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Mediating Role of Technological Pedagogical Content Knowledge (TPACK) in the Relationship between Teacher Self-Efficacy and Instructional Effectiveness

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Abstract- ***This study determined the mediating role of Technological Pedagogical Content Knowledge (TPACK) in the relationship between teacher self-efficacy and instructional effectiveness among elementary teachers in the Third Congressional District, Schools Division of Camarines Sur, for the School Year 2025–2026. A descriptive-correlational-comparative design with mediation analysis was employed. Data were gathered from 117 elementary teachers through total enumeration using an adapted and expert-validated questionnaire. Statistical analyses included weighted mean, Pearson Product-Moment Correlation, simple linear regression, and bias-corrected bootstrapping for mediation analysis. Teachers demonstrated an extremely high level of TPACK, a very high level of self-efficacy, and very high instructional effectiveness. Self-efficacy significantly predicted instructional effectiveness, indicating that teachers with greater confidence in their teaching capabilities exhibited higher levels of instructional performance. TPACK significantly and partially mediated the relationship between self-efficacy and instructional effectiveness, demonstrating that teachers' confidence translated into more effective classroom practice through their competence in integrating technology, pedagogy, and content. The findings suggest that sustaining very high instructional effectiveness requires not only strong teacher self-efficacy but also well-developed Technological Pedagogical Content Knowledge (TPACK). Based on the findings, Project B.R.I.D.G.E. (Building Resilient Instruction, Digital Growth, and Empowerment) was developed as a structured professional development program to enhance teachers' TPACK and self-efficacy, thereby improving instructional effectiveness.***

Keywords: TPACK, Teacher Self-Efficacy, Instructional Effectiveness, Mediation Analysis, Technology Integration

I. INTRODUCTION

The rapid advancement of digital technologies has transformed educational systems, requiring teachers to effectively integrate technology, pedagogy, and content to improve instructional quality. As technology-enhanced learning environments become increasingly prevalent, teachers are expected to demonstrate not only strong content and pedagogical knowledge but also the competence and confidence to utilize digital tools that foster learner engagement and achievement. Despite the growing availability of educational technologies, many teachers continue to encounter challenges in integrating these resources into classroom practice, underscoring the need to strengthen both technological competence and teacher self-efficacy.

Technological Pedagogical Content Knowledge (TPACK), teacher self-efficacy, and instructional effectiveness are widely recognized as essential dimensions of teacher competence. TPACK enables teachers to integrate technology, pedagogy, and content knowledge in designing meaningful learning experiences (Mishra & Koehler, 2006), while teacher self-efficacy reflects teachers' beliefs in their capability to organize and execute instructional tasks successfully (Bandura, 1977). Teachers with higher self-efficacy are more likely to adopt innovative instructional strategies, integrate educational technologies, and sustain effective teaching practices that enhance learner engagement and academic achievement (Lazarides & Warner, 2020; Zee & Koomen, 2016). Consequently, TPACK may serve as a mechanism through which teachers' confidence is translated into effective instructional practice.

International and national educational frameworks reinforce the importance of these competencies. The UNESCO ICT Competency Framework for Teachers, the OECD Education 2030 Framework, and the ISTE Standards emphasize technology integration, digital competence, and learner-centered instruction as

foundations of quality education (ISTE, 2017; OECD, 2019; UNESCO, 2018). Likewise, Sustainable Development Goal 4 (SDG 4) calls for inclusive and equitable quality education through strengthened teacher competence and improved learning environments (United Nations, 2015). In the Philippines, the Philippine Professional Standards for Teachers (PPST), DepEd Memorandum No. 008, s. 2023, and the MATATAG Curriculum further promote technology integration and the development of teachers' digital capabilities to improve instructional quality.

At the local level, public elementary schools in the Third Congressional District of Camarines Sur continue to experience challenges in technology integration despite ongoing government initiatives. School records and monitoring reports indicate concerns related to limited ICT resources, shared digital facilities, infrastructure constraints, and the continuing need for professional development in technology integration. These conditions may affect teachers' confidence and their ability to deliver effective technology-supported instruction, emphasizing the need to examine factors that contribute to instructional effectiveness within the local educational context.

Despite these initiatives, public elementary schools in the Third Congressional District of Camarines Sur continue to face challenges, including limited ICT resources, shared digital facilities, infrastructure constraints, and the need for continuous professional development in technology integration. Although previous studies have established significant relationships among TPACK, teacher self-efficacy, and instructional effectiveness, limited evidence explains how teacher self-efficacy influences instructional effectiveness through TPACK, particularly in the Philippine elementary school context. Therefore, this study examined the mediating role of TPACK in the relationship between teacher self-efficacy and instructional effectiveness among elementary teachers in the Third Congressional District of Camarines Sur. The findings provide empirical evidence for developing professional development programs that enhance teachers' technological competence, instructional confidence, and overall instructional effectiveness.

II. RESEARCH OBJECTIVES

This study determined the mediating role of Technological Pedagogical Content Knowledge (TPACK) in the relationship between perceived self-efficacy and instructional effectiveness of elementary teachers in the Third Congressional District, Schools Division of Camarines Sur. Specifically, this study investigated the following objectives:

1. To assess the level of teachers' Technological Pedagogical Content Knowledge (TPACK) in terms of Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK).
2. To measure the level of teachers' self-efficacy in terms of teaching experience, school environment, and training and support.
3. To determine the level of teachers' instructional effectiveness in terms of planning of the lesson, classroom management, delivery of instruction, and learner outcomes.
4. To determine the direct predictive power of teachers' self-efficacy on their perceived instructional effectiveness.
5. To determine the mediating role of Technological Pedagogical Content Knowledge (TPACK) in the relationship between teachers' self-efficacy and their perceived instructional effectiveness, while controlling for the demographic variables of sex and grade level taught.
6. To design an intervention program based on the findings of the study to enhance the Technological Pedagogical Content Knowledge (TPACK) and self-efficacy of elementary teachers.

III. METHODOLOGY

Research Design

This study employed a quantitative nonexperimental descriptive-correlational research design with predictive and mediation analyses to examine the relationships among teacher self-efficacy,

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Technological Pedagogical Content Knowledge (TPACK), and instructional effectiveness. The descriptive approach determined the levels of the study variables, the correlational approach examined their relationships, regression analysis determined the predictive influence of teacher self-efficacy on instructional effectiveness, and mediation analysis evaluated the mediating role of TPACK

Respondents of the Study

The respondents were 117 permanent public elementary school teachers from seven selected schools in the Third Congressional District, Schools Division of Camarines Sur, during the School Year 2025–2026. Purposive sampling was employed to select the participating schools, while total enumeration was used to include all teachers who satisfied the inclusion criteria. Sex and grade level taught were treated as control variables in the mediation analysis.

Research Instrument

Data were gathered using an adapted and validated questionnaire consisting of three sections: (1) TPACK adapted from Schmidt et al. (2009), (2) teacher self-efficacy adapted from the Teachers' Sense of Efficacy Scale (Tschannen-Moran & Hoy, 2001), and (3) instructional effectiveness based on the Philippine Professional Standards for Teachers (PPST) and the Classroom Observation Tool (COT). The instrument underwent expert validation and pilot testing before administration to ensure content validity, clarity, and reliability.

The study utilized a four-point Likert scale to measure the respondents' perceptions.

Scale	Range	TPACK	Self-Efficacy	Instructional Effectiveness
4	3.26–4.00	Extremely Knowledgeable	Very High Self-Efficacy	Very Highly Effective
3	2.51–3.25	Very Knowledgeable	High Self-Efficacy	Highly Effective
2	1.76–2.50	Moderately Knowledgeable	Moderate Self-Efficacy	Moderately Effective
1	1.00–1.75	Not Knowledgeable	Low Self-Efficacy	Least Effective

Procedure of the Study

After obtaining the necessary institutional approvals, the researcher adapted and validated the research instrument through expert review and pilot testing. Upon approval from the Schools Division Office and school heads, the questionnaires were personally administered to the teacher-respondents from the selected public elementary schools in the Third Congressional District of Camarines Sur. Respondents were informed of the study's purpose and were provided with instructions before completing the questionnaire. After retrieval, all responses were validated for completeness, encoded, organized, and subjected to statistical analysis.

Ethical Considerations

Ethical standards were strictly observed throughout the conduct of the study. Informed consent was obtained from all participants prior to data collection, and participation was entirely voluntary. The confidentiality and anonymity of the respondents were maintained by ensuring that no identifying information was disclosed and that all collected data were used solely for research purposes. Artificial intelligence tools, including ChatGPT, Copilot, and Gemini, were used only as research support tools. All AI-assisted outputs were carefully verified against original academic sources, and the researcher assumed full responsibility for the accuracy, integrity, and originality of the manuscript.

Data Analysis Technique

The gathered data were analyzed using weighted mean to determine the levels of TPACK, teacher self-efficacy, and instructional effectiveness; Pearson Product-Moment Correlation to determine the relationships among the variables; simple linear regression and ANOVA to determine the predictive influence of teacher self-efficacy on instructional effectiveness; and bias-corrected bootstrapped

mediation analysis (5,000 resamples) to examine the mediating role of TPACK. Robust estimation procedures were employed to address the non-normal distribution of the data.

IV. RESULTS AND FINDINGS

This part presents, analyzes, and interprets the data gathered in the study to address the research problems. It allows the researcher to draw meaningful insights and implications for professional practice. The results are organized in accordance with the specific research questions of the study.

Level of Teachers' Technological Pedagogical Content Knowledge (TPACK)

The assessment of teachers' Technological Pedagogical Content Knowledge (TPACK) provided a comprehensive understanding of their capacity to synthesize technology, pedagogy, and content within their instructional delivery. These competencies were considered essential for orchestrating effective and meaningful learning experiences that met the demands of modern classrooms. Table 1 detailed the level of teachers' TPACK across its various interconnected domains, highlighting the multi-dimensional nature of their professional expertise.

Table 1. Summary of Teachers' Technological Pedagogical Content Knowledge (TPACK)

Domain	Mean	Interpretation	Rank
Technological Knowledge	3.11	Very Knowledgeable	6
Content Knowledge	3.46	Extremely Knowledgeable	1
Pedagogical Knowledge	3.43	Extremely Knowledgeable	2
Pedagogical Content Knowledge	3.42	Extremely Knowledgeable	3
Technological Content Knowledge	3.26	Extremely Knowledgeable	5
Technological Pedagogical Knowledge	3.29	Extremely Knowledgeable	4
Overall	3.33	Extremely Knowledgeable	

Note. (EK = Extremely Knowledgeable; (VK) = Very Knowledgeable; (MK) = Moderately Knowledgeable (NK) = Not Knowledgeable. The scale used was. 1.00-1.75- Not Knowledgeable (NK); 1.76-2.50- Moderately Knowledgeable (MK); 2.51-3.25- Very Knowledgeable (VK); 3.26 -4.00 - Extremely Knowledgeable (EK).

The consolidated results of the various domains of teachers' Technological Pedagogical Content Knowledge (TPACK) revealed a distinct hierarchy of competence. The highest indicator reported was Content Knowledge (CK), with a weighted mean of 3.46, interpreted as Extremely Knowledgeable. This was closely followed by Pedagogical Knowledge (PK) at 3.43 and Pedagogical Content Knowledge (PCK) at 3.42, both signifying an Extremely Knowledgeable level of proficiency. Conversely, the lowest indicator was Technological Knowledge (TK), which obtained a mean of 3.11, reflecting a Very Knowledgeable status. Despite this relative dip in the technical domain, the overall average weighted mean across all TPACK domains was 3.33, resulting in a general interpretation of Extremely Knowledgeable.

The results showed that teachers possessed a profound mastery of the core components of teaching, as evidenced by their high levels of Content Knowledge (CK), Pedagogical Knowledge (PK), and Pedagogical Content Knowledge (PCK). This was reflected in their sustained classroom exposure and continuous curriculum implementation, which had strengthened their mastery of subject matter and pedagogical delivery. Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) also received high ratings, indicating that teachers effectively integrated technology when aligned with structured instructional goals. However, a comparatively lower performance was observed in integrating multiple knowledge domains simultaneously, reflecting the inherent complexity and increased cognitive load of balancing content, pedagogy, and technology in instruction. Technological Knowledge (TK) received the lowest rating, which was associated with limited hands-on training with advanced tools or fewer opportunities

for technical upskilling. This demonstrated that teachers were more accustomed to utilizing technology as a supplementary support tool rather than as a standalone digital skill set.

Based on these findings, it was inferred that teachers had established a strong professional identity rooted in traditional pedagogical and content expertise. Their high scores in PCK evidenced that they were not only subject experts but were also highly skilled in translating complex information into teachable forms. However, the decrease in scores as technology was introduced signaled a surge in cognitive demand when merging digital tools with established teaching practices. It was further deduced that while teachers were highly knowledgeable in theoretical and pedagogical domains, their technological proficiency remained functional in nature. This underscored a state of pedagogical primacy, where technology was utilized primarily as a support mechanism within instruction rather than as a central, transformative component of teaching practice.

These findings aligned with the study of Bebis (2025), who emphasized that even when educators were pedagogically prepared, their actual readiness to utilize technology was often hindered by a lag in foundational digital skills and specialized technical knowledge. Similarly, Basargekar and Singhavi (2017) observed that while teachers might have been proficient in traditional instruction, their perceived ICT competence was frequently lower, a condition often exacerbated by a lack of robust institutional support systems. Conversely, these results could be contrasted with studies suggesting that high pedagogical mastery could sometimes compensate for lower technical proficiency, indicating that teachers prioritized functional instructional use over deep, independent technological experimentation. These contrasting perspectives imply that while pedagogical expertise remains a critical strength, sustained technological competence requires continuous skills development and adequate institutional support. Therefore, schools and educational leaders should prioritize technology-focused professional development programs that enhance teachers' confidence and proficiency in integrating digital tools effectively into classroom instruction.

These findings were further supported by the Constructivist Learning Theory (Piaget, 1970; Vygotsky, 1978; as cited in Trinidad & Despojo, 2025), which maintained that learning was an active, learner-centered process optimized through targeted guidance within the Zone of Proximal Development (ZPD). In the context of technological integration, teachers' growth was enhanced through structured training, peer mentoring, and collaborative support systems. However, the findings also revealed that without sustained institutional scaffolding, teachers' competencies could stagnate at basic functional use rather than progress toward transformative integration. This suggests that the gap between teachers' current expertise and their potential to master advanced digital tools may widen in the absence of systemic support. These findings affirmed Vygotsky's view that while teachers possess a strong foundation, achieving full digital mastery depends on a supportive professional environment rather than individual effort alone. Thus, continuous professional development and collaborative learning opportunities remain essential for strengthening teachers' technological pedagogical competencies. Ultimately, sustained institutional support enables teachers to integrate technology more effectively, thereby enhancing instructional quality and improving learner outcomes.

Level of Teachers' Self-Efficacy in terms of Teaching Experience, School Environment and Training and Support

The development of pedagogical mastery among educators is deeply rooted in their belief in their own instructional capabilities. Understanding the level of teachers' self-efficacy across various external and internal factors is essential, as these elements collectively define the quality of classroom delivery and student engagement. Table 2 presents the level of teachers' self-efficacy in terms of teaching experience, school environment, and training and support.

Table 2. Summary of Teachers' Self-Efficacy in terms of Teaching Experience, School Environment and Training and Support

Domains	AWM	Interpretation	Rank
Teaching Experience	3.49	VHSE	1
School Environment	3.45	VHSE	3
Training and Support	3.48	VHSE	2
Overall Average Weighted Mean	3.47	Very High Self-Efficacy	

Note. VHSE=Very High Self-Efficacy; HSE=High Self-Efficacy; MSE=Moderate Self-Efficacy; LSE=Low Self-Efficacy. The Scale use was: 1.00-1.75 (LSE); 1.76-2.50 (MSE); 2.51-3.25 (HSE); 3.26-4.00 (VHSE).

The cumulative assessment of teachers' self-efficacy across the dimensions of Teaching Experience, School Environment, and Training and Support revealed varying levels of confidence among the respondents. Within this framework, Teaching Experience recorded the highest mean score of 3.49, interpreted as Very High Self-Efficacy, followed by Training and Support rated 3.48, also Very High Self-Efficacy. The School Environment dimension yielded the lowest mean score of 3.45, though it remained within the Very High Self-Efficacy. Collectively, the aggregate weighted mean of 3.47 indicates a high and consistent level of self-efficacy among the respondents, which is interpreted as Very High Self-Efficacy.

The collective results indicated that teachers' sense of professional worth was most heavily anchored in their direct pedagogical history rather than external facilitators, which was associated with the years of tacit knowledge and practical wisdom gained through classroom immersion. This validated a resilient professional identity where personal mastery served as the primary engine for instructional confidence. While the scores for training and environment remained high, the relative lead of teaching experience suggested that personal, battle-tested strategies were perceived as more reliable than institutional protocols. Hence, the slightly lower position of the school environment score was likely due to persistent systemic pressures, such as administrative workload; although managed well by the faculty, these factors remained less of a confidence booster than individual professional growth.

Based on these findings, it was inferred that the participating educators possessed a self-reliant professional outlook, primarily valuing their own pedagogical journey as their greatest asset. By prioritizing experiential knowledge, they demonstrated a capacity to maintain high standards of instruction even when external variables were in flux. It was further inferred that while the school provided a conducive atmosphere, the teachers' internal drive and accumulated expertise were the primary forces sustaining the quality of student learning. Therefore, it was concluded that the next phase of professional growth should shift from providing general institutional support to creating platforms that institutionalize teacher expertise, ensuring that individual mastery became a shared environmental strength.

The findings are supported by Khong, Luan, and Ayub (2017), who reported that teacher self-efficacy is a significant determinant of instructional practices, particularly in the consistent organization of teaching tasks. This supports the high results in Teaching Experience, where teachers demonstrated a strong ability to manage instruction and maintain order. Similarly, Masooma Al-Mutawah (2022) demonstrated that teachers with strong self-efficacy are better equipped to implement innovative strategies despite environmental challenges, validating the high scores observed in the Training and Support category. Conversely, Buabeng-Andoh (2019) explains that although teachers may possess adequate competencies, a lack of strong institutional support and pedagogical grounding often limits the full integration of complex instructional strategies. This negates the idea of universal efficacy across all dimensions and is reflected in the slightly lower mean for School Environment. This indicates that while teachers are confident in applying learned strategies, continuous reinforcement and stronger institutional backing remain essential to maximize instructional

effectiveness. The evidence further underscores the need for schools to strengthen supportive policies, collaborative professional learning, and access to instructional resources to reinforce teachers' self-efficacy and sustain high-quality teaching practices.

Finally, this is anchored in Bandura's Self-Efficacy Theory (1977), as cited by Burić et al. (2024), which posits that individuals' beliefs in their capabilities fundamentally influence their motivation, behavior, and performance. This theory serves as the foundation for understanding how teachers internalize their professional successes and setbacks to form a stable sense of competence. In this study, the high levels of teacher self-efficacy across all dimensions reflected a strong internal belief in the ability to successfully manage instructional tasks and adapt to classroom challenges. This demonstrated that when teachers possessed high efficacy, they were more likely to persist through pedagogical obstacles and maintain a high standard of teaching effectiveness even under pressure. Consequently, this theoretical alignment confirmed that professional confidence acted as the primary catalyst for instructional innovation, transforming individual potential into measurable educational excellence.

Level of Teachers' Instructional Effectiveness

Teachers demonstrate varying levels of instructional effectiveness in terms of planning of the lesson, classroom management, delivery of instruction, and learner outcomes. These competencies are essential in ensuring quality teaching and improved student performance in the classroom.

Table 3 detailed the comprehensive assessment of teachers' instructional effectiveness across the domains of Planning, Classroom Management, Delivery of Instruction, and Learner Outcomes. Within this framework, Planning of the Lesson emerged as the primary domain with the highest mean score of 3.64, interpreted as Very Highly Effective. Other indicators exhibited similarly strong results, including Delivery of Instruction with a score of 3.63, and Learner Outcomes at 3.59, all of which fell within the same qualitative description of Very Highly Effective. Conversely, Classroom Management registered the lowest mean score of 3.57, but this was still interpreted as Very Highly Effective. Collectively, the average weighted mean of 3.63 indicated a consistently high level of instructional effectiveness.

Table 3. Summary of Teachers' Instructional Effectiveness

Domains	AWM	Interpretation	Rank
Planning of the Lesson	3.64	VHE	1
Classroom Management	3.57	VHE	4
Delivery of Instruction	3.63	VHE	2
Learner Outcomes	3.59	VHE	3
Overall Average Weighted Mean	3.61	Very Highly Effective	

Note. VHE=Very Highly Effective; HE=Highly Effective; ME= Moderately Effective; LE=Least Effective. The scale used was: 1.00-1.75 (LE); 1.76-2.50 (ME); 2.51-3.25 (HE); 3.26-4.00 (VHE).

The results revealed that teachers demonstrated high instructional effectiveness across all domains, signifying a strong and balanced teaching performance. Planning of the Lesson emerged as the strongest domain, suggesting that teachers place significant emphasis on preparation and structuring as the foundation of instruction. Delivery of Instruction closely followed, reflecting the effective implementation of planned activities and teaching strategies. Learner Outcomes, while slightly lower in comparison, still indicated that students generally achieved expected learning targets. Classroom Management, despite being the lowest among the domains, remained at a highly effective level, showing that order and discipline were consistently maintained. These slight variations across domains may be attributed to differences in instructional priorities, where greater focus is given to lesson preparation and delivery, or to contextual classroom conditions that influence management approaches.

The findings implied that teachers were highly effective in planning and delivering instruction,

ensuring that lessons were well-structured and properly implemented in the classroom. The consistently high ratings across all domains indicated strong instructional competence and a stable level of performance in achieving teaching objectives. However, the slightly lower ratings in Classroom Management and Learner Outcomes indicated that maintaining classroom order and consistently maximizing student achievement varied depending on classroom conditions and learner behavior. This was gleaned from the small variations in the mean scores across the different instructional domains, where preparation and delivery were slightly prioritized over management and outcome optimization. In essence, while teachers demonstrated strong and balanced instructional effectiveness, there was still a need to further strengthen classroom management strategies and enhance practices that directly improved learner outcomes to ensure more consistent and holistic instructional success.

This high perceived competence aligns with Stronge (2018), who viewed instructional quality as a product of integrated planning and delivery, a connection reflected in the high marks teachers reported in both domains. Furthermore, high delivery ratings parallel Arroyo (2022) and Baccay (2023), who noted that contemporary teaching relies on interactive, technology-supported continuity, validating teachers' confidence in maintaining instructional momentum. These results suggest teachers leverage pedagogical foundations for student-centered strategies a transition Valtonen et al. (2017) identified as a hallmark of advanced competence, matching the highly competent baseline observed across all areas. However, Scherer, Howard, and Tondeur (2021) countered that while general delivery self-reports may be high, advanced strategies like differentiation and Higher-Order Thinking Skills (HOTS) require specialized professional development. This implies that perceived effectiveness might not fully capture actual instructional innovation, suggesting these favorable self-reports be interpreted with caution regarding complex classroom execution.

The results are also aligned with Bandura's Self-Efficacy Theory (1977), as cited by Burić et al. (2024), which maintains that teachers' beliefs in their instructional capabilities significantly influence their classroom behaviors and pedagogical choices. Educators with strong self-efficacy are more likely to engage learners actively and sustain positive interactions even within complex environments. This clarifies that the reported effectiveness in instructional delivery is rooted in the teachers' high level of confidence in their teaching roles. However, the relatively lower rating in addressing multiple learning styles suggests that while self-efficacy is high, further strengthening of instructional adaptability is essential to fully align their practice with the theory's emphasis on responsive and diverse teaching strategies. This highlights the need for continuous professional development focused on differentiated instruction. Furthermore, equipping teachers with evidence-based strategies for differentiation and inclusive pedagogy can strengthen their ability to address the diverse learning needs, interests, and abilities of students. Consequently, sustained professional development and collaborative learning opportunities will enable teachers to translate their high self-efficacy into more flexible, learner-centered instructional practices that maximize student engagement and achievement. Fostering a culture of reflective practice and peer collaboration can further enhance teachers' instructional competence by encouraging the sharing of effective teaching strategies and innovative classroom practices. These efforts reinforce the principles of Self-Efficacy Theory by enabling teachers to continuously strengthen their confidence and instructional effectiveness, thereby contributing to improved learner performance and more inclusive educational experiences.

The findings indicate that the respondents demonstrated an extremely knowledgeable level of TPACK, a very high level of teacher self-efficacy, and were very highly effective in instructional effectiveness. These results suggest that the teachers possess strong technological, pedagogical, and content knowledge, demonstrate confidence in performing instructional tasks, and effectively deliver quality instruction. The findings support previous studies which emphasize that teachers with strong technological competence and self-efficacy are more likely to implement effective instructional practices (Mishra & Koehler, 2006; Bandura, 1977

Direct Predictive Power of Teachers' Self-Efficacy on Their Perceived Instructional Effectiveness.

The perceived instructional effectiveness in technology-mediated environments is heavily influenced by teachers' self-efficacy. This psychological confidence shapes critical dimensions of the teaching process, including planning of lessons, classroom management, instructional delivery, and learner engagement. To examine the magnitude of this influence, a linear regression analysis was conducted. The resulting data encompassing the model fit, ANOVA omnibus tests, and parameter estimates are structured and presented across Table 4 to 5.

Model Fit and ANOVA Omnibus Tests of the Regression Analysis: The results of the regression analysis are presented in Table 4. Preliminary diagnostics indicated a violation of the normality assumption; thus, robust estimation methods were applied to ensure the validity of the inferential tests. The regression model yielded an R^2 value of .272 and an adjusted R^2 of .265, indicating that 27.2% of the variance in instructional effectiveness was explained by teachers' self-efficacy. The overall model was statistically significant, F (1, 113) = 42.20, $p < .001$. The ANOVA omnibus results confirmed a substantial individual effect of self-efficacy on instructional effectiveness, $F(1, 113) = 36.63$, $p < .001$, with a partial eta squared effect size of $\eta^2p = .272$.

Table 4 *Model Fit*

R^2	Adj. R^2	df	df (res)	F	p
0.272	0.265	1	113	42.2	<.001

ANOVA Omnibus Tests

	SS	df	F	p	η^2p
Model	3.739	1	42.199	<.001	0.272
Self-Efficacy	3.739	1	36.628	<.001	.272
Residuals	10.012	113			
Total	13.750	114			

Note. Inferential tests and p-values are based on robust estimation.

The results indicate that the model is statistically significant, suggesting that teachers' self-efficacy exerts a meaningful influence on instructional effectiveness. The coefficient of determination shows that teachers' confidence in their instructional capabilities explains a notable proportion of the variance in teaching performance, indicating a substantial effect size. This may be attributed to the strong internal link between an educator's psychological readiness and classroom execution. It suggests that when teachers have strong confidence in their ability to master complex digital tools, they become more resilient and better organized in their instructional practices. This systematic influence is further reflected in their perceived capability to plan lessons effectively, manage classroom activities, engage learners, and respond to instructional challenges.

The findings implied that teachers' self-efficacy is a significant determinant of instructional effectiveness, as supported by the robust regression model. From these findings, it can be concluded that higher levels of self-efficacy are systematically associated with improved instructional performance, including more effective classroom engagement and adaptive teaching practices. This is evident as an educator's internal confidence directly translates into more resilient and innovative classroom execution. Collectively, the results confirm that self-efficacy serves as a strong, foundational, and meaningful predictor of instructional effectiveness in technology-mediated learning environments.

This result was consistent with Lazarides and Warner (2020), who identified teacher self-efficacy as a key predictor of instructional practices and classroom effectiveness. Similarly, Khong et al. (2017) found that teachers with strong self-efficacy were more likely to implement innovative teaching strategies and sustain effective classroom engagement. Mahmood (2020) further emphasized that self-efficacy enhances teachers' willingness to adopt learner-centered and technology-enhanced instructional approaches. These findings reinforce the importance of teachers' confidence in applying effective instructional strategies that promote meaningful learning experiences. However, Scherer et al. (2021) argued

that self-efficacy alone may not fully translate into effective practice when contextual and institutional constraints are present. This suggests that while self-efficacy significantly contributes to instructional effectiveness, its impact is strengthened when supported by adequate resources, professional development, and favorable teaching conditions. Collectively, these studies indicate that teacher self-efficacy is most effectively translated into high-quality instruction when complemented by continuous institutional support and opportunities for professional growth.

The findings were anchored in Bandura's Self-Efficacy Theory (1977), as cited by Burić et al. (2024), which posits that beliefs in one's capabilities influence behavior, effort, and persistence. The theory explains why teachers with stronger self-efficacy are more likely to demonstrate resilience, invest greater effort, and effectively address instructional challenges. It further suggests that teachers with high self-efficacy are more willing to adopt effective instructional strategies and continuously improve their classroom practices. The findings also support Constructivist Learning Theory, which emphasizes the teacher's role in facilitating meaningful learning experiences through active engagement and adaptive instructional practices. These theoretical perspectives indicate that teacher confidence and learner-centered instruction work together to strengthen classroom performance and instructional quality. Together, these theories explain how teachers' confidence in their capabilities contributes to higher levels of instructional effectiveness by fostering effective teaching practices and meaningful student learning.

Parameter Estimates (Coefficients) of Teachers' Self-Efficacy and Instructional Effectiveness. The results of the parameter estimate for the regression analysis were presented in Table 5. The regression coefficient for teachers' self-efficacy was 0.814, with a standard error of 0.132. The standardized coefficient (β = 0.521) indicates a moderate to strong positive relationship between the variables. This relationship was statistically significant (113) = 6.169, $p < .001$), with a 95% confidence interval ranging from 0.548 to 1.070.

It was analyzed that the significant positive coefficient of teachers' self-efficacy indicated a direct and meaningful influence on instructional effectiveness. The moderate beta coefficient suggested that variations in self-efficacy corresponded to noticeable changes in teaching performance across instructional domains. This might be brought by teachers' confidence in their ability to perform instructional tasks effectively. It suggests that teachers with higher levels of self-efficacy are more capable of carrying out instructional responsibilities and responding to classroom demands. The consistency of the statistical estimates further indicates that self-efficacy serves as an important factor associated with instructional effectiveness.

Table 5 *Parameter Estimates (Coefficients)*

			95% Confidence Interval					
Names	Estimate	SE	Lower	Upper	β	df	t	p
(Intercept)	3.640	0.028	3.585	3.694	0.000	113	31.125	< .001
Self-Efficacy	0.814	0.132	0.548	1.070	0.521	113	6.169	< .001

Note: Inferential tests and p-values are based on robust estimation

The findings implied that teachers' self-efficacy was a significant determinant of instructional effectiveness, indicating that higher professional confidence was associated with improved teaching performance. This was evidenced by the positive and statistically significant relationship between the variables, reflecting the role of self-belief in shaping instructional outcomes. It was inferred that this relationship represented a consistent pattern in which teachers with stronger self-efficacy exhibited more effective instructional behaviors, including organized lesson implementation, sustained classroom engagement, and adaptive responses to teaching challenges. Therefore, it was concluded that teachers' self-efficacy played a significant role in instructional effectiveness, as higher levels of self-efficacy

corresponded to higher levels of performance across teaching domains.

This result was consistent with Zee and Koomen (2016), who found that teachers with high self-efficacy were more likely to employ effective instructional strategies and maintain positive classroom environments that enhanced student learning. Similarly, Khong et al. (2017) established that teacher self-efficacy significantly influenced instructional practices, particularly in adapting and applying innovative teaching approaches. Furthermore, the openness to learner-centered and technology-enhanced instruction highlighted by Mahmood (2020), Al-Mutawah (2022), and Mayer (2020) reinforced the conclusion that teachers' self-efficacy was a significant predictor of instructional effectiveness. These findings collectively supported the conclusion that higher levels of self-belief were associated with higher levels of performance across teaching domains, providing empirical support for the present study. This underscores the importance of strengthening teacher confidence to enhance instructional quality. Moreover, continuous professional development programs may help sustain and further improve these positive instructional outcomes.

The findings were anchored in the Technological Pedagogical Content Knowledge (TPACK) framework of Mishra and Koehler (2006), as cited in Chai et al. (2023). The framework posited that effective teaching occurs through the integration of technology, pedagogy, and content knowledge. The present findings suggest that teachers' self-efficacy may facilitate the effective application of these interconnected domains, thereby contributing to improved instructional effectiveness. Furthermore, the results were grounded in Bandura's Self-Efficacy Theory, as cited in Burić et al. (2024). This theory asserted that individuals' beliefs in their capabilities to perform specific tasks influence their actions, effort, and persistence. In the context of the study, the theory provided a basis for understanding why teachers with higher self-efficacy demonstrated higher levels of instructional effectiveness. Teachers who possessed stronger confidence in their abilities were more likely to exert effort, persist in addressing instructional challenges, and implement appropriate teaching strategies, which contributed to effective instructional performance.

The Mediating Role of Technological Pedagogical Content Knowledge (TPACK) in the Relationship between Teachers' Self-efficacy and their Perceived Instructional Effectiveness, while controlling for the Demographic Variables of Sex and Grade Level Taught.

The mediating role of Technological Pedagogical Content Knowledge (TPACK) in the relationship between teachers' self-efficacy and perceived instructional effectiveness, while controlling for sex and grade level taught, was examined to determine how teachers' professional beliefs translate into instructional performance. Understanding how teachers' confidence in their capabilities influences instructional effectiveness, and how TPACK functions as an intervening mechanism between these variables, provides valuable insights into strengthening teaching competence and instructional practice. Controlling for demographic variables further ensured that the observed relationships were examined independently of potential differences associated with sex and grade level taught.

Indirect and Total Effects of Teachers' Self-Efficacy on Instructional Effectiveness with TPACK as the Mediator. The indirect and total effects of teachers' self-efficacy on instructional effectiveness, with TPACK serving as the mediator, are presented in Table 6.

Table 6. Summary of the Mediation Analysis

Effect	β	p-value	Interpretation
Self-Efficacy → TPACK	0.409	< .001	Significant
TPACK → Instructional Effectiveness	0.353	< .001	Significant
Direct Effect (Self-Efficacy → Instructional Effectiveness)	0.400	< .001	Significant

Indirect Effect (Self-Efficacy → TPACK → Instructional Effectiveness)	0.144	0.001	Significant
Total Effect (Self-Efficacy → Instructional Effectiveness)	0.544	< .001	Significant
Sex (all direct and indirect effects)	—	> .05	Not Significant

Note. Confidence intervals computed with method: Bias-corrected bootstrap.
Note: Bias is a completely standardized effect size.

The mediation analysis utilizing bias-corrected bootstrapping with 5,000 resamples revealed a significant total effect of teachers' self-efficacy on instructional effectiveness (β = 0.544, p < .001). Significant component paths were likewise observed from teachers' self-efficacy to TPACK (β = 0.409, p < .001) and from TPACK to instructional effectiveness (β = 0.353, p < .001). The indirect effect of teachers' self-efficacy on instructional effectiveness through TPACK was also significant (β = 0.144, 95% CI [0.107, 0.398], p = .001). The direct effect of teachers' self-efficacy on instructional effectiveness remained significant after the inclusion of TPACK as the mediator (β = 0.400, p < .001). Meanwhile, sex showed no significant indirect effect on instructional effectiveness through TPACK (β = 0.015, p = .617), no significant effect on TPACK (β = 0.042, p = .615), and no significant direct effect on instructional effectiveness (β = –0.041, p = .581). Similarly, grade level taught (Grades 1–6) showed no significant effects on TPACK or instructional effectiveness, either directly or indirectly (p > .05).

These results showed that teachers' self-efficacy had a significant relationship with instructional effectiveness, with Technological Pedagogical Content Knowledge (TPACK) serving as a significant mediating mechanism. The significant total effect suggested that higher teacher confidence was associated with better instructional performance through greater willingness to engage in instructional tasks, address challenges, and integrate content, pedagogy, and technology in classroom practice. The significant indirect effect further reflected that part of this relationship operated through TPACK, as self-efficacy supported the integration of these knowledge domains. The remaining significant direct effect showed that self-efficacy also contributed independently to instructional effectiveness, possibly rooted in core teaching competencies such as classroom management, communication skills, and subject mastery. The non-significant demographic effects reflected consistency of the relationships across groups, possibly due to uniform professional standards, equal access to training, and similar instructional expectations regardless of sex and grade level handled.

It was inferred that teachers' self-efficacy maintained a significant relationship with instructional effectiveness, as evidenced by the regression results showing significant direct, indirect, and total effects. This was substantiated by statistically significant coefficients and effect sizes, indicating that self-efficacy contributed meaningfully to variations in instructional effectiveness, both independently and through the mediation of TPACK. Such a relationship reflected that confidence in teaching capability strengthened the application of pedagogical and technological knowledge in classroom practice. Furthermore, the data revealed that instructional effectiveness was shaped not only by technical competence but also by psychological factors such as self-belief. The consistency of this relationship across demographic groups indicated that the observed effects remained stable regardless of sex or grade level handled. In essence, teachers' self-efficacy significantly influenced instructional effectiveness through both direct and mediated pathways, demonstrating a consistent impact across diverse teacher profiles.

This is associated with the study of Chai, Koh, and Tsai (2013), who observed that teachers' self-beliefs serve as a primary catalyst in the development of technological pedagogical content knowledge, thereby reinforcing the significant role of self-efficacy in instructional effectiveness. Abbitt (2011) and Scherer et al. (2021) further support this relationship by emphasizing that the effect of confidence on

performance is often indirect, operating through the mastery and application of TPACK domains, which aligns with the mediating role identified in the present findings. In addition, Bakar et al. (2020) highlight that teachers with high self-efficacy demonstrate greater resilience in addressing technological constraints, which strengthens instructional delivery and provides empirical support to the significant relationship observed between self-efficacy and instructional effectiveness.

The findings were explained by the Responsive, Modernized, and Holistic Theory (RMH) proposed by Hapita (2026), which emphasizes that instructional effectiveness develops through the interaction of teachers' self-efficacy and technological competence. The significant mediating effect of TPACK showed that teachers' confidence contributed to instructional effectiveness through their ability to integrate technology, pedagogy, and content knowledge, supporting the theory's view that effective instruction emerges when psychological readiness and technological capability work together. The findings also align with the TPACK Framework of Mishra and Koehler (2006), as cited in Chai et al. (2023), which highlights the integration of technological, pedagogical, and content knowledge in teaching practice. Furthermore, the results were consistent with Bandura's Self-Efficacy Theory (1977), as cited in Burić et al. (2024), which posits that beliefs in one's capabilities influence performance, as teachers with stronger self-efficacy demonstrated higher instructional effectiveness directly and through TPACK.

V. AN INTERVENTION PROGRAM TO ENHANCE THE TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) AND SELF-EFFICACY OF ELEMENTARY TEACHERS

Instructional innovation refers to the application of evidence-based and context-responsive teaching strategies designed to enhance teaching effectiveness and address identified professional development needs. In this study, Project B.R.I.D.G.E. (Building Resilient Instruction, Digital Growth, and Empowerment) serves as the instructional innovation framework aimed at enhancing teachers' Technological Pedagogical Content Knowledge (TPACK), self-efficacy, and instructional effectiveness. This innovation is grounded in the Modified ADDIE model, focusing specifically on the Analysis, Design, and Development (ADD) phases to ensure a systematic and evidence-based approach. The Analysis phase identifies instructional and professional development needs based on empirical findings. The Design phase translates these identified needs into structured learning objectives, learning content, learning activities, and assessment strategies. The Development phase involves the creation and refinement of instructional materials, resources, and support tools aligned with teachers' professional growth needs. Through these phases, the intervention ensures that instructional improvements are data-driven, contextually relevant, and responsive to the realities of elementary education.

Analysis. During the Analysis phase, the study revealed areas for continuous enhancement in teachers' Technological Pedagogical Content Knowledge (TPACK) and self-efficacy. Although teachers demonstrated high levels of TPACK, self-efficacy, and instructional effectiveness, variations were observed across specific dimensions, particularly in technology-related competencies that require continuous learning, adaptation, and application. The findings further established that teachers' self-efficacy significantly predicts instructional effectiveness and that TPACK serves as a significant mediator in the relationship between self-efficacy and instructional effectiveness. These findings underscore the importance of strengthening teachers' technological competencies and professional confidence to further enhance instructional practices. Consequently, the proposed intervention focuses on reinforcing teachers' technology integration skills, strengthening self-efficacy, and promoting the effective application of TPACK in classroom instruction. This phase ensures that the proposed innovation is grounded in the empirical findings of the study and responsive to the professional development needs of elementary teachers.

Design. The Design phase operationalizes the identified needs into a structured instructional

framework anchored on the Responsive, Modernized, and Holistic (RMH) Theory. In alignment with its core dimensions, the intervention is structured to strengthen: (1) Responsiveness by enabling teachers to adapt instructional strategies based on learners' needs, classroom performance, and engagement through learner-centered and evidence-informed teaching approaches; (2) Modernization through the meaningful integration of digital tools and emerging educational technologies that enhance instructional delivery, strengthen technology integration, and promote the development of 21st-century learning competencies; and (3) Holistic Development by fostering teachers' Technological Pedagogical Content Knowledge (TPACK), strengthening teacher self-efficacy, and supporting continuous professional growth through collaborative learning, mentoring, coaching, and reflective practice. The design was informed by the study's findings, which revealed that while teachers demonstrated high levels of self-efficacy and instructional effectiveness, Technological Knowledge (TK) remained the least developed component of TPACK, indicating the need for more focused technology-enhancement initiatives. Likewise, the significant mediating role of TPACK highlights the importance of designing professional development activities that integrate technology, pedagogy, and content knowledge rather than addressing these competencies in isolation. Guided by the RMH Theory, the design ensures that instructional planning extends beyond content delivery by promoting adaptive, technology-integrated, and professionally sustained teaching practices that strengthen instructional effectiveness and support continuous improvement in teaching and learning.

Development. During the Development phase, instructional materials and support tools were created and refined to ensure alignment with the findings of the study and the professional needs of teachers. These include ICT-integrated lesson exemplars, digital teaching toolkits, TPACK-based instructional resources, self-efficacy enhancement materials, reflective practice templates, and collaborative learning guides. All materials were developed to be practical, accessible, and aligned with curriculum standards, ensuring their applicability in actual classroom settings. In addition, professional support resources were prepared to facilitate mentoring, collaboration, and continuous learning among teachers. This phase ensures that the intervention is not merely conceptual but fully operational, equipping teachers with concrete tools and resources to strengthen TPACK, enhance self-efficacy, and improve instructional effectiveness in support of quality teaching and learning.

VI. CONCLUSION

1. Teachers demonstrated an Extremely Knowledgeable level of Technological Pedagogical Content Knowledge (TPACK) across the domains of Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Knowledge. Technology-related domains had lower ratings than pedagogical and content-related domains.
2. Teachers exhibited a Very High level of self-efficacy in terms of teaching experience, school environment, and training and support.
3. Teachers demonstrated a Very Highly Effective level of instructional effectiveness in terms of lesson planning, classroom management, delivery of instruction, and learner outcomes.
4. Teacher self-efficacy is a strong predictor of instructional effectiveness. Higher self-efficacy leads to greater teaching effectiveness.
5. Technological Pedagogical Content Knowledge (TPACK) mediates the relationship between teacher self-efficacy and instructional effectiveness, amplifying the positive impact of self-efficacy on teaching outcomes.
6. Project B.R.I.D.G.E. (Building Resilient Instruction, Digital Growth, and Empowerment) provides structured professional development to enhance teachers' TPACK and self-efficacy, thereby improving instructional effectiveness.

VII. RECOMMENDATIONS

1. School ICT Coordinators, Master Teachers, and School Heads should implement structured technology enhancement programs that focus on strengthening teachers' Technological Pedagogical

Content Knowledge (TPACK), particularly in technology-related domains. Rather than relying solely on conventional seminars, schools should conduct hands-on workshops, technology-integration laboratories, and collaborative lesson-development sessions in which teachers have opportunities to explore, evaluate, and apply digital tools in real classroom contexts. Such activities may strengthen teachers' capacity to integrate technology more effectively with pedagogy and content, thereby improving instructional practice.

2. School Heads, Learning and Development Coordinators, and Master Teachers should establish continuous mentoring and coaching programs that reinforce teachers' self-efficacy in performing instructional tasks. These initiatives may include peer coaching, Learning Action Cell (LAC) sessions, demonstration teaching, and reflective conferences that provide teachers with opportunities to share successful practices and address instructional challenges collaboratively. Sustained professional support may further strengthen teachers' confidence in managing classroom responsibilities and adapting to evolving educational demands.
3. Teachers and instructional leaders should continue to enhance instructional effectiveness through reflective practice, collaborative planning, and evidence-based teaching strategies. Schools may institutionalize regular classroom observations, instructional coaching, and professional learning communities that focus on improving lesson planning, classroom management, instructional delivery, and learner outcomes. Such initiatives may contribute to the continuous refinement of instructional practices and the maintenance of high standards of teaching performance.
4. Since self-efficacy was found to be a significant predictor of instructional effectiveness, school administrators should prioritize professional development activities that build teachers' confidence in implementing innovative instructional strategies. Opportunities for leadership roles, action research, demonstration teaching, and participation in professional learning networks may be expanded to provide teachers with meaningful mastery experiences. These experiences may further strengthen teachers' beliefs in their professional capabilities and enhance their effectiveness in classroom instruction.
5. Given the significant mediating role of TPACK in the relationship between self-efficacy and instructional effectiveness, professional development programs should simultaneously address technology integration competencies and teacher confidence. Training initiatives should move beyond basic technology utilization and emphasize the meaningful integration of technology, pedagogy, and content within instructional practice. By strengthening both TPACK and self-efficacy, schools may further enhance teachers' instructional effectiveness and promote more responsive teaching practices in technology-rich learning environments.
6. School Heads, District Supervisors, and Schools Division Office officials may consider adopting and implementing Project B.R.I.D.G.E. (Building Resilient Instruction, Digital Growth, and Empowerment) as a structured professional development intervention. The program may be integrated into the school's Individual Professional Development Plan (IPDP), Learning and Development programs, and In-Service Training (INSET) activities to ensure sustained implementation. Furthermore, monitoring and evaluation mechanisms should be established to assess its effectiveness in enhancing teachers' TPACK, self-efficacy, and instructional effectiveness. Future researchers may likewise conduct follow-up studies to evaluate the long-term impact of the program across different educational settings.

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