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Analyzing the Relationship Between the Sense of Efficacy and Technological Pedagogical Content Knowledge of Teachers

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A B S T R A C T

This study aimed to determine the significant relationship between teachers' sense of efficacy and technological pedagogical content knowledge (TPACK). Simple random sampling was used, which included 50 teachers as respondents. Through non-experimental quantitative descriptive-correlational research techniques, validated questionnaire, Mean, Pearson-Product Moment Correlation Coefficient (Pearson-r), and Multiple Linear Regression, results showed that the level of sense of efficacy was very high or always manifested. It was also found that the level of TPACK was very high or always manifested. There was a significant relationship between the sense of efficacy and teachers' technological pedagogical content knowledge. This implies that teachers with a strong sense of efficacy are likelier to have a high level of TPACK. These teachers are more likely to experiment with innovative teaching methods and technologies, enhancing their TPACK. Accordingly, instructional strategies best influence teachers' technological pedagogical content knowledge; this implies that when teachers are adept at employing a variety of instructional strategies, they are better equipped to integrate technology effectively into their teaching practices.

A R T I C L E I N F O

1. INTRODUCTION

Modernization has affected our society, particularly in education, where instructors need to become familiar with the tools of the trade. Since some teachers are accustomed to teaching using the same methodology they frequently utilize, they might need help adjusting to the new delivery manner. Several studies have also highlighted challenges faced by teachers regarding technological pedagogical content knowledge (TPACK), such as inadequate teacher preparation, limited knowledge of technology applications, insufficient technological   facilities (https://www.academia.edu/40546246/Challenges_Encountered_by_Teachers_on_TPACK_ Technological_Pedagogical_and_Content_Knowledge_), and content knowledge gap (Koehler & Mishra, 2009). In the Philippines, the sudden shift to online and remote learning due to the COVID-19 pandemic forced educational institutions to adopt emergency remote teaching that posed significant challenges for teachers, such as technological limitations, pedagogical gaps, and social difficulties. Additionally, balancing content, pedagogy, and technology remains a challenge. There are still gaps in digital literacy that affect teachers' ability to navigate online teaching and learning resources (Ramos *et al.*, 2020).

Based on the current issues of TPACK it implies that technology is increasingly being used in learning and teaching environments. Teachers play an essential role in introducing new developments in the learning and teaching process to the next generation. This encourages schools to adopt new technology and applications to improve educational methods (Altinay *et al.*, 2020). Teachers must have a positive attitude toward implementation to accomplish integration in teaching and learning and the intended goal. As a result, if they have a good impression of the benefits of utilizing technology, it will boost their self-efficacy, and they will use technology in teaching and learning (Govender & Govender, 2009).

In addition, it is possible to hypothesize that teachers' opinions about their ability to work successfully with technology in general are directly connected to their use of technology in the classroom. Measuring technological self-efficacy is a helpful predictor of the efficiency of teacher education programs. The school system is likewise conscious of the relevance of technology in raising a more knowledgeable generation. Technology integration in teaching and learning has become a priority that most teachers have incorporated into any topic today. The use of technology to support objectives and engage students in meaningful learning is referred to as technology integration (Dias, 1999).

Further, the TPACK Framework provides a comprehensive lens for understanding the interplay of Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) in educational technology integration (Mishra & Koehler, 2006). This framework emphasizes that effective educational technology requires a strong foundation in content and pedagogy, with technology serving as an enhancer. Specifically, Technological Pedagogical Knowledge (TPK) explores the relationship between technological tools and pedagogical practices, while Pedagogical Content Knowledge (PCK) focuses on aligning teaching practices with learning objectives. Technological Content Knowledge (TCK) also examines the intersection of technology and content. Teachers' self-efficacy plays a critical role in navigating this complex space, influencing their confidence and competence in integrating technology effectively.

Self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." Over the past few decades, researchers in various social science fields have focused on this concept. He also contends that people's perceptions of their abilities are influenced by their beliefs, skills, and knowledge. Thus, it is thought that

a person's goals, choice of activities, accomplishments, the amount of effort they put forth, and the resistance or resilience they show when facing a challenging task are all influenced by their sense of efficacy. The construct has been the subject of numerous studies because it has proven to have significant implications, particularly in educational settings.

Teachers' Positive behaviors are linked to their high sense of teaching efficacy, which raises student achievement. Highly effective teachers are more committed, open to new ideas, and put more effort into their lessons. They also give low-achieving students more of their attention (Hoy & Spero, 2005). Social cognitive theory is based on self-efficacy. Self-efficacy is the belief, or confidence, that one can effectively execute a behavior required to achieve a result; the higher the degree of self-efficacy, the more an individual feels he can perform the behavior needed to produce an inevitable consequence (see https://www.simplypsychology.org/social-cognitive-theory.html#SnippetTab).

Conversely, it has elucidated that TPACK significantly shapes our daily lesson plans. A planning process that involves selecting the learning outcomes for the day or class session as the content, followed by choosing an activity type as the pedagogy, which determines how the students will learn the content, was proposed. Finally, the appropriate technologies are selected to support the activity type and facilitate student learning. The authors emphasize the importance of incorporating all aspects of the TPACK framework in instructional planning to create an optimal learning environment for students. The fundamental concept of TPACK is that expertise in a subject only sometimes translates to effective teaching, as pedagogical knowledge is also essential. Therefore, one must combine subject knowledge with teaching skills to be an excellent teacher. With the increasing emphasis on technology, it is crucial to integrate technology with content and pedagogy to create an effective learning environment (Elas *et al.*, 2019).

As emphasized by Koehler and Mishra (2009), *"TPACK is the foundation of effective technology-enhanced teaching, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and epistemological theories; and knowledge of how technologies can be used to improve learning."*

With the cited issues on TPACK and the importance of a sense of efficacy and TPACK in teaching, the researchers prompted to conduct this study specifically aims to address the following objectives: (1) to determine the level of sense of efficacy of teachers in terms of performance attainment, classroom management, and instructional strategies; (2) to determine the level of teachers' technological pedagogical content knowledge in terms of technological pedagogical knowledge, technological content knowledge, and pedagogical content knowledge (TPACK); (3) to determine the significant relationship between sense of efficacy and TPACK; and (4) to determine which domain (s) of sense of efficacy best influences TPACK.

2. METHODS
2.1. Research Design

The researchers used the non-experimental quantitative descriptive–correlational as a research design for this study. The researchers used this because it was the appropriate design for the study. The researchers considered two variables in this study: the sense of efficacy and the technological pedagogical content knowledge. The correlational studies aim to quantify how closely connected certain variables are in the target population. The whole

duration of the study was one semester or approximately 5 months.

2.2. Research Respondents

The respondents of this study were the secondary school teachers of a public school in the Island Garden City of Samal. Using a simple random sampling, 50 teachers were chosen. Delice (2010) mentioned that a sample size between 30 and 500 at a 5% confidence level is generally sufficient for many researchers.

2.3. Research Instruments

The source of data for this study was taken through survey questionnaires. The first and second parts of the research questionnaire adapted by the researchers were from the third Teaching and Learning International Survey. Part 1 of the instruments has three sections. Section 1 is about performance attainment with five (5) statements; Section 2 is about classroom management with five (5) statements; and Section 3 is about Instructional Strategies with five (5) statements. The second part of the questionnaire was technological pedagogical content knowledge (TPACK), which consists of three sections. Section 1 is about technological pedagogical knowledge (TPK), Section 2 is about technological content knowledge (TCK), and Section 3 is about pedagogical content knowledge (PCK). Each section in the second part has five (5) statements. The instruments were modified and validated by a set of experts. Both parts of the instrument were interpreted using a five-point Likert scale from Very Low to Very High.

2.4. Data Gathering Procedure

The research was conducted in a public school where the respondents were secondary school teachers. The following procedures were used in gathering the data: (1) ask permission to conduct the study, (2) adapt questionnaires from the National Center for Education Statistics website and subject them to validation of experts, (3) distribute questionnaires to the identified respondents, (4) retrieve the questionnaires after having been accomplished by the respondents, and (5) collated and tabulated the data.

2.5. Data Analysis

The data obtained from the survey questionnaires were analyzed using descriptive and inferential statistics. The following statistical tools were utilized: (1) Mean was used to determine the level of sense of efficacy and technological pedagogical content knowledge (TPACK) of teachers, (2) Pearson Product-Moment Correlation Coefficient to determine the significant relationship between sense of efficacy and TPACK, and (3) Multiple Linear Regression Analysis to determine which domain (s) best influence(s) TPACK. The calculation was aided with Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 22.

3. RESULTS AND DISCUSSION

This section contains the results and discussion of the data obtained from the questionnaire responses based on this study's research objectives. The discussion of the topic is arranged in the order of level of sense of efficacy, level of technological pedagogical content knowledge of teachers, significance of the relationship between sense of efficacy and technological pedagogical content knowledge of teachers, and regression analysis on the influence of sense of efficacy on TPACK.

3.1. Level of Sense of Efficacy

The level of sense of efficacy of teachers is shown in **Table 1**. Of all the indicators, performance attainment got the highest mean score (M=4.74, SD=.27), described as very high, indicating that the teachers are exhibiting expertise in applying knowledge and skills in integrating technology when delivering the lessons all the time. On the other hand, Classroom Management got the next highest mean score (M=4.66, SD=.39), described as very high, which tells that the teachers are utilizing technology in implementing classroom management rules all the time. Instructional Strategies obtained the lowest mean score (M=4.63, SD=.36) but still described as very high. This shows that the teachers integrate their knowledge and skills in technology in applying teaching strategies when delivering their lessons to the class.

The overall mean (M=4.68, SD=.23) was described as very high, meaning that the teachers have manifested efficacy in applying knowledge and skills in integrating technology into their teaching job. This result implies that teachers have kept abreast with the changing nature of technology and provided learning opportunities effectively. It emphasizes that the integration process is more on understanding how to adapt it to the pedagogy of each subject area, how to equip teachers through continuous training programs, and most especially, moving towards professional development to empower the teachers.

Table 1. Level of sense of efficacy.

Indicators	SD	M	Descriptive Equivalent
Performance Attainment	0.27	4.74	Very High
Classroom Management	0.39	4.66	Very High
Instructional Strategies	0.36	4.63	Very High
Overall Mean	0.23	4.68	Very High

Note: N = 50, M = Mean, SD = Standard Deviation

3.2. Level of Technological Pedagogical Content Knowledge

The level of technological pedagogical content knowledge of teachers is shown in **Table 2**, with an overall mean (M=4.47, SD=.43) described as very high. This means that the technological pedagogical content knowledge of teachers was always manifested. This implies that teachers consistently apply the TPACK Framework, resulting in an effective integration of technology into teaching. Teachers also perceive that this framework is essential for the successful integration of technology into teaching (see https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/). As Dewi *et al*. (2021) mentioned, TPACK is particularly useful for developing teacher learning abilities in line with the period of the Industrial Revolution 4.0.

Looking at each indicator, pedagogical content knowledge (PCK) got the highest mean (M=4.65, SD=.40), which was described as very high. This means that PCK among teachers was always manifested. This means that teachers consistently demonstrate their ability to apply their understanding of the subject to their teaching strategies, facilitating effective teaching. This further means that there is strong evidence that PCK is a critical element of effective teaching (Coe *et al.*, 2014). It has been perceived that teachers who use PCK may develop high teacher self-efficacy beliefs, which can result in further effective teaching and learning (Grieser & Hendricks, 2018).

Technological Pedagogical Knowledge (TPK) got the second highest mean (M=4.42, SD=.55), which is described as very high. This means that TPK was always manifested. This further means that teachers have constantly demonstrated their ability to apply their understanding of teaching methods to their use of technology, thus facilitating effective

learning. This result was supported by several studies and articles (Dogan *et al*., 2021; Gondwe, 2021; see https://educatellc.com/subject-help/english-language/literature/).

Lastly, Technological Content Knowledge (TCK) got the lowest mean (M=4.35, SD=.68); however, it is still described as very high. This means that TCK was always manifested. This further suggests that teachers have consistently displayed their ability to apply their understanding of a subject to their use of technology, thereby aiding effective learning. The result of this study aligns with several studies conducted on TCK (Ayten, 2021; Dogan *et al*., 2021; Willermark, 2021; Nueva, 2019).

Table 2. Level of technological pedagogical content knowledge of teachers.

Indicators	*SD*	*M*	Descriptive Level
Technological Pedagogical Knowledge	0.55	4.42	Very High
Technological Content Knowledge	0.68	4.35	Very High
Pedagogical Content Knowledge	0.40	4.65	Very High
Overall Mean	0.43	4.47	Very High

Note: N = 50, M = Mean, SD = Standard Deviation

3.3. Significance of the Relationship between Sense of Efficacy and Technological Pedagogical Content Knowledge (TPACK)

Table 3 shows the significance of the relationship between the sense of efficacy and technological pedagogical content knowledge of teachers. Results revealed an overall r-value of .521 with a p-value of 0.000, less than the 0.05 degree of a significant relationship. Thus, the null hypothesis was rejected. It can be seen that classroom management (r=.309, p=.029) and instructional strategies (r=.529, p=.000) have a significant relationship to the teachers' technological pedagogical content knowledge. This implies that how teachers manage their classrooms is closely tied to their understanding and application of technology in teaching (TPACK). This means that teachers who strongly understand how to integrate technology into their teaching methods (TPACK) are likely to be more effective in managing their classrooms. They can use technology to create engaging learning environments, maintain student interest, and manage student behavior. Various studies (Rosenberg & Koehler, 2015; Schmidt *et al*., 2009) suggest that effective classroom management and the successful integration of technology in teaching (TPACK) are interconnected.

In addition, the teachers' teaching methods are interconnected to their understanding and application of technology in teaching (TPACK). This further means that teachers who understand how to integrate technology into their teaching methods (TPACK) are likely to use more effective instructional strategies. They can use technology to create engaging learning environments, deliver content in various ways to cater to different learning styles and assess student learning in real time. Several researchers (Alghamdi, 2023; Lee *et al*., 2022; Voogt *et al*., 2013) suggest that effective instructional strategies and the successful integration of technology in teaching are closely related. Lastly, the sense of efficacy among teachers was significantly related to technological pedagogical content knowledge (r=.521, p=.000). This entails that teachers with a strong sense of efficacy are likelier to have a high level of TPACK. Researchers (Joshi, 2023; Zeng *et al*., 2022; Kul *et al*., 2019; Yerdelen-Damar *et al*., 2017) have established that these two constructs are significantly related. This result was also supported by the TPACK Framework of Mishra and Koehler (2006), stating that teachers' self-efficacy plays a critical role in navigating this complex space, influencing their confidence and competence in integrating technology effectively.

Table 3. Significance of the relationship between sense of efficacy and technological pedagogical content knowledge of teachers.

Sense of Efficacy	Technological Pedagogical Content Knowledge			
	Technological Pedagogical Knowledge	Technological Content Knowledge	Pedagogical Content Knowledge	Overall
Performance Attainment	0.084 (0.561)	0.041 (0.778)	0.214 (0.136)	0.122 (0.398)
Classroom Management	0.157 (0.277)	0.383* (0.006)	0.147 (0.308)	0.309* (0.029)
Instructional Strategies	0.617* (0.000)	0.471* (0.001)	0.272 (0.056)	0.592* (0.000)
Overall	0.437* (0.002)	0.470* (0.001)	0.300* (0.034)	0.521* (0.000)

*p<.05 – Significant

3.4. Regression Analysis on the Influence of Sense of Efficacy on Technological Pedagogical Content Knowledge (TPACK)

Table 4 is the regression analysis of the influence of the sense of efficacy on the TPACK of teachers. It shows the domain of sense of efficacy that best influences TPACK. The obtained F-value of 9.837 is significant at $p<0.05$, which indicates a model fit. Also, the R-squared value .351 suggested that the variance in TPACK of teachers was attributed to the domains of sense of efficacy specified in this study. This means that .649, or 64.9% of the variance, could be credited to other things that are already beyond the concern of this study.

However, this section's focal point was determining the domain that best influences technological pedagogical content knowledge; the data show that instructional strategies are the only predictor of TPACK. Instructional strategies obtained a *β*-coefficient value of .681 with the corresponding computed t-value of 4.684, and the p-value is less than 0.05, which was set as the significance level of the study.

Table 4. Regression analysis of the influence of sense of efficacy on technological pedagogical content knowledge.

Sense of Efficacy	Technological Pedagogical Content Knowledge		
	β	t.	Sig.
Constant	0.703	0.669	0.507
Performance Attainment	-0.097	-0.504	0.617
Classroom Management	0.231	1.737	0.089
Instructional Strategies	0.681	4.684	<0.001*
R		0.625	
R²		0.351	
F		9.837	
p		<0.001*	

*p<.05 – Significant

Therefore, it could be inferred that instructional strategies as a domain of a sense of efficacy can best influence TPACK. This signifies that when teachers are adept at employing various instructional strategies, they are better equipped to integrate technology effectively into their teaching practices. This parallels the study of Ning et al. (2022), which yielded similar results. Various studies (Bai et al., 2023; Ning et al., 2022; Rahman et al., 2022; Zhang & Tang, 2021) have explored the influence of instructional strategies on TPACK. It can be said that

teachers' sense of efficacy in instructional strategies can significantly influence their TPACK. Enhancing both constructs can lead to more effective teaching practices, particularly in integrating technology in education (Bai *et al.*, 2023; Rahman *et al.*, 2022).

4. CONCLUSION

TPACK is a framework that identifies the knowledge teachers need to teach effectively with technology. When teachers have a high sense of efficacy, they tend to display more significant levels of planning and organization, are more open to new ideas, and are more willing to experiment with new methods to meet the needs of their students better. Based on the study's findings, it has been shown that the level of sense of efficacy of teachers was very high. This means that a sense of efficacy was always manifested. This implies that teachers have kept themselves abreast with technology's changing nature and effectively provided learning opportunities. Keeping up with technological advancements can create more engaging, interactive, and effective student learning experiences. This could lead to the development of a high level of sense of efficacy in terms of performance attainment, classroom management, and teachers' instructional strategies.

In addition, teachers' technological pedagogical content knowledge was very high or always manifested. This implies that teachers are consistently applying the TPACK Framework, effectively integrating technology into teaching. This allows teachers to effectively integrate technology into their pedagogy and content knowledge, thus creating more engaging and interactive learning experiences. Teachers are consistently applying the TPACK will be better prepared for the future of education.

Moreover, a significant relationship existed between the teachers' sense of efficacy and technological pedagogical content knowledge. Teachers with a strong sense of efficacy are likelier to have a high level of TPACK. These teachers are more likely to experiment with innovative teaching methods and technologies, enhancing their TPACK. When the teachers have high TPACK, it can create more engaging and effective learning experiences, eventually leading to improved student outcomes.

Lastly, among the domains of teachers' sense of efficacy, instructional strategies best influence TPACK. This implies that when teachers are adept at employing various instructional strategies, they are better equipped to integrate technology effectively into their teaching practices. Teachers who can employ various instructional strategies can create diverse learning experiences. When these strategies are combined with technology, it can lead to more engaging and interactive learning environments.

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6. AUTHORS' NOTE

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