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# TPACK Correlates Mathematics Teachers' Performance in Selected Private Higher Education Institutions (PHEIS)

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## Abstract

Technological pedagogical content knowledge (TPACK) is a framework that views teachers' knowledge necessary for curriculum design and instruction focused on preparing their students for thinking and learning mathematics with digital technologies. TPACK is essential for Mathematics teachers as it enables them to effectively integrate technology into their teaching practices. This study investigated the correlation between Mathematics teachers' TPACK competencies and their teaching performance in selected higher education institutions (HEIs). This study utilized a descriptive-correlational design with 120 randomly selected participants. The data collected were analyzed using Linear Regression analysis to determine the relationship between TPACK competencies and teaching performance. The findings revealed that teachers' TPACK competencies are significantly related to their performance in teaching Mathematics. The study's findings have significant implications for Mathematics education and teacher training programs. Mathematics teachers must develop their TPACK competencies to effectively integrate technology into their teaching practices. Teacher training programs should focus on developing Mathematics teachers'

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TPACK competencies to improve Mathematics teaching. The study's methodology can be replicated in other contexts to investigate the relationship between TPACK competencies and teaching performance in Mathematics education.

*Keywords: TPACK, mathematics, instruction, teaching performance, PHEIs*

## Introduction

Before the pandemic, there had already been an effort to integrate technology into teaching-learning. Yet, because of the pandemic, there was a greater demand for the use of technology in education to resume having classes with the help of distance learning education. The pandemic tracked the digital transformation of different industries, including education. To meet the demands of time, HEIs spent a lot of resources in capacitating their faculty members to deliver online classes and procure a learning management system to help in the teaching-learning process. The advancement of science makes this "new normal" possible and technology has assisted in those innovative actions.

According to Nagasubramani and Raja (2018), the role of technology in the field of education is four-fold: it is included as a part of the curriculum, as an instructional delivery system, as a means of aiding instructions, and as a tool to enhance the entire learning process. This means that technology has a greater use in education. With the help of technology, education has gone from passive and reactive to interactive and aggressive. According to Diano et al. (2021), teachers should facilitate the delivery of the lesson and make sure the learning experiences of the students in Mathematics are meaningful by creating memorable lessons that will help students become lifelong learners.

As Shulman (1986) emphasized in his Pedagogical Content Knowledge (PCK) framework, teachers need to be experts in the subject matter and know the pedagogy in teaching. However, in this 21st century, it is essential for teachers to be well-versed on integrating technology into teaching

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(Ismail, Majid & Shafie, 2019). That is why Koehler and Mishra (2006) introduced the Technological Pedagogical Content Knowledge (TPACK) framework to describe the knowledge base, for the effective integration of technology in education.

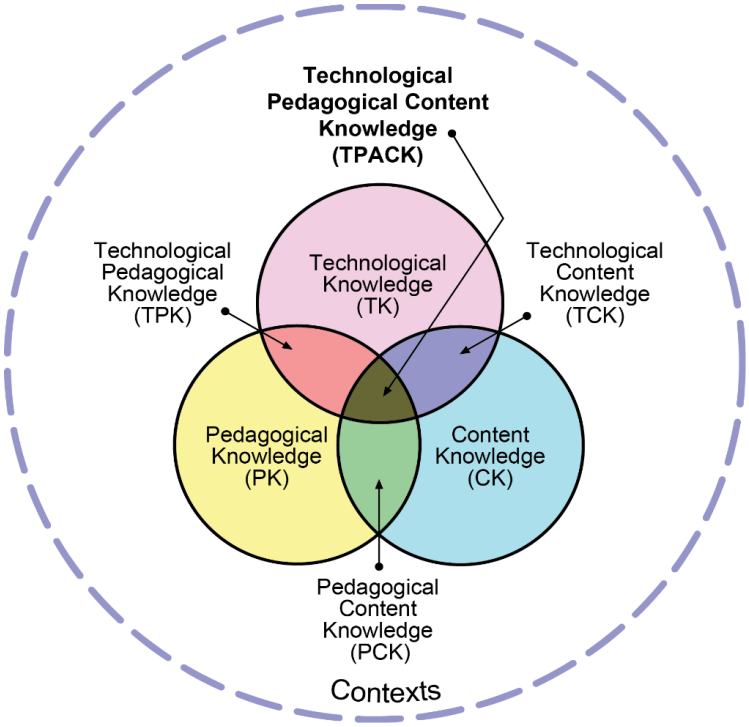


*Figure 1: TPACK Framework*

TPACK is a specialized, highly applied type of knowledge that support content-based technology integration (Harris & Hofer, 2011). The TPACK framework consists of seven components. At the heart of the TPACK framework is the dynamic interplay of three key structures of knowledge: Content (CK), Pedagogy (PK), and Technology (TK). This approach is not merely looking at these three knowledge bases separately. The TPACK framework exceeds the limit by highlighting the kinds of knowledge that lie within the intersection of those three key structures: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK).

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With these, the main objective of this study is to explore the Technological Pedagogical and Content Knowledge (TPACK) and performance of Mathematics Teachers amidst the pandemic. Specifically, the study correlates the TPACK and teaching performance of Mathematics teachers in the selected higher education institutions (HEIs).

## Methodology

***Design***. This study will follow the quantitative research approach operating on a descriptive-correlational research design. Relatively, the descriptive method is appropriate to this study since it aims to describe the present condition of TPACK of the mathematics teachers and their performance. The correlational research design was used to correlate the TPACK level and teaching performance of Mathematics teachers.

***Environment.*** This study was conducted in selected private Higher Education Institutions (HEIs) in Cebu City, Philippines.

***Participants.*** The participants of this study were the 120 Mathematics teachers in the selected private HEIs. They were selected using stratified random sampling. The inclusion criteria for this study were: (i) a Mathematics teacher or handling math subjects in any course or program; (ii) must be currently employed on the selected private HEIs; and (iii) must have at least three years of teaching experience. Subsequently, the exclusion criteria included: (i) not a mathematics teacher; (ii) not currently employed on the selected private HEIs; and (iii) having less than three years of teaching experience.

***Instrument.*** This study utilized two (2) research instruments. The first instrument is the rating scale adopted from the study of Schmidt et al. (2009) entitled "Survey of Preservice Teachers' Knowledge of Teaching and Technology". While the second instrument that was utilized is the Faculty Evaluation Form used by HEIs to evaluate the teachers' performance.

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***Data Collection.*** The following steps were followed by the researchers to effectively execute the data collection procedure: sent a letter to the Chief Academic Officer to seek permission to conduct the study at the PHEIs; ask the HR office for the names of the teachers handling Mathematics subject; presented the tool to the Mathematics Teacher and asked consent for permission to conduct the study; have the Math teachers answer the rating scale; and ask the dean and/or program head for the teaching performance of the mathematics teachers.

***Data Analysis.*** The data from the survey instrument and faculty evaluation form were gathered and analyzed. The results were treated statistically using weighted mean, standard deviation, and linear regression analysis.

***Ethical Consideration***. The manuscript was submitted, reviewed, and provided clearance to proceed with the data collection by the Research Ethics Committee (REC) of the University of the Visayas. The data collection was under the UV-REC's close monitoring to ensure safety protocols during the experiment, and confidentiality of data was observed.

## Results and Discussion

***Table 1***

***Teachers' Level of Technological Pedagogical Content Knowledge***

| Components | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Technological Knowledge (TK) | 3.86 | 0.54 | Proficient |
| Pedagogical Knowledge (PK) | 4.07 | 0.58 | Proficient |
| Content Knowledge (CK) | 4.33 | 0.59 | Advance |
| Technological-Pedagogical Knowledge (TPK) | 3.88 | 0.56 | Proficient |

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| | | | |
|---|---|---|---|
| Technological Content Knowledge (TCK) | 3.75 | 0.56 | Proficient |
| Pedagogical Content Knowledge (PCK) | 3.92 | 0.58 | Proficient |
| Technological Pedagogical Content Knowledge (TPACK) | 3.80 | 0.55 | Proficient |
| Grand Mean | 3.94 | 0.57 | Proficient |

*Note. n=120. 1.00-1.80 = Beginner; 1.81-2.60 = Developing; 2.61-3.40 = Approaching Proficiency; 3.41-4.20 = Proficient; 4.21-5.00 = Advanced.*

The level of the Technological Pedagogical Content Knowledge of teachers is proficient as shown in table 1. This indicates that the mathematics teachers in selected HEIs in Cebu City have adept knowledge of integrating technology into teaching and how to further develop this knowledge. According to Ozudogru and Ozudogru (2018), it was stated by the National Council of Teachers of Mathematics or NCTM that in technology-rich classrooms, students can develop multiple representations of concepts and engage in activities with higher motivation. The results imply that teachers can expertly teach lessons that appropriately combine mathematics, technologies, and teaching approaches. They also know how to use ICT to support students' self-directed learning and as a tool for problem-solving in groups, critical thinking, and creative thinking skills.

***Table 2***

***Teaching Performance of Mathematics Teachers***

| Performance | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Proficiency | 4.47 | 0.43 | Excellent |

*Note. n=120. 1.00-1.80 = Needs Improvement; 1.81-2.60 = Fair; 2.61-3.40 = Good; 3.41-4.20 = Very Good; 4.21-5.00 = Excellent.*

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Table 2 presents the teaching performance of the mathematics teachers. The data collected indicates that most of them performed exceptionally, with a mean of 4.47 which is considered an excellent performance. According to the study of Tambunan et al. (2021), teacher performance in building interest significantly influences student interest to excel at mathematics. This indicates that teachers with excellent teaching performance ratings positively influence the students' performance. The study conducted by Bichi (2017) emphasized that the evaluation of teacher performance is a continuous, routine, and mandatory exercise in educational settings. The relevance of teacher performance evaluation on students' learning outcomes and school accountability is enormous and cannot be underestimated. Teachers are not exclusively responsible for students' learning but play a significant role in it. An individual teacher can make a huge impact; however, student learning cannot reasonably be attributed solely to the teacher.

***Table 3***

***Correlation of TPACK and Performance of Mathematics Teachers***

| Model | | Unstandardized Coefficients | | p-value | Interpretation |
|---|---|---|---|---|---|
| | | B | Std. Error | | |
| 1 | (Constant) | 2.349 | .331 | .000 | Significant |
| | TPACK | .546 | .083 | .000 | Significant |

a. Dependent Variable: Performance

Equation: y' = 0.546x + 2.349

*Where: y' = Performance*

*X = TPACK*

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The data is assumed to be normal and homogenous thus, linear regression analysis was utilized. As seen in Table 3, the constant is significant with a beta value of 2.349, and TPACK is also significant with a beta value of 0.546. With this, the predictive equation derived is y=0.546x+2.349, where y is the performance while x is the TPACK. The results show that teachers' knowledge of TPACK significantly predicts their teaching performance. As teachers' TPACK increases, their teaching proficiency also increases, which can be predicted using the linear equation mentioned.

## Conclusion

The findings revealed that the mathematics teachers have proficient knowledge of the TPACK components and performed outstandingly at teaching Mathematics. Furthermore, teachers' TPACK competencies are significantly related to their performance in teaching Mathematics. Based on the findings, the researchers can safely conclude that TPACK in mathematics extends beyond learning a technology tool and its operation to how to use technology to improve Mathematics teaching. The TPACK level can be used to predict the performance of teachers.

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## Academic Profile

Niña Bienna Marie Y. Monterde is a professional teacher with a Bachelor of Elementary Education, majoring in General Education, Cum Laude, from the University of the Visayas in 2018. She is pursuing a Master of Arts in Education, majoring in Mathematics, at the same university. Monterde holds a license as a professional teacher and a Certificate of Eligibility from the Civil Service Commission, which reflects her commitment to her profession. She has gained teaching experience through various roles at the University of the Visayas. She is currently the BEED Program Coordinator and an Instructor at the College of Education, where she has been working since 2019. Her dedication to her profession is evident in her previous role as an SHS Teacher in the Basic Education Department of the same university from February to June 2019. Monterde's research work like "Discovery Approach in Teaching Mathematics among Grade Six Students" has been recognized and published in the Solid-State Technology journal in 2021; Monterde has also presented her research work at various conferences, including the Regional Research Conference and the 3rd Undergraduate Research Conference, held at the University of the Visayas in Cebu City, Philippines. Her research work was recognized at the Regional Research Conference in August 2019, where she was awarded an Outstanding Research Presenter. Monterde's academic background,

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experience in teaching and education, and research work make her an asset to the University of the Visayas and the field of Mathematics education.