was interpreted.

The third statement concerned the research subjects' knowledge on new technologies that are currently being developed in the field of their subject, and results showed that

this statement got a weighted average of 4.02, a standard deviation of 0.72 with a verbal interpretation “Agree”. The third statement together with the first statement was the most consistent among the four statements on the Technological Content Knowledge (TCK) domain of TPACK. The last statement deals with respondents’ knowledge of how to use technologies to participate in scientific discourse in their field, and findings showed that this statement obtained a weighted mean of 3.98, a standard deviation of 0.78, and a verbal interpretation of “Agree”.

The overall research subjects’ levels of Technological Content Knowledge (PCK) domain of TPACK obtained a weighted mean of 4.12, a standard deviation of 0.75 and a verbal interpretation of “Agree”.

Technological, Pedagogical, and Content Knowledge (TPC)

This part of the research instrument contains the core question in the knowledge of technology, pedagogy, and content acknowledged by the research subjects and it consists of four statements.

The first statement deals with participants’ knowledge of the use of strategies that combine content, technologies, and teaching approaches that they learned about in their coursework in the classroom, and findings revealed that it obtained the highest weighted mean of 4.26, the standard deviation of 0.73 and a verbal interpretation “Agree”. The second statement questioned the respondents’ knowledge on selecting technologies that enhance the content of a lesson, and results showed that this statement got a weighted average of 4.23, the standard deviation of 0.73, and verbal interpretation of “Agree”.

The third statement asked the respondents’ knowledge on selecting technologies to use in the classroom that enhance what I teach, how I teach, and what students learn, and results illustrated that it got a weighted mean of 4.21, a standard deviation of 0.65, and verbal interpretation “Agree”. In addition, the third statement was the most consistent among other statements on TPACK. The last statement deals with research subjects’ knowledge of teaching lessons that appropriately combine their teaching subject, technologies, and teaching approaches, and findings revealed that this statement obtained a weighted mean of 4.24, a standard deviation of 0.66, and a verbal interpretation of “Agree”.

The overall research subjects’ level of Technology, Pedagogical, and Content Knowledge (TPACK) obtained a weighted mean of 4.24, a standard deviation of 0.69, and with verbal interpretation “Agree”.

Table 2.
Respondents' Level of TPACK

Domains of TPACK	MEAN	SD	Interpretation
Technological Knowledge (TK)	**4.04**	**0.76**	**Agree**
1. I keep up with important new technologies.	4.33	0.65	Agree
2. I frequently play around with technology.	4.12	0.71	Agree
3. I know about a lot of different technologies.	3.79	0.84	Agree
4. I have the technical skills I need to use technology.	3.93	0.75	Agree
Pedagogical Knowledge (PK)	**4.28**	**0.83**	**Agree**
1. I can adapt my teaching based upon what students currently understand or do not understand.	4.36	0.85	Agree
2. I can adapt my teaching style to different learners.	4.31	0.81	Agree
3. I can use a wide range of teaching approaches in a classroom setting	4.26	0.80	Agree
4. I can assess student learning in multiple ways.	4.19	0.86	Agree
Content Knowledge (CK)	**4.49**	**0.75**	**Agree**
1. I have sufficient knowledge about my teaching subject.	4.57	0.74	Agree
2. I can use a subject-specific way of thinking in my teaching subject	4.40	0.77	Agree
3. I know the basic theories and concepts of my teaching subject.	4.52	0.74	Agree
4. I know the history and development of important theories in my teaching subject.	4.45	0.77	Agree
Technological Pedagogical Knowledge (TPK)	**4.27**	**0.71**	**Agree**
1. I can choose technologies that enhance the teaching approaches for a lesson.	4.29	0.71	Agree
2. I can choose technologies that enhance students' learning for a lesson.	4.24	0.66	Agree
3. I can adapt the use of the technologies that I am learning about to different teaching activities.	4.31	0.72	Agree
4. I am thinking critically about how to use technology in my classroom.	4.26	0.77	Agree
Pedagogical Content Knowledge (PCK)	**4.35**	**0.81**	**Agree**
1. I know how to select effective teaching approaches to guide student thinking and learning in my teaching subject.	4.26	0.83	Agree
2. I know how to develop appropriate tasks to promote students' complex thinking of my teaching subject.	4.26	0.86	Agree
3. I know how to develop exercises with which students can consolidate their knowledge of my teaching subject.	4.40	0.83	Agree
4. I know how to evaluate students' performance in my teaching subject.	4.45	0.74	Agree

Technological Content Knowledge (TCK)	**4.12**	**0.75**	**Agree**
1. I know how technological developments have changed the field of my subject.	4.33	0.72	Agree
2. I can explain which technologies have been used in research in my field.	4.14	0.75	Agree
3. I know which new technologies are currently being developed in the field of my subject.	4.02	0.72	Agree
4. I know how to use technologies to participate in scientific discourse in my field.	3.98	0.78	Agree
Technological, Pedagogical, and Content Knowledge (TPC)	**4.24**	**0.69**	**Agree**
1. I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.	4.26	0.73	Agree
2. I can choose technologies that enhance the content of a lesson.	4.23	0.73	Agree
3. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	4.21	0.65	Agree
4. I can teach lessons that appropriately combine my teaching subject, technologies, and teaching approaches.	4.24	0.66	Agree

The Difference between the College of Education Faculty TPACK Level and in Terms of; Sex, Specialization, Educational Attainment, Age and Years of Teaching Experience.

The t-test was utilized to gain differences in terms of respondents' sex (see Table 3). The table shows that there was no significant difference among the mean of all TPACK domain scores ($p>0.05$) based on sex. The mean PK, CK, TK, and PCK scores of female faculty were higher than those of male participants. Meanwhile, the mean TPK, TCK, and TPC scores of male faculty were higher than female participants.

Table 3.
Faculty's TPACK Scores Based on Their Sex

TPACK Domain	Sex	Mean	SD	Sig
PK	Male	4.22	0.90	0.553
	Female	4.36	0.52	
CK	Male	4.47	0.84	0.837
	Female	4.51	0.45	
TK	Male	4.03	0.66	0.907
	Female	4.06	0.67	
PCK	Male	4.31	0.89	0.753
	Female	4.39	0.59	
TPK	Male	4.30	0.66	0.754
	Female	4.24	0.68	
TCK	Male	4.20	0.62	0.387
	Female	4.01	0.74	
TPC	Male	4.28	0.66	0.624
	Female	4.18	0.65	

A series of one-way ANOVA tests were done to compare scores in the TPACK domains in terms of respondents' specialization, education, age and years of teaching experience.

As seen in Table 4, it showed that there was no significant difference among the mean of PK, CK, PCK, TPK, TCK, and TPC scores ($p>0.05$) based on specialization. However, a significant difference was found in the mean TK scores ($p<0.05$). The mean PK, TK, PCK, TPK, TCK, and TPC scores of language faculty were higher than those of other participants' fields of specialization. Conversely, the mean CK scores of the Mathematics and Science faculty were higher than any other participants' field of specialization.

Table 4.
Faculty's TPACK Scores Based on Their Specialization

Specialization	PK	CK	TK	PCK	TPK	TCK	TPC
Social Sciences and Humanities	4.14	4.39	3.85	4.19	4.14	3.99	4.13
Physical Education	4.00	4.33	3.96	4.21	4.00	3.79	4.00
Mathematics and Science	4.47	4.67	3.94	4.42	4.39	4.31	4.36
Language	4.56	4.61	4.58	4.67	4.61	4.42	4.50
Sig	0.37	0.683	*0.038	0.479	0.229	0.207	0.38

As seen in Table 5, it showed that there was no significant difference among the mean of all TPACK domain scores (p>0.05) based on education. The mean PK, TK, PCK, and TPK scores of college graduate faculty were higher than those of master and doctorate graduate participants. Conversely, the mean TCK and TPC scores of the doctoral graduate faculty were higher than college and master graduate participants. Finally, the mean CK scores of master graduate faculty were higher than college and doctorate graduate participants.

Table 5.
Faculty's TPACK Scores Based on Their Educational Attainment

Education	PK	CK	TK	PCK	TPK	TCK	TPC
College	4.42	4.55	4.27	4.48	4.40	4.17	4.27
Master	4.28	4.58	3.86	4.36	4.13	4.01	4.13
Doctorate	4.03	4.16	4.06	4.06	4.38	4.28	4.44
Sig	0.52	0.324	0.191	0.464	0.461	0.614	0.534

As seen in Table 6, it showed that there was no significant difference among the mean of all TPACK domain scores (p>0.05) based on age. The mean of all TPACK dimensions scores of 26-40 age bracket faculty were higher than those of other age bracket participants.

Table 6.
Faculty's TPACK Scores Based on Their Age

Age	PK	CK	TK	PCK	TPK	TCK	TPC
Below 25	3.83	4.25	3.92	4.08	3.83	3.33	3.83
26-40	4.50	4.57	4.39	4.50	4.45	4.30	4.34
41-55	4.23	4.49	3.99	4.34	4.30	4.20	4.26
56-70	4.29	4.46	3.67	4.21	4.08	3.88	4.17
Sig	0.572	0.921	0.15	0.814	0.463	0.107	0.687

As seen in Table 7, it showed that there was no significant difference among mean all TPACK dimensions' scores ($p>0.05$) based on several years of teaching experience. On one hand, the mean PK, CK, PCK, TPK, TCK and TPC scores of 31-40 years of teaching experienced faculty were higher than those of other years of teaching experienced participants. On the other hand, the mean TK scores of 21-30 years of teaching experienced faculty were higher than those of other years of teaching experienced participants.

Table 7.
Faculty's TPACK Scores Based on Their Years of Teaching Experienced

Years in Teaching	PK	CK	TK	PCK	TPK	TCK	TPC
1-10	4.37	4.50	4.08	4.35	4.32	4.05	4.23
11-20	4.28	4.59	4.06	4.47	4.25	4.25	4.23
21-30	4.13	4.28	4.22	4.22	4.41	4.16	4.28
31-40	3.88	4.13	3.13	3.50	3.25	3.25	3.75
41-50	5.00	5.00	3.50	5.00	5.00	4.50	5.00
Sig	0.753	0.717	0.263	0.447	0.172	0.359	0.656

DISCUSSION

This study examined the TPACK competence level of teachers of the College of Education at Quezon City University. The study on teachers' TPACK level was based on the variables of sex, field of specialization, educational attainment, age, and years in teaching. Findings showed that teachers‘ competence in content knowledge, pedagogical knowledge, pedagogical content knowledge, and technological pedagogical knowledge were very high while participants’ competence in technological knowledge and technological-content knowledge were high. Participants’ overall TPACK competence was very high.

Reviewing the literature, the results of having a high or very high TPACK level among college teacher participants is almost identical to the findings found in the literature. In detail, the CK and PK subscale scores of participants were good or high (Koyuncuoglu, 2021; Paidi, 2021; Kara, 2021; Nuangchalerm, 2020). The TCK and PCK subscale scores of the participants were above moderate (Koyuncuoglu, 2021).The study also investigated whether college teachers‘ TPACK levels differ by sex, field of specialization, educational attainment, age, and years in teaching.

The results indicated that there was no significant difference between TPACK levels of male and female participants in the study. The same results found no significant differences between TPACK levels of teacher participants in terms of educational attainment, age and years in teaching. However, there was a difference found in the competence level of participants’ technological knowledge when grouped according to their field of specialization. Results showed that college teachers from the Language Department had significantly higher technological knowledge level than other participants’ specializations.

When the literature was reviewed, similar results of no significant difference were found in comparing the participants’ TPACK level based on the variable of sex. In particular, no variation was found in the TPACK scores of the participants (Kara, 2021; Koyuncuoglu, 2021; Suzuk, 2021). No significant difference was also found in the CK and TPK subscale scores of the participants (Kara, 2021; Koyuncuoglu, 2021). The same results of no variation were found in the TCK subscale scores of the participants (Kara, 2021; Suzuk, 2021). In addition, the TK (Suzuk, 2021) and PK (Kara, 2021) subscale scores of the participants did not differ based on sex or gender.

In comparing the participants’ TPACK level based on the variable of educational attainment, no variation was found in the mean TK, PCK, TPK, and TPACK scores of the participants (Koyuncuoglu, 2021; Paidi, 2021). In addition, no difference was found in the PK and CK subscale scores of the participants (Paidi, 2021). In differentiating

the participants' TPACK level based on the variable of field of specialization or department, a significant difference was found in the mean TK scores of the participants (Koyuncuoglu, 2021; Suzuk, 2021).

In contrasting the participant's TPACK level based on the variable of age and years in service, no correlation was found between the participant's age and the constructs that do not hold the technology component (PK, CK, PCK), and no correlations were found between the years of service and the CK, PCK and TPACK level of the participants. (Rolando, 2021).

CONCLUSION

Given the findings, the researchers conclude that the QCU - College of Education teacher's overall TPACK level was very high. The TPACK level of the teachers participants in the subdomains of TPACK namely, content knowledge, pedagogical knowledge, pedagogical content knowledge, and technological pedagogical knowledge were very high while the participant's competence in technological knowledge and technological content knowledge were high.

The participants' competence on overall TPACK and subdomains do not differ based on sex, educational attainment, age, and years in teaching. However, there was a difference found in the competence level of participants' technological knowledge when grouped according to their field of specialization. This study suggests continuous workshops, seminars, and training about technology integration in instruction must be the platform not just for college teachers but also for school administrators. Forum group discussion or knowledge sharing concerning technology, pedagogy, and content knowledge will be great options to further enrich the teachers' knowledge of TPACK. Awareness of the college teachers on the benefits of technology integration in teaching should be maintained. Giving rewards in teaching with technology and its innovation by school administrators is encouraged. The insertion of the use of technology in instruction as one of the criteria or categories during teacher observation is proposed.

For further research options, exploring the kinds of variables that may affect the TPACK competency of college lecturers combined by qualitative research across different colleges will be great steps.

References

Abante, S. A., Cruz, R. R., Guevarra, D. F., & Larada, M. I., Macale, M. J., Roque, M.W., Salonga, L. C. & Cabrera S.W. (2021). A comparative analysis on the challenges of online learning modality and modular learning modality: A basis for training program. *International Journal of Multidisciplinary Research and Analysis*, 4(1), pp. 463-476. https://doi.org/10.47191/ijma/v4-i4-17.

Ammade, S., Mahmud, M., Jabu, B., Tahmir, S. (2020). *TPACK model based instruction in teaching writing: An analysis on TPACK literacy*. https://doi.org.10.26858/ijole.v4i2.12441

Altun, T, & Akyildiz, S. (2017). Investigating student teachers' technological pedagogical content knowledge (TPACK) levels based on some variables. *European Journal of Education Studies*, 3(5), pp. 467-485.

Bernard, P. (2020). Online experimentation during COVID-19 secondary school closures: Teaching methods and student perceptions. *Chemistry Education.* https://doi.org/10.1021/acs.jchemed.0c00748.

Cahapay, M. B. (2020). Rethinking education in the new normal post-COVID-19 era: A curriculum studies perspective. *Aquademia*, 4(2), ep20018, pp. 1–5.

Cantrell, M. A.. (2011). demystifying the research process: understanding a descriptive comparative research design. *Pediatric Nursing*, *37*(4), 188–190. https://go.gale.com/ps/i.do?p=AONE&u=googlescholar&id=GALE|A265869622&v=2.1&it=r&sid=AONE&asid=fdeab004

Chai, C.-S., Koh, J. H.-L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society*, 16(2), pp. 31–51.

Cubos, B. A. C. (2018). Training teacher: Analysis of training in platforms through the TPACK model[Unpublished doctoral dissertation]. Universidad Pedagógica Nacional.

Cullinane, C., & Montacute, R. (2020). COVID-19 and social mobility impact brief #1: School shutdown.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *PROSPECTS*. https://doi.org/10.1007/s11125-020-09464-3.

Fish, W. W., & Gill, P. B. (2019). Perceptions of online instruction. *Online Submission*, 8 (1).

Formplus Blog. (2020, January 23). *Descriptive Research Designs: Types, Examples & Methods*. https://www.formpl.us/blog/descriptive-research

Gregory, S., Scutter, S., Jacka, L., McDonald, M., Farley, H., & Newman, C. (2019). Barriers and enablers to the use of virtual worlds in higher education: An Exploration of educator perceptions, attitudes and experiences. Educational Technology & Society, 18(1), 3-12.

Hill, J.E. & Uribe-Florez, L. (2020). Understanding secondary school teachers' TPACK and technology implementation in Mathematics classrooms. *International Journal of Technology in Education* (IJTE), 3(1), pp. 1-13.

Hyman, L., Lamb, J., & Bulmer, M. (2006). The use of pre-existing survey questions: Implications for data quality. In *Proceedings of the European Conference on Quality in Survey Statistics* (pp. 1-8). Wales, UK: Cardiff.

Irmita, L., & Atun, S. (2018). The influence of technological pedagogical and content knowledge (TPACK) approach on science literacy and social skills. Journal of Turkish Science Education, 15(3), 27-40.

Irwanto, I. (2021). Research trends in technological pedagogical content knowledge (TPACK): A systematic literature review from 2010 to 2021. *European Journal of Educational Research*, 10(4), 2045-2054. https://doi.org/10.12973/eu-jer.10.4.2045

Jackson, S.L. (2009). Research Methods and Statistics: A Critical Thinking Approach, Third Edition. Cengage Learning.

Kaden, U. (2020). COVID-19 school closure-related changes to the professional life of a K– 12 teacher. *Education Sciences*, *10*(6), pp. 165. https://doi.org/10.3390/educsci10060165.

Kara, S. (2021). An investigation of Technological Pedagogical and Content Knowledge (TPACK) competencies of pre-service visual arts teachers. *International Journal of Technology in Education* (IJTE), 4(3), pp. 527-541. https://doi.org/10.46328/ijte.184.

Kelentrić, M., Helland, K., & Arstorp, A. T. (2017). Professional digital competence framework for teachers. https://www.udir.no/in-english/professional-digital-competence-framework-for-teachers/.

Koehler, M. and Mishra, P., "What is technological pedagogical content knowledge?" *Contemporary Issues in Technology and Teacher Education,* 9(1), pp. 60-70.

Koh, J.H.L Chai, C.S. Benjamin, W. and Hong, H.Y., Technological Pedagogical Content Knowledge (TPACK) and design thinking: A framework to support ICT lesson design for 21st century learning. *The Asia-Pacific Education Researcher*, 24(3), pp. 535-543.

Koh, J. H. L., Chai, C. S., & Tsai, C. C. (2010). Examining the technological pedagogical contentknowledge of Singapore pre-service teachers with a large-scale survey. [Article]. Journal of Computer Assisted Learning, 26(6), 563-573

Koyuncuoglu, O. (2021). An investigation of graduate students' Technological Pedagogical and Content Knowledge (TPACK). International Journal of Education in Mathematics, Science, and Technology (IJEMST), 9(2), 299-313. https://doi.org/10.46328/ijemst.1446

Krejcie, R. V., & Morgan, D. W., (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement.

Lederman, D. (2020). Will the shift to remote teaching be boon or bane for online learning? *Inside Higher Ed*.

Mangoma, V. P. (2023). The Perceived Effects of Accreditation in the Practice among Certified Public Accountants in the Philippines. Journal of Biomechanical Science and Engineering, 131-143.

McCombes, S. (2019, May 15). *Descriptive Research | Definition, Types, Methods & Examples*. Scribbr. https://www.scribbr.com/methodology/descriptive-research/

McGarr, O., & McDonagh, A. (2019). *Digital competence in teacher education, Output 1 of the Erasmus+funded developing student teachers' digital competence* (DiCTE) project. https://dicte.oslomet.no/

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Ozden, S.Y., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education*, 71(1), pp. 206-221.

Motala, S., & Menon, K. (2020). In search of the 'new normal': Reflections on teaching and learning during Covid-19 in a South African university. *Southern African Review of Education*, 26(1), 80-99.

Nuangchalern, P. (2020). TPACK in ASEAN perspectives: Case study on Thai pre-service teachers. *International Journal of Evaluation and Research in Education*, 9(4), pp. 993-999.

Paidi, Subali, B., & Handoyo, L. (2021). The mastery of technological, pedagogical, and content knowledge among Indonesian biology teachers. European Journal of Educational Research, 10(3), 1063-1073. https://doi.org/10.12973/eu-jer.10.3.1063

Peters, M. A., Rizvi, F., McCulloch, G., Gibbs, P., Gorur, R., Hong, M., & Misiaszek, L. (2020). Reimagining the new pedagogical possibilities for universities post-Covid-19: An EPAT collective project. *Educational Philosophy and Theory*, 1.

Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon, 9*(5), 1–6. http://doi.org/10.1108/10748120110424816

Rolando, L.G.R., Salvador D.F., Vasconcellos, R.F.R.R, and Da Luz, M.R.M.P. (2021). TPACK for meaningful learning survey: "paths" for professional development of biology teachers in Brazil. TOJET: The Turkish Online Journal of Educational Technology, Vol 20 (2), 169-181

Rosenberg, J.M. and Koehler, M.J., Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, 47(3), 186-210.

Schmid, M., Brianza, E. and Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. Elsevier International Journal for Computer and Education. Vol 157 https://doi.org/10.1016/j.compedu.2020.103967

Shin, J. C., & Cummings, W. K. (2010). Multilevel analysis of academic publishing across disciplines: research preference, collaboration, and time on research. Scientometrics, 85, 581-594.

Suzuk, E., & Akınci, T. (2021). Comparing Pre-Service Teachers' Self-Confidence Levels in Technological Pedagogical Content Knowledge in Terms of Several Variables. Journal of Education and Learning. Vol. 10 (1), 82-93

Székely, L., & Nagy, Á. (2011). Online youth work and eYouth — A guide to the world of the digital natives. *Children and Youth Services Review, 33*(11), 2186–2197. http://doi.org/10.1016/j.childyouth.2011.07.002

Todd, R. W. (2020). Teachers' perceptions of the shift from the classroom to online teaching. *International Journal of TESOL Studies*, *2*(2), 4-16.

Toquero, C. M., & Talidong, K. J. (2020). Webinar technology: Developing teacher training programs for emergency remote teaching amid COVID 19. *Interdisciplinary Journal of Virtual Learning in Medical Sciences*, 11(3), 200-203.

Yorgancioğlu, D. (2020). Critical reflections on the surface, pedagogical and epistemological features of the design studio under the "new normal" conditions. *Journal of Design Studio*, 2(1), 25-36.

Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest: The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Ethical Statement: All subjects gave their informed consent for inclusion in the study before participating. The research protocol was approved by the QCU Research Ethics Board (Project identification code), and the study followed the Declaration of Helsinki.