

Technological Pedagogical Content Knowledge (TPACK) And Performance of Master Teachers

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Abstract — Integrating technology into basic education remains a pressing challenge, particularly in geographically isolated and disadvantaged areas (GIDA), where infrastructure and capacity limitations hinder effective implementation. Central to addressing this gap are Master Teachers, who act as instructional leaders and mentors in advancing digital literacy and pedagogical innovation. Guided by the Technological Pedagogical and Content Knowledge (TPACK) framework, this study examined the competencies of Master Teachers and assessed their effectiveness in mentoring peers on the use of technology in public elementary schools across the Pacific area of Northern Samar for the school year 2024–2025. Employing a descriptive-correlational research design, the study analyzed responses from Master Teachers and their mentees using structured surveys and Individual Performance Commitment and Review (IPCR) ratings. TPACK competencies were measured across seven domains—TK, CK, PK, PCK, TCK, TPK, and overall TPACK—alongside demographic and professional data such as age, sex, educational attainment, position, teaching experience, trainings attended, and IPCR performance. Results revealed high levels of self-assessed and peer-rated TPACK, with Technological Pedagogical Knowledge (TPK) and overall TPACK emerging as the strongest areas. Notably, IPCR ratings significantly correlated with TPACK levels, suggesting that performance metrics are better predictors of technological pedagogical competence than static demographic factors. These findings affirm the critical role of Master Teachers in fostering technology integration and instructional mentoring. The study recommends performance-informed professional development, peer coaching programs, and succession planning to strengthen digital leadership in schools and ensure the sustainability of innovative, tech-enhanced teaching practices.

Keywords — *TPACK Competencies, Master Teachers, Technology Integration, Mentoring Effectiveness, and Professional Development*

I. Introduction

This study investigated the Technological Pedagogical Content Knowledge (TPACK) competencies of Master Teachers in the Pacific Area of Northern Samar, Philippines, and their effectiveness in providing technology-related mentorship to colleagues. This research is crucial given the region's persistent low student performance, particularly in Science, as evidenced by various assessment results, and the broader challenges of digital transformation in geographically isolated areas. While previous studies affirmed TPACK's relevance, there was limited empirical research on how Master Teachers in underserved Philippine regions operationalized these

competencies for peer support and ICT integration. The study aimed to bridge this gap by assessing Master Teachers' self-reported and peer-evaluated competencies across TPACK domains (TK, PK, CK, TPK, TCK, PCK, and overall TPACK), while also considering demographic and professional variables. Although limited in scope to one geographic area and lacking longitudinal data or classroom observations, the findings are intended to provide evidence-based insights for developing targeted professional development initiatives and digital mentoring programs, ultimately contributing to Science education and digital readiness in disadvantaged schools.

Literature Review

The evolving demands of 21st-century education have significantly redefined the competencies required of teachers, especially those in leadership roles such as Master Teachers. Central to these evolving competencies is the Technological Pedagogical Content Knowledge (TPACK) framework, which offers a comprehensive model for understanding how teachers integrate technology into their pedagogical practices and subject content (Mishra & Koehler, 2006). As digital tools become increasingly embedded in instructional delivery, educators are expected not only to be proficient in their respective disciplines and in effective teaching strategies but also to skillfully incorporate technology to enhance student learning. For Master Teachers—tasked with mentoring colleagues, leading professional learning communities, and modeling best practices—the mastery of TPACK is particularly critical. Their performance in instructional leadership, capacity-building, and classroom innovation is intricately linked to their ability to harmonize technological, pedagogical, and content knowledge domains. This review of literature explores foundational and recent studies on the TPACK framework, its implications for teacher effectiveness, and the measurable impact of TPACK competencies on the performance of Master Teachers in diverse educational settings. The discussion also highlights gaps in current scholarship, particularly in relation to rural and under-resourced school contexts, where digital integration and instructional leadership face unique constraints and opportunities.

The "Conceptual Literature" section comprehensively reviews the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), positioning it as a cornerstone for 21st-century educator competencies, particularly for Master Teachers who serve as instructional leaders. Numerous recent empirical studies underscore TPACK's practical impact: Al-Dasouki (2025) found that TPACK-based interactive digital content significantly improves educational aids production skills and cognitive achievement in early childhood university students. Masfuah et al. (2024) demonstrated that Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) positively influence the overall TPACK of primary prospective teachers, suggesting targeted training benefits. Yang & Wei (2025) developed a reliable scale to assess the quality of teacher training programs through a TPACK lens, validating its utility.

Further research highlights the complex interplay of TPACK with other factors: Masry-Herzallah (2025) revealed that TPACK and technological self-efficacy are significant predictors

of online teaching effectiveness, with gender moderating these relationships, especially relevant during the COVID-19 pandemic. Adipat et al. (2023) emphasized that continuous professional development and reflective practices are crucial for enhancing TPACK. Studies by Elmaadaway & Abouelenein (2022) and Hindawi (2022) showcase TPACK's adaptability across diverse subjects like mathematics, science, English, and Arabic, improving teaching skills and attitudes. Mohammed (2024) and Al-Qahtani (2021) specifically illustrated that TPACK-based programs enhance digital content knowledge and creative teaching skills among pre-service and in-service science teachers, leading to improved student creative thinking and academic performance. Yildiz & Baltaci (2023) and ScienceDirect (2024) further reinforce TPACK's role as a model for effectively incorporating technology into teaching and learning, providing strategies for effective technology integration. Local studies in the Philippines, such as Academia (2023) in the Samar Division and Scribd (2021) in Northern Samar, acknowledge the importance of ICT integration but also identify significant barriers like limited resources and insufficient training. Petko et al. (2025) presented an updated TPACK model, reflecting its dynamic nature in response to technological advancements. Trust et al. (2021) and Teaching Commons (2023) collectively reaffirm that Master Teachers, with robust TPACK, are indispensable for leading technology-enhanced instruction and fostering a digitally competent teaching force. Rahayo (2023) and Özen & Kurtuluş (2023) also contribute by examining TPACK's application in elementary schools and its correlation with the use of digital assessment tools, respectively. In summary, collective literature strongly supports that continuous, TPACK-aligned professional development and reflective practices are vital for advancing the instructional leadership and mentoring capacities of Master Teachers in evolving educational landscapes.

Recent studies underscore the critical role of Technological Pedagogical Content Knowledge (TPACK) for Master Teachers, particularly in their capacity to provide technology-related assistance to colleagues, as exemplified by research in the Division of Taguig City and Pateros. The current study, which examines Master Teachers' TPACK competencies and their effectiveness in mentoring peers in technology integration, aligns with numerous international investigations into the TPACK framework across various educational levels and cultural contexts, while also highlighting its unique contributions. For instance, Aslam et al. (2021) affirmed the correlation between robust TPACK and professional effectiveness among university teachers in Pakistan, though their focus was on higher education and digital citizenship. Similarly, Voithofer and Nelson (2021) examined TPACK in U.S. teacher preparation programs, emphasizing its embedding in professional development, while the present study assesses the real-time application of TPACK by individual Master Teachers in public elementary schools.

Further distinctions are drawn with studies like Alhababi's (2017) Saudi-based research on classroom-level TPACK integration, which differed in scope and methodology by focusing exclusively on male English language teachers. In contrast, the current study utilizes quantitative data from Master Teachers across disciplines and genders in a public school context, assessing both self and peer evaluations. Mahmoudi, Rashtchi, and Abbasian (2017) provided insights into

in-service training's role in enhancing TPACK in Iran, but the present study emphasizes mentoring roles in K–12 settings and incorporates IPCR-based performance indicators instead of solely self-reported tools. Knapp (2017) explored the impact of TPACK-focused professional development on teacher self-efficacy among U.S. social studies teachers, offering a subject-specific and cultural contrast to the broader application of TPACK among Filipino Master Teachers in geographically isolated schools. Alhejoj (2020) examined the alignment between self-reported and observed TPACK among mathematics instructors in Jordanian community colleges, noting discrepancies similar to those the current research validates through multi-source evaluation, yet differing in academic level and subject specificity. While Hsu and Chen (2019) proposed the TLPACK model in Taiwan, expanding theoretical depth by integrating learner and contextual knowledge, the current study remains focused on the core TPACK framework to assess its mentoring and leadership applications within public basic education. Mohamed (2023) examined the correlation between TPACK components and mobile learning tool usage among U.S. virtual teachers, highlighting a gap in technology-focused teacher preparation similar to Northern Samar's challenges, but exclusively focusing on virtual classrooms. Wilson (2024) confirmed the importance of content-aligned professional development on TPACK growth, similar to the current study, but focused on general teacher populations rather than the mentoring performance of Master Teachers. Finally, Tracz (2022) applied TPACK in a non-traditional corporate training setting, affirming the necessity of structured professional development and reflective practices for effective technology integration, a principle that underpins the current study's focus. In synthesis, these studies collectively reinforce TPACK's significance for improving instructional quality; however, the present study offers a unique lens by focusing on Master Teachers in remote, under-resourced Philippine schools and incorporating both performance evaluation and peer assessment to understand the real-world application of TPACK in mentoring roles, an area still underrepresented in existing literature.

II. Methodology

This study utilized a descriptive-correlational research design (Creswell, 2014) to examine the Technological Pedagogical and Content Knowledge (TPACK) levels of Master Teachers and their effectiveness in providing technology-related assistance to colleagues in public elementary schools within the Pacific Area of Northern Samar during the 2024–2025 school year. The descriptive component profiled Master Teachers based on demographic and professional attributes, including age, sex, civil status, educational attainment, teaching position, years of teaching experience, and Individual Performance Commitment and Review (IPCR) ratings. TPACK competencies were assessed across seven domains—Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and integrated TPACK—using both self-evaluations and peer assessments, aligning with Mishra and Koehler's (2006) framework. Additionally, the analysis included performance indicators from

Master Teachers' IPCRs, specifically their effectiveness in promoting the positive use of ICT and providing ICT-based teaching and learning resources, consistent with DepEd's appraisal standards (Department of Education, 2022).

III. Results and Discussion

Profile of Master Teachers

As to the age distribution of the respondents, it indicates that the teaching workforce is largely composed of mid- to late-career educators, with 58.9% falling between 45 and 56 years old. This suggests a stable and experienced cohort capable of contributing to instructional quality and mentoring novice teachers, as highlighted by Bayani and Lingat (2022). However, the prevalence of older educators also implies an impending need for succession planning and strategic capacity-building to prepare for retirements and institutional continuity. Complementing this demographic is the workforce's significant female majority (83.9%), reflecting national patterns in the feminization of teaching in the Philippines (PSA, 2023). While this trend underscores the strong role of women in education, it also reinforces the need for gender-responsive leadership training to foster inclusive decision-making and equitable educational practices (UNESCO, 2022). In terms of civil status, the predominance of married teachers (85.7%) raises concerns about work-life balance. Llego (2021) emphasized that marital responsibilities can intersect with professional obligations, influencing stress levels and job performance—thus highlighting the importance of institutional wellness policies.

Highest educational attainment among respondents reveals a commitment to continuous professional growth, with 78.6% pursuing graduate education and 21.4% having completed a Master's degree. This aligns with DepEd's call to strengthen teachers' academic credentials to enhance instructional competence (DepEd Order No. 66, s. 2007), and echoes Garcia and Mateo's (2022) recommendation for stronger institutional support mechanisms like scholarships and study leaves. Regarding professional positions, the teaching force is notably composed of seasoned Master Teachers—67.9% are Master Teacher I, 26.8% Master Teacher II, and 5.4% Master Teacher III. This distribution suggests a high level of pedagogical leadership and research engagement, consistent with the standards outlined in DepEd Order No. 42, s. 2007. Tuaño and Dizon (2021) affirm that the presence of Master Teachers enhances peer mentoring and innovation in curriculum implementation, fostering a culture of excellence. Furthermore, the respondents demonstrate deep teaching experience, with over 70% having served more than two decades in the profession. According to Salandanan (2021), such longevity often translates into adaptive teaching and institutional loyalty, although it necessitates continuous digital upskilling in today's tech-driven educational landscape (OECD, 2023).

Professional development is evidently a strong feature among respondents, with 85.7% having attended three or more training programs. This level of engagement is aligned with the

Continuing Professional Development (CPD) Act of 2016 (RA 10912), which promotes lifelong learning and the adoption of innovative teaching practices (Bautista et al., 2023). These CPD efforts are reinforced by high individual performance, as shown by the 92.9% of teachers who received an Individual Performance Commitment and Review (IPCR) rating between 4.21 and 5.00. While this reflects a commendable level of commitment and effectiveness, Manzano and Dela Cruz (2022) caution that reliance solely on administrative evaluations may introduce biases; hence, they advocate for a triangulated performance review system incorporating peer and student feedback. Taken together, the profile paints a picture of a dedicated, competent, and development-oriented teaching workforce. However, these strengths must be supported by responsive policies focusing on gender inclusivity, digital transformation, and balanced professional wellbeing to sustain quality education in the evolving academic context.

Level of Technological Pedagogical and Content Knowledge (TPACK) of master teachers as assessed by themselves and the teachers under their supervision

Across all domains—Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and overall TPACK—both groups rated themselves as "Highly Knowledgeable" (HK), with mean scores consistently between 4.20 and 5.00. This suggests a strong self-perception of instructional competence and digital literacy among educators, aligning with findings by Mishra and Koehler (2006), who emphasize that the integration of technology, pedagogy, and content is critical for 21st-century teaching effectiveness.

In the domain of Technology Knowledge (TK), master teachers rated themselves slightly higher ($M=4.929$) than the teachers they supervise ($M=4.425$), which could reflect their greater exposure to professional development opportunities or leadership roles in technology integration. This supports the assertion by Koehler et al. (2014) that seasoned educators with sustained engagement in digital pedagogy often demonstrate higher self-efficacy in handling emerging technologies. Likewise, both groups reported strong Content Knowledge (CK) in core subjects like Mathematics, Science, Literacy, and Social Studies, with master teachers consistently rating themselves higher. Notably, the highest rating for master teachers ($M=5.000$) was in "having various ways and strategies of understanding science," suggesting a deep disciplinary expertise, which is a cornerstone of effective teaching (Shulman, 1986).

Interestingly, the TPACK dimension itself, which synthesizes all subdomains, yielded high mean scores: master teachers ($M=4.839-4.929$) and teachers ($M=4.747-4.959$). These findings underscore the system's readiness for integrated, technology-enhanced instruction, a critical demand in post-pandemic education (Trust & Whalen, 2020). The minimal differences between the ratings of master teachers and their supervisees suggest that collaborative learning environments and mentoring may be contributing to a shared culture of instructional innovation. However, while self-ratings reflect confidence, studies caution that self-perceptions may not

always align with actual classroom practices (Voogt et al., 2015). Hence, triangulating these results with classroom observations or student achievement data is recommended to validate the application of TPACK in authentic learning contexts.

Level of Effectiveness of the Master Teachers in Providing Technology – Related Assistance to Colleagues as Stated in their IPCR Rating

The two focus areas are (1) Positive Use of ICT and (2) Teaching and Learning Resources Including ICT. A majority of the master teachers received Outstanding ratings in both areas, with 66.1% rated Outstanding for Positive Use of ICT, and 62.5% for Teaching and Learning Resources, indicating a high level of competence and support extended to peers in integrating technology in instruction.

These findings align with the TPACK framework (Mishra & Koehler, 2006), which emphasizes that technological knowledge must be shared and contextualized within pedagogical and content expertise to be most impactful. The high performance ratings suggest that master teachers are not only knowledgeable but are also effectively mentoring their colleagues in applying digital tools for instruction, which is a vital aspect of distributed leadership (Harris, 2014). This mentoring role strengthens the school's capacity to build collective teacher efficacy—a proven predictor of student achievement (Hattie, 2018).

The "Outstanding" performance of 66.1% in the area of Positive Use of ICT illustrates that a significant number of master teachers go beyond individual competence to model and promote responsible, effective, and ethical use of digital tools among their peers. This behavior resonates with ISTE Standards for Coaches (ISTE, 2022), which emphasize the importance of empowering educators through modeling and collaboration.

Similarly, the 62.5% Outstanding rating in the use of ICT-related teaching and learning resources indicates that master teachers are actively involved in curating, developing, or introducing technology-enhanced learning materials. This reflects the shift toward instructional leadership, wherein teacher-leaders like master teachers not only teach but also influence school-wide practices and professional development (Leithwood et al., 2020).

Furthermore, the remaining teachers rated as "Very Satisfactory" (33.9% and 37.5%, respectively) still demonstrate strong performance, suggesting that while there is room for growth, the overall effectiveness of master teachers is commendable. This speaks to a mature professional culture within the schools—one that fosters continual learning, adaptation, and digital transformation (Trust & Whalen, 2020). To maximize the impact of this group, schools could consider more structured peer-coaching programs or Professional Learning Communities (PLCs) led by these master teachers, which are shown to enhance teacher capacity and student outcomes (Darling-Hammond et al., 2017).

Test of Relationship Between the Profile of the Respondents and Their Level Technological Pedagogical and Content Knowledge (TPACK) of Master Teachers

The correlation analysis which revealed that among the various demographic and professional factors—such as age, sex, civil status, educational attainment, position, years of experience, and trainings attended—only the Individual Performance Commitment and Review (IPCR) rating exhibited a statistically significant relationship with the level of Technological Pedagogical and Content Knowledge (TPACK) among master teachers. Specifically, the correlation coefficient ($r = 0.413$, $p = 0.002$) indicates a moderate positive relationship, suggesting that higher IPCR ratings are associated with stronger TPACK competence. This finding suggests that performance-based indicators, rather than personal or background characteristics, are more predictive of a teacher's capacity to integrate technology effectively in instruction.

The significant relationship between IPCR ratings and TPACK supports existing literature that links teaching effectiveness and professional growth with the integration of pedagogical and technological skills. As highlighted by Chai et al. (2020) and Koehler et al. (2013), teachers who excel in their overall instructional performance also tend to demonstrate deeper integration of content, pedagogy, and technology. IPCR ratings, which assess areas such as innovation, collaboration, and student outcomes, reflect many of the same competencies inherent in TPACK. In contrast, variables like age, gender, civil status, or even the number of trainings attended were not significantly correlated with TPACK levels, affirming the view that competence in technology-enhanced teaching arises more from intentional professional practice than from personal background or formal qualifications (Mishra & Koehler, 2006; Teo, 2019).

These findings have important implications for teacher development. Rather than focusing on demographic factors, schools and education systems should prioritize performance-based assessments and reflective practices to support teachers' growth in TPACK. IPCR ratings can serve not only as evaluative tools but also as indicators to identify teacher leaders who can mentor peers in technology integration. Furthermore, training programs should go beyond passive participation, ensuring that professional development includes meaningful application, coaching, and contextualized feedback (Angeli & Valanides, 2020). In sum, enhancing TPACK in the teaching force requires targeted, performance-informed strategies that support ongoing and practice-based learning.

Test of Relationship Between the Profile of the Respondents and Their Level Effectiveness of the Master Teachers in Providing Technology – Related Assistance as Stated in their IPCR Rating

The strong negative correlation between experience and ICT use ($r = -0.806$) is particularly striking. This finding suggests that more experienced master teachers may be less likely to engage in ICT-related assistance to colleagues, possibly due to generational gaps in digital fluency or resistance to adopting new technologies. This supports the argument by Howard et al. (2021), who found that younger educators or those newer to the profession often exhibit greater ease and

willingness to integrate digital tools into teaching practices. It also aligns with findings by Teo (2019), who emphasizes that age and length of service can sometimes correlate inversely with digital self-efficacy. Thus, this result highlights the importance of targeted interventions to support experienced educators in developing ICT confidence and capabilities.

Conversely, a positive and significant relationship was found between the number of trainings attended and ICT use, indicating that teachers who participate in more training programs tend to be more effective in assisting others with technology. This confirms the research of Angeli and Valanides (2020), who underscore the role of sustained professional development in enhancing teachers' TPACK and digital teaching effectiveness. However, the lack of significant correlation between training and the use of teaching and learning resources suggests that mere attendance in ICT-related training may not automatically translate to broader instructional support unless applied meaningfully. Additionally, the significant positive correlation between IPCR ratings and the use of teaching and learning resources ($r = 0.358, p = 0.007$) suggests that master teachers who perform well overall are more likely to be effective in supporting colleagues' access to and utilization of instructional materials. This reflects studies by Chai et al. (2020), which indicate that performance excellence often encompasses technology facilitation, collaboration, and the promotion of digital learning tools.

IV. Conclusion

1. Based on the demographic and professional profiles of Master Teachers, the study concluded that the elementary teaching workforce in the Pacific Area of Northern Samar is composed of academically committed and professionally seasoned individuals, predominantly female, with strong engagement in graduate education and ICT-related training. This highlights a robust institutional culture of lifelong learning and leadership readiness. However, it also suggests the need for gender-sensitive succession planning and supportive strategies to help educators balance professional advancement with personal responsibilities.
2. The consistently high self- and peer-assessed levels of Technological Pedagogical and Content Knowledge (TPACK) among Master Teachers indicate their substantial readiness to integrate technology into pedagogical and content-specific contexts. The slightly higher self-ratings suggest a strong sense of self-efficacy in digital instruction. The conclusion emphasizes the value of sustaining and validating these competencies through performance-based assessments, classroom observations, and learner outcomes to ensure authenticity in TPACK application.
3. The IPCR-based performance results confirmed that Master Teachers effectively facilitated technology-related assistance in their schools, particularly in promoting the use of ICT and developing digital learning materials. This validates their pivotal role as

instructional mentors and innovation leaders. The conclusion affirms the strategic importance of institutionalizing their role in school-based technology integration through formal recognition, structured mentoring programs, and ongoing resource support.

4. The finding that professional characteristics—such as ICT training and IPCR ratings—correlated significantly with higher TPACK levels led to the conclusion that competence in digital pedagogy is more strongly influenced by performance and continuous professional development than by fixed demographic attributes. This supports the prioritization of training-focused and outcome-driven approaches in enhancing the digital teaching capacities of Master Teachers.
5. The established relationship between professional background and the effectiveness of Master Teachers in providing technology-related assistance underscores the importance of investing in capacity-building programs tailored to their leadership responsibilities. The conclusion reinforces the need for differentiated, needs-based professional development and coaching systems that empower Master Teachers to lead digital transformation initiatives in their respective school communities.

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