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Research Article

TPACK Competence and PMES-COT Ratings of Proficient and Highly Proficient High School Mathematics Teachers

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Abstract
This study investigated the correlation that exists between the perceived Technological Pedagogical Content Knowledge (TPACK) competence and the actual teaching performance of mathematics teachers in Eastern Samar public secondary schools. The study was based on the TPACK Framework, Pedagogical Content Knowledge Theory, and the Self-Efficacy Theory, and was employed with the comparative-correlational design, which involved 62 teachers (50 Proficient and 12 Highly Proficient) who were chosen with the help of random sampling. The self-report TPACK instrument, as well as the official Performance Management and Evaluation System-Classroom Observation Tool (PMES-COT) ratings, were used to collect data. Non-parametric tests such as the Mann-Whitney U and Spearman Rho were used due to unequal group sizes and non-normal distribution. Findings showed that there was no significant difference between the overall perceived TPACK competence across the groups ($p = 0.624$), and both groups gave High to Very High ratings. The PMES-COT ratings of both groups were outstanding, and there was no significant difference in the results of observed performance ($p = 0.060$). Correlation analysis showed that there was a gap between perception and practice, with the Proficient ($r = 0.122$, $p = 0.399$) and the Highly Proficient ($r = -0.194$, $p = 0.547$) groups showing no significant correlation between the perceived competence and the objective ratings. The statistical significance of the difference in the strength of correlation between the two stages of career was not statistically significant according to the Fisher z test ($p = 0.38$), meaning that no difference could be detected under the current sample condition. The findings indicate that self-reported TPACK is more of a professional confidence measure and may not be as reliable as an objective instructional mastery measure.
Keywords: TPACK, PMES-COT, Competence of Teachers, Classroom Observation, Mathematics Education, Technology Integration.

Introduction

In the 21st century, the educational context has been radically transformed by technological innovations, making the use of digital technologies an indispensable part of modern education. This change has been identified within the domain of mathematics education, where abstract concepts that were previously isolated in rote instruction are being actualized using visualization, simulation, and interactive space. At the core of this change is the technological pedagogical content knowledge (TPACK) model (Mishra and Koehler, 2006). This model builds on pedagogical content knowledge (PCK) proposed by Shulman (1986) by making technology a third, mutually dependent field, and opines that the efficacy of teaching can be enhanced when content, pedagogy, and technology are creatively synthesized (Koehler and Mishra, 2009). Besides the theoretical knowledge, two other important aspects that lead to the development of TPACK are the collaboration in lesson planning and reflective practice (Schmidt *et al.,* 2009).

Empirical research has revealed that the advanced levels of TPACK competence are correlated with instructional practices that facilitate critical thinking and problem-solving (Wardani and Jatmiko, 2021; Setyo *et al.,* 2023), and TPACK is thus held to be a broadly applied and theoretically based framework to analyze the digital teaching competence (Miguel-Revilla *et al.,* 2020). This is in line with Sustainable Development Goal 4 (SDG 4) of the United Nations, which stipulates that any inclusive and quality education requires the continuous professional development of qualified teachers as a prerequisite (United Nations,

2015). The ICT integration is one of the core responsibilities identified by the Philippine Professional Standards of Teachers (PPST) in its local version. The Department of Education (2025) came up with the performance management and evaluation system (PMES) to measure these standards through DepEd Memorandum No. 17, s. 2025. The system will make use of the classroom observation tool (COT) as a systematic indicator of general instructional practice that may indirectly reflect aspects of pedagogical, content, and technological knowledge (Banua *et al.,* 2022; Pineda *et al.,* 2024). Whereas the COT is used to assess objective quality of the processes (Molina *et al.,* 2018), and performance is commonly determined by the professional practice and productivity of a teacher (Hero, 2019), a lot of difficulties exist in correlating the objective outcomes with the self-reported teacher competence.

The main problem of contemporary teacher assessment is the gap between perception and practice, which is justified by the self-efficacy theory of Bandura (1997). According to this theory, although high self-efficacy is the cause of professional confidence, it is not necessarily a perfect reflection of actual performance. The educators can work in the blind space and misjudge their level of competence because of their professional identity or previous success, not even knowing about their technical constraints (Max *et al.,* 2022). It is usually complicated by the social desirability bias, in which teachers offer positive answers that fit the expectations of the institution instead of their regular implementation in classrooms (Clifford and Jerit, 2015; Larson, 2018). Empirical studies of self-report measures show that self-report measures tend to score higher than performance-based measures (Mohammadpour and Maroofi, 2025) and that more recent studies have specifically found that the constructive validity of self-report measures of mathematics teacher knowledge and test-based performance is often close to zero, indicating constructs that may measure quite different things: confidence versus objective mastery (Kadluba and Obersteiner, 2025).

This disconnection is recorded in different fields in the Philippines. Salazar (2023) mentioned that the overconfidence tendency was observed in the English proficiency of Grade 12 students, and Canuto *et al.,* (2024) did not identify significant correlations between perceived teacher competencies and the actual effect on students in terms of instruction. In terms of TPACK, in particular, the knowledge that teachers have in technology (TK) is the weakest area, although their content and pedagogical knowledge is usually high (Agustini *et al.,* 2019; De Freitas and Spangenberg, 2019; Kara, 2021). In some cases, especially with Filipino STEM teachers, TPACK is usually built up in stages, with some teachers remaining at a 'novice' level in technology integration despite having well-developed other areas (Morales *et al.,* 2022). Although the innovative professional development, such as the DECODE model, has proven to be promising in empowering teachers (Wahono *et al.,* 2025), the lack of direct empirical research makes a critical gap: the relationship between the internal TPACK self-assessment of a teacher and the objective performance on the national observation tools, such as the PMES-COT, has not been directly provided yet. This paper aims to fill this gap by performing a comparative and correlational research in Eastern Samar as a way of illustrating a holistic, evidence-based insight into contemporary teacher competence at various stages in the career.

Statement of the Problem

The objective of the study is to establish the correlation between the perceived technological pedagogical content knowledge (TPACK) competence and the classroom observation tool (COT) rating of mathematics teachers in public high schools of the performance management and evaluation system (PMES). In particular, it aims to provide answers to the following questions:

1) What is the level of TPACK competence of proficient and highly proficient public high school mathematics teachers?
2) What is the level of performance of proficient and highly proficient public high school mathematics teachers based on their classroom observation tool (COT) ratings under PMES?
3) Is there a significant difference in the perceived TPACK competence between proficient and highly proficient public high school mathematics teachers?
4) Is there a significant difference in the PMES-COT ratings between proficient and highly proficient public high school mathematics teachers?
5) Is there a significant relationship between the perceived TPACK competence and the PMES-COT ratings of the proficient and highly proficient public high school mathematics teachers?

Materials and Methods

Research Design

This study utilized a comparative-correlational research design (Creswell and Creswell, 2018). The comparative part examined the existence of any significant difference in TPACK competence and the

classroom observation tool (COT) rating between two different career stages. The correlational element explored the level and direction of the relationship between the self-perceived competence and actual performance of teachers in terms of official observation ratings.

Respondents

The sample consisted of 62 junior high school mathematics teachers in the Schools Division of Eastern Samar, chosen through random sampling. The respondents were divided into two categories: proficient teachers (n=50; Teacher I-III) and highly proficient teachers (n=12; Master Teacher I-IV), according to the career stage of the Department of Education (DepEd) guidelines. The unequal grouping is a characteristic of the organizational structure of the country, in which the number of master teacher positions is restricted by a fixed proportion (DECS Order No. 70, s. 1988).

Inclusion criteria entailed the following: All respondents had to be Bachelor of Secondary Education graduates with a Major in Mathematics and had to have completed a classroom observation teaching (COT) demonstration in the 2024-2025 school year.

Research Instrument

A three-part instrument validated by subject matter experts and a language expert was used to collect data.

- ✧ Self-Reported TPACK: A modified version of the tool by Valtonen *et al.* (2017), adapted to measure 21st-century technological, pedagogical, and content knowledge.
- ✧ Performance Rating: Official Classroom Observation Indicator (COI) ratings in accordance with the performance management evaluation system (PMES).
- ✧ The Lawshe Content Validity Index (CVI) of the instrument was 0.83, which reflects good relevance and suitability to the local setting. Pilot testing was conducted to determine reliability, whereby the Cronbach's Alpha coefficient was 0.88, which is a high internal consistency. Importantly, an informed consent form was incorporated at the start of the tool so that all the participants were informed properly of the voluntary nature of the study, confidentiality measures, and use of the data before they could go through the actual questionnaire.

Data Collection Procedure

The research data collection was done under a strict ethical and administrative procedure. To maintain compliance with the Data Privacy Act of 2012 and prevent compromising the well-being of participants, the researcher obtained the permission of the Research Ethics Committee (REC) of Leyte Normal University (LNU) in the first place. When REC was approved, there was a formal Letter of Request dispatched to the Regional Office of the DepEd Region VIII and the Schools Division Superintendent of Eastern Samar. After the appropriate clearance of the region and division level, the researcher liaised with the school heads and program heads, both through written communication and planned visits. The survey was conducted personally and outside teaching hours to prevent interference with classes. The consent form was read and signed by participants, which highlighted the fact that participation was not mandatory, and no data used to identify them was going to be gathered so as to ensure complete anonymity. Information was kept in encrypted files, and this procedure was undertaken within a limited time span so as to ensure that the participants were not inconvenienced to a larger extent.

Statistical Treatment

Jamovi (Version 2.6) was used in data processing at the level of significance $p < 0.05$. Non-parametric tests were applied to achieve statistical rigor owing to unequal group sizes and non-normal distribution. Differences between career stages were compared using the Mann-Whitney U test, and the relationship between perceived competence and actual classroom performance was determined using Spearman's rank-order correlation (Spearman's rho). Lastly, Fisher's r-to-z transformation was used to assess the difference in the strength of correlation between the two sets.

Results and Discussion

Table 1. The level of technological pedagogical content knowledge (TPACK) competence of 62 mathematics teachers, categorized by their career stage (proficient, n=50, and highly proficient, n=12).

	Group	Mean	SD	Verbal interpretation
TPACK overall	Highly proficient	4.23	.508	Very high
	Proficient	4.13	.577	High

Table 1 data reveal that mathematics teachers overall seem to feel very competent in general TPACK; this attests to a high level of professional confidence. The highly proficient group reported a Very High level of overall TPACK (M = 4.23, SD = 0.508), whereas the proficient group rated themselves a little lower at a High level (M = 4.13, SD = 0.577). These results indicate that educators at different career levels believe they have the ability to effectively combine technology, pedagogy, and content in their teaching practice.

Even though the self-reported scores indicate a high degree of perceived competence, it should be noted that there is a possibility of self-assessment bias. Studies have shown that self-perceived TPACK does not necessarily relate to perceived performance in the classroom, and only slight correlations are usually found between perception and practice (Backfisch *et al.,* 2020). Therefore, whereas the scores indicate high self-confidence, they cannot be viewed as evidence of instructional mastery.

The marginally higher rating of the highly proficient category could be a product of the experience, professional growth, and the long-term interaction with the teaching practice, which supports the integration of technology and pedagogy. On the other hand, the proficient group, as well as being a bit less, still shows a good base in the perceived TPACK, indicating their willingness to use the integrated knowledge in their classes.

Altogether, these results create a vivid understanding of the self-perceived TPACK competence of teachers. Nevertheless, the study highlights the necessity to contrast these perceptions with an objective assessment of classroom performance, including the classroom observation tool (COT) (DepEd, 2025), to get to know whether confidence is correlated with effective classroom performance.

Table 2. Level of performance of proficient and highly proficient mathematics teachers through PMES COT ratings (proficient, n=50, and highly proficient, n=12).

	Group	**Mean**	**SD**	**Verbal interpretation**
PMES-COT rating	Highly proficient	4.81	.184	Outstanding
	Proficient	4.62	.344	Outstanding

Table 2 shows that both career stages achieved an Outstanding verbal interpretation in their observed performance. The highly proficient teachers demonstrated an observed mean rating of M=4.81, with a low standard deviation of SD=0.184. Similarly, the proficient teachers achieved a mean rating of M=4.62, with a standard deviation of SD=0.344. The results show that the quality of instructional practice, assessed using the COT, is high among all the respondents. The fact that both groups received an Outstanding rating suggests that these teachers demonstrate the standards of effective teaching practice expected of them in their professional roles.

The very low standard deviations for both groups further signify a high degree of uniformity in the exceptional quality of performance exhibited by the teachers in the classroom setting. Nevertheless, the fact that PMES-COT scores cluster around the upper performance limit with a low level of variability indicates that the observation instrument may have a ceiling effect. This narrow scope can be a limitation to the sensitivity of the tool in identifying the subtle differences in instructional performance of high-performing teachers.

Table 3. Comparison of the TPACK competence between highly proficient and proficient mathematics teachers.

		Statistic	**P**	**Mean difference**	**Interpretation**
TPACK competence	Mann-Whitney U	272	.624	.079	No significant difference

Table 3 displays the results of the Mann-Whitney U test, which was utilized to compare the overall self-reported TPACK competence between career stages. With a calculated p-value of 0.624, which is notably higher than the standard significance level of 0.05. This statistical outcome confirms that there is no statistically significant difference in the overall self-perceived TPACK competence between highly proficient and proficient mathematics teachers.

This is an interesting revelation when compared to the descriptive statistics in Table 1. The statistical analysis explains that the difference in numbers is not significant in spite of the fact that the highly proficient group achieved a mean of 4.23 (Very High) and the proficient group achieved a mean of 4.13 (High).

Essentially, the subjective judgment of competence between the two groups is statistically the same, indicating that both career stages possess a comparable level of professional confidence.

This observation serves as solid empirical evidence for the theoretical arguments regarding the limitations of self-report data found in the literature. According to the literature, self-assessments are prone to self-assessment bias and mainly assess self-efficacy or intent and not the existing competency. Since the two groups are already well-established professionals, their self-confidence would balance out, thereby masking the official difference between the career levels as presented by the Philippine Professional Standards of Teachers (PPST) is not evident in these subjective indicators.

These results demonstrate why objective and external assessment, such as the classroom observation tool (COT), is crucial to evaluate the actual pattern of development of teaching expertise. The literature has repeatedly indicated that self-report measures would be complemented by objective assessment processes due to the fact that the correlation between self-reported TPACK and the actual implementation of the classroom is generally small or moderate. According to Backfisch *et al.,* (2020), such self-assessments may create the illusion of mastery, whereas von Kotzebue (2022) adds that measures that are evaluated through performance can much more effectively predict the quality of the instruction.

Table 4. Comparison of the PMES COT ratings between highly proficient and proficient mathematics teachers.

		Statistic	P	Mean difference	Interpretation
PMES-COT rating	Mann-Whitney U	195	.06	.125	No significant difference

Classroom observation tool (COT) is an objective evaluation of the quality of the instruction that is not limited to particular categories of career stages. Based on the Mann-Whitney U test results in Table 4, the test contained a p-value of 0.06. Because this value is slightly greater than the 0.05 level of significance. This statistical result shows that no significant difference was found regarding objective classroom performance ratings between highly proficient and proficient mathematics teachers.

Descriptive data confirms this parity with both groups scoring an outstanding mean rating of 4.81 -highly proficient and 4.62 -proficient. These results indicate that both career stage teachers successfully address the instructional practice requirements that are required by their professional roles. It is necessary to mention that this parity can be partly due to the minimal discriminating ability of the PMES-COT on the high levels of performance, instead of the complete equality regarding the instructional expertise.

This performance gap is insignificant with implications for the professional progression model provided by the Philippine Professional Standards for Teachers (PPST). Although the PPST is theoretically designed to separate career stages based on increasingly deep expertise, the COT, which is a measure of process quality, does not statistically compare the two in this regard. This is an indication that even teachers with low overall perceived TPACK competence can achieve peak performance ratings. It also suggests that the COT tool, as it is implemented in the current performance management and evaluation system (PMES), would possibly tend to measure general pedagogical excellence, but not the particular synthesis of technology, pedagogy, and content. As a result, there is a strong rationale to make classroom observation rubrics more consistent with the TPACK competencies to better differentiate and assess high-level 21st-century technology integration. Although the PMES-COT allows objective measurement of the general quality of instruction, TPACK domains are not explicitly separated and thus cannot be regarded as a direct indicator of integrated knowledge of technology, pedagogy, and content.

Table 5. Correlation between TPACK competence and PMES COT ratings of a proficient mathematics teacher.

		r value	df	p value	Interpretation
TPACK competence and PMES COT ratings	Spearman's rho	.122	48	.399	No significant difference

Table 5 shows the correlation between the self-reported overall TPACK competence and the PMES-COT ratings for the proficient teacher group, analyzed using Spearman's rho. The analysis yielded a correlation coefficient (r) of 0.122, with a p-value (p) of 0.399. The p-value exceeds the conventional level of significance; thus, the correlation is considered insignificant.

The statistical insignificance (p=0.399) combined with the very low correlation coefficient (r=0.122) means that, for the proficient teacher group, the level of a teacher's self-reported overall TPACK competence has a low discernible linear relationship with the teacher's objective score on the classroom observation tool (COT). This means that a high score on the self-assessment does not predict a high score on the observed performance, and vice versa. The variation in the proficient teachers' perceived competence is not reflected in the variation of their observed performance.

This result empirically validates the central research question regarding the gap between perception and practice. The literature indicates that research has demonstrated that self-assessments are not always related to current competence or performance in a classroom environment. The non-significant relationship substantiates the hypothesis that the two variables, self-perception and observed practice, do not exhibit a statistically significant relationship in this particular group, as they are used to measure different constructs. The literature also notes that the self-report measures the teachers' self-efficacy or confidence, while the COT rating measures the teachers' actual instructional practice and performance. The insignificant relationship supports the caution in the literature that self-reports can provide little information on actual classroom competence.

Table 6. Correlation between TPACK competence and PMES COT ratings of a highly proficient mathematics teacher.

		r value	df	p value	Interpretation
TPACK competence and PMES COT ratings	Spearman's rho	-.194	10	.547	No significant difference

Table 6 shows the results of the Spearman's rho correlation between the highly proficient teachers' overall TPACK self-reports and their PMES-COT ratings. The analysis yielded a correlation coefficient (r) of -0.194, with a p-value (p) of 0.547. Since the p-value (0.547) is greater than the standard significance level alpha = 0.05, the correlation is deemed insignificant.

The finding of an insignificant correlation (p=0.547) means that, for this highly proficient group, their self-reported overall TPACK competence does not have a statistically significant relationship with their objective COT score. This is consistent with the result of the proficient group (Table 5) and gives solid empirical support that self-perception is not a valid proxy of objective performance at all career stages.

Even though the correlation coefficient is negative, the correlation is statistically insignificant and must be viewed with caution, considering a small sample of the highly proficient group. The observed inverse relationship is not inferential but descriptive and does not justify conclusive findings on overconfidence or discrepancy between perceived ability and observed results.

This finding is in line with existing literature that has shown the lack of correlation between self-reported competence and actual practice. The literature makes it clear that the small-to-moderate correlation between the self-reported TPACK and the actual implementation is well-documented (Backfisch *et al.,* 2020). Furthermore, the finding confirms the conclusion of von Kotzebue (2022) that self-reported TPACK lacked the significance of predicting the quality of lesson planning in technology-enhanced lessons. Within the settings of a highly proficient group, the insignificant correlation affirms the fact that their high levels of confidence are not a reliable predictor of observed instructional effectiveness. This highlights the fact that objective measures such as the COT are required to justify the quality of instruction.

Table 7. The difference between the correlation of TPACK competence and PMES COT ratings of proficient and highly proficient mathematics teachers.

Group	Correlation (r)	N	z-test statistics	p-value	Interpretation
Proficient teachers	.122	50	.877	0.38	No significant difference
Highly proficient teachers	–.194	12			

Table 7 shows the results of Fisher's z test, which yielded a p-value (p) of 0.38. Since the p-value (0.38) is greater than the standard significance level alpha = 0.05. The conclusion is that the difference between the correlation for the proficient group (r=0.122) and the negative correlation for the highly proficient group (r=-0.194) is not statistically meaningful. This finding indicates that no statistically detectable difference exists between the correlation patterns of the two career stages within the limits of the present sample. The

weak or inverse relationships found in both correlation analyses are not distinct enough to suggest that one career stage's self-assessment bias is more or less pronounced than the others.

This result is highly important to note that, despite the use of objective measures such as the COT, the self-reported TPACK collection is of little use in predicting real competence, since the two measures are independent of each other. The evidence, thus, points to the need to base the valid assessments of instructional competence primarily on the objective tool (PMES-COT) and to ensure the proper ways of directing the professional development efforts.

Conclusion

This paper discovered that there existed a very evident discrepancy between the perceived confidence of mathematics teachers in their TPACK competence and their performance in the classroom. Both careers' stages of teachers were high in overall TPACK, which indicates a high level of professional self-efficacy, but no significant differences between proficient and highly proficient teachers were found. This implies that self-reported competence may, in most cases, be a measure of professional confidence as opposed to actual teaching mastery, which is in line with earlier studies of self-assessment bias.

According to classroom observations based on the PMES-COT, both groups were of a high-performing level, and no significant differences were found in objective performance across career stages. This implies that experience in itself may not make one classroom more effective than other classrooms and that although the PMES-COT can capture the overall teaching quality, it might not be able to capture subtle differences in high-level skills.

Lastly, the weak correlation in the self-reports of TPACK and performance as observed proves that there is a perception-practice gap. The belief held by teachers regarding their competence is not always accurate in determining the effectiveness of teachers in their practice. The results of these studies point to the importance of objective, performance-centered measures of teacher competence and professional growth to focus on. They also support the applicability of both TPACK and PCK frameworks, demonstrating that even experienced teachers might require specific assistance to help them to turn their knowledge into practical classroom activities.

This research has a number of limitations. First, perceived competence might be inflated by social desirability and self-assessment bias imposed by the use of self-reported TPACK measures. Second, the high PMES-COT ratings and minimal variability in scores indicate the possibility of a ceiling effect and the inability of the tool to identify subtle differences in instructional performance. Third, the unequal sample sizes, specifically the fewness of the highly proficient teachers, decrease the statistical power, especially in correlation and comparative studies. The findings should be viewed with these limitations to generalize the results and draw conclusions about the findings.

Recommendations

The following are recommended based on the findings of the study:

- **Mathematics Teachers:** A teacher is encouraged to undertake systematic reflection to appreciate the fact that self-reported TPACK competence is not always closely correlated with classroom performance. They are advised to engage in ongoing professional growth on the basis of practical, hands-on integration of technology, pedagogy, and content (TPACK) in mathematics teaching so that the high level of professional confidence would be reflected in practical gains to student learning outcomes.
- **School Heads and Instructional Supervisors:** Instructional leaders are recommended to take a diagnostic and focused approach to teacher support instead of using general COT scores. Through the combination of objective observation in the classroom and reflective personal assessment, supervisors can be able to identify specific areas of professional development, including offering less experienced teachers basic mentorship or veterans' complex guidance on how to adapt to changing digital tools.
- **Department of Education (DepEd):** It is suggested that the DepEd should also improve the PMES by institutionalizing self-assessment in the form of a low-stakes reflective element, as well as formal observation tools to assist their teachers in detecting internal blind spots in technology integration. Also, updating the COT rubric to emphasize more on the quality and depth of integrating technology in particular would more clearly identify the high-level competencies in the 21st century, and would help in more productive professional development planning.

- **Teacher Education and Professional Training Institutions:** Teacher training should be focused on application-based and practical learning, whereby teachers practically illustrate how to integrate technology, pedagogy, and content in a real classroom situation. Such focus makes sure that the theoretical competence that is acquired in training can be directly applied to real-life instructional contexts, in effect complying with training outcomes with national teaching requirements and teacher performance standards.
- **Future Researchers:** To make these results more generalizable, future studies should entail larger sample sizes that will be spread into various geographical divisions, as well as in the various areas of study, like Science and English. Moreover, it is suggested that the qualitative research should be conducted to identify the underlying psychological and environmental conditions that lead to high teacher confidence regardless of the observed performance levels, to get a better understanding of how self-perception is correlated with classroom performance.

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