



Research Article

Technological, Pedagogical, and Content Knowledge of DepEd Teachers in Kidapawan City Division: A Convergent Parallel Mixed-Methods Study

Gary N. Juntarciego^{1*} | Arlene P. Navos² | Ferdinand A. Failano, Jr.³ | Marilyn S. Mantiquilla⁴
| Katty H. Planco⁵ | Juliet G. Tabaldo⁶ | Marites L. Contayoso⁷

¹ Udomwittaya School, Phetchabun, Thailand | ² Dansuli Elementary School, Sultan Kudarat, Philippines | ³ Habitat Elementary School, Kidapawan City, Philippines | ⁴ Meocan Elementary School, Cotabato, Philippines | ⁵ Lepaga Elementary School, Cotabato, Philippines | ⁶ Damawato Elementary School, Cotabato, Philippines | ⁷ Minapan High School, Cotabato, Philippines
*Correspondence: gary.juntarciego@yahoo.com

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Abstract

Technological, Pedagogical, and Content Knowledge (TPACK) is critical for effective technology integration, yet evidence on teachers' proficiency and factors influencing its development remains limited in local contexts. This convergent parallel mixed-methods study examined TPACK among Department of Education (DepEd) teachers in the Schools Division Office of Kidapawan City, assessing levels, demographic differences, technology-integration experiences, and quantitative-qualitative convergence. Quantitative data from 304 stratified-randomly selected teachers were analyzed using descriptive statistics, one-way analysis of variance (ANOVA), and Tukey's HSD post hoc test, while qualitative data from 12 purposively selected participants were thematically analyzed. Results showed very high overall TPACK ($M = 4.35$, $SD = 0.614$). TK and TCK were high, while other domains were very high. Training and seminar participation significantly differed across several domains, while overall TPACK significantly differed by teaching experience. Qualitative themes included contextualized instruction, differentiated pedagogy, learner engagement, reflective adaptation, and technological limitations. Findings support continued professional development and institutional support to strengthen technological competencies.

Keywords: Technological pedagogical content knowledge; TPACK; technology integration; mixed methods; teacher competence; professional development

1. Introduction

The integration of technology has become a defining feature of contemporary education as schools continue to adapt to rapid digital transformation and post-pandemic instructional reforms. Teachers are increasingly expected to possess not only strong pedagogical and content knowledge but also the competencies needed to integrate digital technologies effectively into teaching and learning. Consequently, technology integration has become an essential indicator of instructional quality and teacher effectiveness in 21st-century education (Chai et al., 2020; Mishra, 2021). One of the most widely adopted frameworks for understanding these competencies is the Technological Pedagogical Content Knowledge (TPACK) framework, which explains that effective technology-enhanced teaching results from the dynamic interaction among technological, pedagogical, and content knowledge rather than from mastery of these domains in isolation (Mishra & Koehler, 2006). As a result, TPACK has become a central framework for evaluating teachers' readiness to implement technology-supported instruction across diverse educational settings (Chai et al., 2020).

In the Philippine educational context, the Department of Education (DepEd) has intensified initiatives to promote digital transformation through blended learning, online platforms, and continuous information and communication technology (ICT) professional development programs, particularly following the disruptions brought about by the COVID-19 pandemic. Despite these efforts, disparities persist in teachers' access to technological resources, digital competence, and opportunities for professional development. Such disparities are especially evident across school divisions with varying levels of technological infrastructure, institutional support, and contextual conditions, potentially influencing teachers' ability to integrate technology effectively into classroom instruction (Mishra, 2021; McDougall & Phillips, 2024).

Despite the growing body of TPACK research, several important gaps remain. Philippine studies have consistently reported that teachers generally demonstrate moderate to high levels of TPACK and that factors such as professional development, teaching experience, institutional support, and access to technological resources significantly influence technology integration (Obenza et al., 2024; Gempes & Obenza, 2025). Likewise, local investigations have highlighted the importance of continuous capacity-building programs in enhancing teachers' technological and pedagogical competencies within the K–12 educational system. However, these studies have predominantly relied on quantitative approaches that measure teachers' TPACK levels, providing limited insight into how teachers actually experience and enact the integration of technology, pedagogy, and content in authentic classroom contexts. Moreover, relatively few studies have employed convergent parallel mixed-methods designs that integrate quantitative assessments with qualitative evidence to explain teachers' instructional practices comprehensively (Creswell & Plano Clark, 2021). Existing international literature likewise demonstrates that TPACK is

highly contextual and influenced by institutional support, professional development, technological infrastructure, and teaching experience (Fabian et al., 2024; Çam, 2024; Chai et al., 2022; Tanta, 2025). Nevertheless, empirical evidence from local Philippine school divisions characterized by diverse urban and semi-rural educational contexts, such as the Schools Division Office of Kidapawan City, remains scarce. These gaps underscore the need for research that not only measures teachers' TPACK competencies but also examines how these competencies are translated into classroom practice within specific educational settings.

To address these gaps, this study employed a convergent parallel mixed-methods design to examine the Technological Pedagogical Content Knowledge (TPACK) of DepEd teachers in the Schools Division Office of Kidapawan City. The quantitative strand determined teachers' TPACK levels and examined differences across selected demographic variables, while the qualitative strand explored teachers' experiences and practices in integrating technology, pedagogy, and content during instruction. The integration of quantitative and qualitative findings provides a more comprehensive understanding of teachers' TPACK competencies and instructional practices than either approach alone (Creswell & Plano Clark, 2021). The findings are expected to inform professional development initiatives, guide educational policy on technology integration, and contribute to the growing body of TPACK research within the Philippine educational context.

Theoretical Framework

This study is anchored in the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006), which posits that effective technology integration emerges from the interaction of teachers' technological, pedagogical, and content knowledge. Rather than treating these domains as independent competencies, the framework emphasizes their dynamic integration through Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), and their intersections—Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Pedagogical Content Knowledge (PCK)—culminating in Technological Pedagogical Content Knowledge (TPACK). Teachers with well-developed TPACK are better able to select appropriate technologies, employ effective instructional strategies, and deliver subject content in ways that enhance student learning and engagement. Consequently, the framework provides an appropriate theoretical lens for examining teachers' competencies in integrating technology into classroom instruction.

The study is further informed by Constructivist Learning Theory, which views learning as an active process in which learners construct knowledge through meaningful experiences, social interaction, and reflection. Within technology-enhanced learning environments, constructivist principles support the use of digital tools to facilitate inquiry, collaboration, problem solving, and

learner-centered instruction. This perspective complements the TPACK framework by emphasizing that technology should be integrated not merely as an instructional aid but as a pedagogical resource that promotes meaningful learning experiences.

Methodologically, the study adopts a pragmatic worldview, which recognizes that complex educational problems are best understood through the integration of quantitative and qualitative evidence. Pragmatism provides the philosophical foundation for the convergent parallel mixed-methods design by allowing the simultaneous examination of teachers' measured TPACK competencies and their lived experiences in technology integration. Integrating both forms of evidence enables a more comprehensive understanding of how teachers enact technological, pedagogical, and content knowledge within the context of public schools in the Schools Division Office of Kidapawan City.

Statement of the Problem

This study seeks to answer the following research questions:

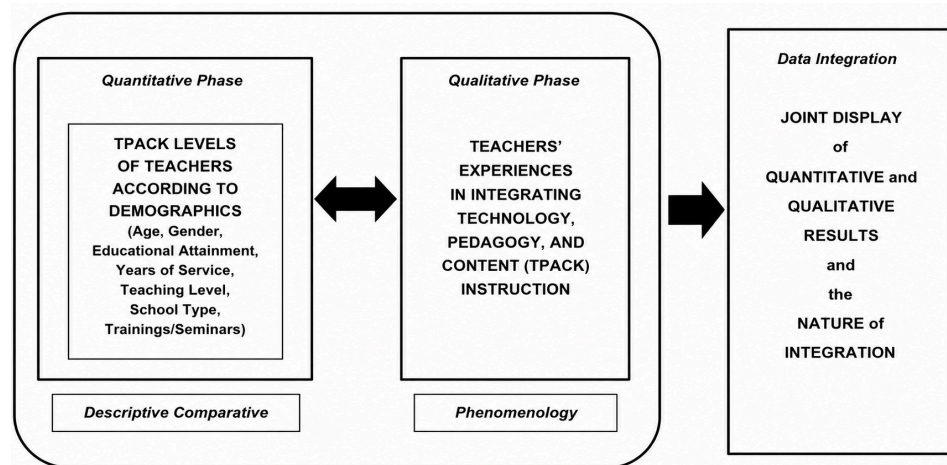
1. What is the level of TPACK of DepEd teachers in Kidapawan City Division?
2. What significant differences exist in the level of TPACK when grouped according to demographic profile (e.g., age, gender, educational attainment, years of service, teaching level, and school type)?
3. How do DepEd teachers in Kidapawan City Division, describe their TPACK (i.e., how they experience and enact the integration of technology, pedagogy, and content in their teaching)?
4. To what extent do the quantitative findings corroborate with the qualitative findings within the convergent parallel design?

2. Materials and Methods

2.1 Research Design

This study employed a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected concurrently, analyzed independently, and integrated during interpretation to provide a comprehensive understanding of teachers' Technological Pedagogical Content Knowledge (TPACK) (Creswell & Plano Clark, 2021). The study adopted the convergent mixed-methods framework of Gempes and Obenza (2025), which guided the concurrent implementation of both strands and the integration of findings through a joint display. The quantitative strand utilized a descriptive-comparative design to determine teachers' TPACK levels and examine differences across demographic variables using a five-point Likert-scale questionnaire. Data were analyzed using descriptive statistics, one-way analysis of variance (ANOVA), and Tukey's Honestly Significant Difference (HSD) post hoc test. The qualitative strand employed a phenomenological approach to explore teachers' lived

experiences in integrating technology, pedagogy, and content into classroom instruction. Semi-structured interviews were analyzed using thematic analysis to identify recurring patterns related to TPACK enactment. The findings from both strands were integrated through joint displays and narrative comparison to determine areas of convergence, complementarity, and divergence, thereby providing a more comprehensive understanding of teachers' TPACK competencies and instructional practices.



Legend: TPACK - Technological Pedagogical Content Knowledge
ANOVA – Analysis of Variance

Figure 1. Conceptual Design Convergent Mixed Methods

2.2 Research Locale

The study was conducted in the Schools Division Office of Kidapawan City, located in Kidapawan City, North Cotabato, Philippines. The division is composed of elementary and secondary public schools situated in both urban and rural communities, serving diverse learners from various socio-economic and cultural backgrounds. As part of the Department of Education (DepEd), the division continuously implements programs and initiatives related to curriculum development, instructional improvement, and technology integration in teaching and learning. The research setting was deemed appropriate for the study because teachers in the division are exposed to varying levels of technological resources, digital learning opportunities, and professional development activities related to technology-enhanced instruction. These contextual conditions provided a suitable environment for examining teachers' Technological, Pedagogical, and Content Knowledge (TPACK) competencies and experiences.

2.3 Research Participants

The quantitative participants comprised 304 public school teachers from the Schools Division Office of Kidapawan City, representing both elementary and secondary levels. Respondents varied in terms of sex, age, educational attainment, years of service, teaching level, and training or seminars attended.

Stratified random sampling was employed to ensure proportional representation across school levels and demographic groups, thereby enhancing the representativeness of the sample and minimizing sampling bias.

The qualitative strand included 12 purposively selected teachers with firsthand experience in technology-integrated instruction. Participants were selected based on their teaching experience, willingness to participate, and capacity to provide rich insights into TPACK implementation, while ensuring diversity in teaching level, years of service, and technological exposure. Semi-structured interviews were conducted to explore their experiences in integrating technology, pedagogy, and content knowledge in classroom instruction. Ethical principles, including informed consent, voluntary participation, confidentiality, and participant privacy, were strictly observed throughout the interview process.

2.4 Research Instruments

Quantitative data were collected using an adapted TPACK Self-Efficacy Scale administered through Google Forms. The instrument employed a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) and measured the seven TPACK domains: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). It also included items on respondents' demographic characteristics, including sex, age, educational attainment, years of service, teaching level, and training or seminars attended. The adapted instrument underwent expert validation and reliability testing prior to data collection to ensure its validity and internal consistency.

Qualitative data were gathered using a researcher-developed semi-structured interview guide based on the study objectives and the TPACK framework. The guide contained open-ended questions exploring teachers' experiences with technology integration, instructional practices, challenges encountered, strategies for integrating technology, pedagogy, and content, and perceptions of technology-supported teaching. The semi-structured format, supplemented by probing questions, allowed participants to elaborate on their experiences while ensuring alignment with the study's objectives.

2.5 Data Collection

Prior to data collection, the researcher secured approval from the Graduate School, the Schools Division Office of Kidapawan City, and the appropriate ethics review authorities. After obtaining permission, the researcher coordinated with school heads and designated coordinators for the dissemination of the Google Form survey link to identified teacher respondents. The respondents were informed about the purpose of the study, the voluntary nature of participation, and the confidentiality of their responses before completing the online survey. After the retrieval of completed survey responses, the quantitative

data were organized, encoded, and prepared for statistical analysis. For the qualitative phase, selected participants were contacted individually and invited to participate in the interview process. Online interviews were conducted through Zoom or Google Meet at schedules convenient to the participants. Prior to the interviews, informed consent was secured from all participants, including permission for audio recording. The interviews were audio-recorded, transcribed verbatim, and reviewed carefully to ensure accuracy and completeness of the collected data.

2.6 Data Analysis

Quantitative data were analyzed using descriptive and inferential statistics. Mean and standard deviation were computed to determine teachers' TPACK levels across the seven domains and overall TPACK. One-way Analysis of Variance (ANOVA) was used to examine significant differences in TPACK competencies across demographic variables, including sex, age, educational attainment, years of service, teaching level, and training or seminars attended. Whenever significant differences were detected, Tukey's Honestly Significant Difference (HSD) post hoc test was performed to identify specific group differences.

Qualitative data were analyzed using thematic analysis. Interview transcripts were reviewed, coded, and organized into categories, from which broader themes describing teachers' TPACK experiences and technology integration practices were generated and interpreted in relation to the study objectives and the TPACK framework.

Consistent with the convergent parallel mixed-methods design, quantitative and qualitative findings were analyzed independently and integrated during the interpretation stage using joint displays. The integrated analysis identified areas of convergence, divergence, and complementarity between the two datasets, providing a more comprehensive understanding of teachers' TPACK competencies and technology integration practices in the Schools Division Office of Kidapawan City.

2.7 Ethical Considerations

The study was conducted in accordance with established ethical standards for research involving human participants. Prior to data collection, permission to conduct the study was secured from the appropriate authorities, including the Graduate School and the Department of Education through the Schools Division Office of Kidapawan City. Participation in the study was entirely voluntary, and informed consent was obtained from all participants before the administration of surveys and interviews. Participants were informed about the purpose of the study, the nature of their participation, their right to withdraw at any time without penalty, and the confidentiality of their responses. To protect privacy and anonymity, no personal identifiers were disclosed in any report or publication, and pseudonyms or codes were used where necessary. All data gathered were used strictly for academic purposes and were stored securely in

password-protected devices accessible only to the researchers. The study ensured that no participant was exposed to harm, coercion, or undue pressure, and all information collected was treated with utmost confidentiality and respect throughout the research process.

3. Results and Discussion

The findings reveal that the overall level of Technological, Pedagogical, and Content Knowledge (TPACK) among DepEd teachers in the Kidapawan City Division is very high ($M = 4.35$, $SD = 0.614$). This indicates that teachers possess a strong and integrated understanding of technology, pedagogy, and content, enabling them to deliver effective and meaningful instruction across various learning contexts. Across the domains, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge all registered very high levels. This suggests that teachers are highly competent in aligning teaching strategies with subject matter and in integrating technology to enhance learning. However, Technology Knowledge and Technological Content Knowledge were rated slightly lower at a high level, indicating opportunities for further improvement in technical proficiency and subject-specific technology integration.

Table 1. Level of Technological, Pedagogical, and Content Knowledge
Level of TPACK

Indicators			Mean	Std. Deviation	Interpretation
Technology Knowledge			4.18	0.682	High
Pedagogical Knowledge			4.43	0.609	Very High
Content Knowledge			4.41	0.589	Very High
Pedagogical Content Knowledge			4.42	0.588	Very High
Technological Content Knowledge			4.18	0.630	High
Technological Pedagogical Knowledge			4.42	0.605	Very High
Technological	Pedagogical	Content	4.42	0.597	Very High
Knowledge					
Overall Mean			4.35	0.614	Very High

The relatively low standard deviations show consistency in responses, implying that the very high level of TPACK is common among the respondents. Overall, the results answer the research question by establishing that DepEd teachers in the Kidapawan City Division demonstrate a very high level of TPACK, although continued enhancement in technological skills may further strengthen their instructional effectiveness. These findings are supported by existing literature which emphasizes that teachers with strong TPACK are better

equipped to deliver effective, technology-enhanced instruction. The very high levels across most domains affirm the claim of Punya Mishra and Matthew J. Koehler that effective teaching results from the integration of technology, pedagogy, and content. Likewise, Chai Ching Sing et al. (2022) highlight that high TPACK supports innovative teaching and learner engagement. However, the slightly lower ratings in Technology Knowledge and Technological Content Knowledge align with Markus Schmid et al. (2021), indicating that technological proficiency remains an area for further development.

Table 2. Differences in TK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	2.705	0.101	Not Significant
Age	1.135	0.288	Not Significant
Years of Service	0.610	0.959	Not Significant
Educational Attainment	1.337	0.256	Not Significant
Teaching Level	0.646	0.758	Not Significant
Trainings/Seminars	2.788	0.041	Significant

Table 2.1. Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.0617	0.8827	Not Significant
1-2	5 or more	0.3399	0.0223	Significant
1-2	None	0.0293	0.9929	Not Significant
3-4	5 or more	0.2782	0.1597	Not Significant
3-4	None	-0.0324	0.9937	Not Significant
5 or more	None	-0.3106	0.1622	Not Significant

The ANOVA results revealed that trainings and seminars significantly differed in relation to Technology Knowledge (TK), while sex, age, years of service, educational attainment, and teaching level did not. The post hoc result showed that teachers who attended five or more trainings had significantly higher TK than those who attended only one to two trainings. This indicates that repeated professional development exposure strengthens teachers' familiarity, confidence, and competence in using digital tools for instruction (Tondeur et al.,

2021). Although Obenza et al. (2024) found that sex moderated the relationship between cognitive absorption and AI literacy, with the increase in AI literacy being less pronounced among females than males, the present study found no significant TK difference by sex. This may mean that in the Kidapawan City Division, similar ICT training, school-based technology expectations, and everyday exposure to digital teaching tools may have reduced possible male-female differences in technology competence.

Table 3. Differences in PK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	0.771	0.381	Not Significant
Age	0.529	0.985	Not Significant
Years of Service	0.780	0.808	Not Significant
Educational Attainment	0.735	0.569	Not Significant
Teaching Level	1.051	0.399	Not Significant
Trainings/Seminars	3.897	0.009	Significant

Table 3.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.0617	0.8827	Not Significant
1-2	5 or more	0.3399	0.0223	Significant
1-2	None	0.0293	0.9929	Not Significant
3-4	5 or more	0.2782	0.1597	Not Significant
3-4	None	-0.0324	0.9937	Not Significant
5 or more	None	-0.3106	0.1622	Not Significant

The results showed that trainings and seminars significantly differed in relation to Pedagogical Knowledge (PK), while the other demographic variables did not. The post hoc result indicates that teachers with five or more trainings differed significantly from those with no training exposure. This suggests that pedagogical competence is strengthened by sustained professional learning, especially when teachers are repeatedly exposed to learner-centered strategies, differentiated instruction, assessment practices, and classroom management approaches (Lucas & Moreira, 2021). The non-significant findings for

educational attainment and teaching level may imply that teachers across academic qualifications and ranks operate under similar curriculum standards and instructional expectations, which may equalize their pedagogical practices.

Table 4. Differences in CK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	0.261	0.610	Not Significant
Age	1.070	0.372	Not Significant
Years of Service	0.877	0.670	Not Significant
Educational Attainment	0.754	0.556	Not Significant
Teaching Level	0.649	0.754	Not Significant
Trainings/Seminars	5.942	0.001	Significant

Table 4.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.2181	0.0206	Significant
1-2	5 or more	0.2979	0.0266	Significant
1-2	None	-0.1102	0.6630	Not Significant
3-4	5 or more	0.0798	0.9088	Not Significant
3-4	None	-0.3282	0.0176	Significant
5 or more	None	-0.4081	0.0132	Significant

The ANOVA results showed a significant difference in CK based on trainings and seminars. Post hoc findings revealed that teachers with greater training exposure generally demonstrated higher CK than those with fewer or no trainings. This indicates that content mastery is not only acquired through formal education but is also continuously refined through curriculum updates, subject-area trainings, and professional learning activities (Koehler, Mishra, & Cain, 2022). The non-significant findings for age, sex, years of service, educational attainment, and teaching level may reflect the standardization of curriculum implementation in DepEd, where teachers are guided by common learning competencies, teaching guides, and subject expectations.

Table 5. Differences in PCK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	0.018	0.894	Not Significant
Age	0.464	0.995	Not Significant
Years of Service	0.629	0.949	Not Significant
Educational Attainment	1.062	0.376	Not Significant
Teaching Level	0.578	0.815	Not Significant
Trainings/Seminars	5.950	0.001	Significant

Table 5.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.1783	0.0864	Not Significant
1-2	5 or more	0.3457	0.0070	Significant
1-2	None	-0.1163	0.6263	Not Significant
3-4	5 or more	0.1674	0.5028	Not Significant
3-4	None	-0.2946	0.0429	Significant
5 or more	None	-0.4619	0.0037	Significant

The findings revealed that trainings and seminars significantly differed in relation to PCK. This suggests that professional development helps teachers connect appropriate teaching strategies with specific subject content. Teachers with greater training exposure may be better able to simplify difficult concepts, contextualize lessons, and select instructional approaches suited to learner needs. This supports Mishra (2021), who emphasized the contextual and practice-based nature of TPACK development. Although teaching level did not show a significant difference, this may be explained by the fact that classroom teachers across ranks are guided by similar curriculum standards and are expected to apply comparable pedagogical-content integration in daily instruction.

Table 6. Differences in TCK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	1.432	0.232	Not Significant
Age	0.882	0.656	Not Significant
Years of Service	0.734	0.863	Not Significant
Educational Attainment	0.685	0.603	Not Significant
Teaching Level	0.595	0.801	Not Significant
Trainings/Seminars	3.164	0.025	Significant

Table 6.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.1209	0.4549	Not Significant
1-2	5 or more	0.2934	0.0565	Not Significant
1-2	None	-0.0901	0.8275	Not Significant
3-4	5 or more	0.1725	0.5498	Not Significant
3-4	None	-0.2111	0.3053	Not Significant
5 or more	None	-0.3835	0.0450	Significant

The ANOVA results revealed that trainings and seminars significantly differed in relation to TCK. The post hoc result showed that teachers with five or more trainings differed significantly from those with no training exposure. This indicates that subject-specific technology integration improves when teachers receive sustained ICT-related professional development. TCK was also among the comparatively lower TPACK domains, suggesting that teachers may be stronger in content and pedagogy than in using advanced or subject-specific digital tools. This is consistent with Schmid, Brianza, and Petko (2021), who noted that TCK is often challenging because it requires teachers to match technology with disciplinary representations and content-specific learning needs. Although sex was not significant, Obenza et al. (2024) may be used to acknowledge that sex can shape AI-related engagement; however, this study suggests that local training exposure may be more influential than sex in explaining TCK differences.

Table 7. Differences in TPK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	0.325	0.569	Not Significant
Age	0.723	0.869	Not Significant
Years of Service	0.773	0.817	Not Significant
Educational Attainment	0.641	0.633	Not Significant
Teaching Level	0.175	0.996	Not Significant
Trainings/Seminars	2.814	0.040	Significant

Table 7.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-2	3-4	0.1476	0.2798	Not Significant
1-2	5 or more	0.2757	0.0845	Not Significant
1-2	None	-0.0356	0.9868	Not Significant
3-4	5 or more	0.1281	0.7623	Not Significant
3-4	None	-0.1832	0.4367	Not Significant
5 or more	None	-0.3113	0.1489	Not Significant

The findings showed that trainings and seminars significantly differed in relation to TPK, although the Tukey HSD comparisons did not identify a specific pairwise group difference. This may happen when the overall ANOVA detects a general pattern of group variation, but the adjusted post hoc test becomes more conservative in identifying exact pairwise differences. The result still suggests that professional development exposure contributes to teachers' ability to use technology to support pedagogy, engagement, collaboration, and assessment. This is consistent with Valtonen et al. (2021), who emphasized that technology-supported pedagogy develops through repeated exposure to digital teaching practices. The non-significant findings for sex and age may suggest that digital teaching expectations have become common across demographic groups.

Table 8. Differences in TPACK Levels Across Demographic Variables Using ANOVA

Demographic Variable	F-value	p-value	Decision
Sex	0.325	0.569	Not Significant
Age	0.723	0.869	Not Significant
Years of Service	0.773	0.817	Not Significant
Educational Attainment	0.641	0.633	Not Significant
Teaching Level	0.175	0.996	Not Significant
Trainings/Seminars	2.814	0.040	Significant

Table 8.1 Post Hoc Analysis (Tukey HSD) for Significant Component Findings

Group 1	Group 2	Mean Difference	p-value	Interpretation
1-5 years	6-10 years	0.0840	0.4210	Not Significant
1-5 years	11-15 years	0.1730	0.0380	Significant
1-5 years	16 years and above	0.2410	0.0040	Significant
6-10 years	11-15 years	0.0890	0.3170	Not Significant
6-10 years	16 years and above	0.1570	0.0410	Significant
11-15 years	16 years and above	0.0680	0.5620	Not Significant

The findings revealed that years of service significantly differed in relation to overall TPACK. The post hoc analysis showed that teachers with longer teaching experience, particularly those with 11-15 years and 16 years and above, had significantly higher TPACK than teachers with 1-5 years of service. This directly answers the panel's question on whether the difference is found among new or seasoned teachers. The result suggests that integrated TPACK is developed not only through training but also through prolonged classroom exposure, curriculum adaptation, problem-solving, and reflective practice (Chai et al., 2022; Mishra, 2021). Meanwhile, sex, age, educational attainment, teaching level, and trainings/seminars did not significantly differ in overall TPACK. Although Obenza et al. (2024) suggested that males may show stronger AI-literacy gains through cognitive absorption, the present study found no sex-based difference in overall TPACK, which may indicate that classroom-based technology integration among teachers is shaped more by professional experience and institutional teaching demands than by sex alone.

Overall, the findings revealed that trainings and seminars attended significantly differed across several individual TPACK domains such as Technology Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Knowledge. This suggests that professional development activities contribute substantially to the enhancement of specific teacher competencies related to technology integration, pedagogy, and subject-content mastery.

However, trainings and seminars attended did not significantly differ in relation to overall Technological Pedagogical Content Knowledge (TPACK). Instead, years of service emerged as the significant variable affecting integrated TPACK competencies. This finding may indicate that while trainings and seminars strengthen isolated or domain-specific competencies, the development of overall TPACK requires sustained classroom experience, reflective instructional practice, curriculum adaptation, and long-term application of technology in authentic teaching contexts.

The result supports the view of Mishra and Koehler (2006) that TPACK is a highly integrative and contextualized form of teacher knowledge that develops through the dynamic interaction of pedagogy, technology, content, and teaching experience. Similarly, Chai et al. (2022) emphasized that integrated TPACK competencies are strengthened not only through formal training but also through continuous instructional practice and contextual teaching experiences over time.

Thus, the findings suggest that professional development programs may effectively enhance specific instructional competencies, but the mastery of integrated TPACK appears to be more strongly influenced by prolonged teaching experience and actual classroom implementation.

Table 9. Thematic Analysis on Teachers' TPACK Experiences in Kidapawan City Division

Theme	Category	Codes (Initial Meanings)	Sample Evidence (Verbatim)	Interpretation
1. Contextualized and Learner-Centered Content Delivery	Use of real-life and localized examples	real-life examples, local context, familiar situations, storytelling	"I use real-life examples like money and daily experiences..." (R10)	Teachers ground content in learners' experiences, demonstrating strong Content Knowledge (CK) and constructivist teaching.
	Simplification strategies	visual aids, analogies, step-by-step	"I use analogies, memes, and engaging materials..." (R1)	Teachers simplify complex concepts to make learning accessible and meaningful.

		explanation, memes		
2. Differentiated and Adaptive Pedagogical Practices	Use of varied strategies	cooperative learning, inquiry-based, direct instruction, group work	"I use cooperative learning and inquiry-based activities..." (R1)	Teachers apply diverse strategies to meet varied learner needs, reflecting strong Pedagogical Knowledge (PK).
	Differentiation and adjustment	enrichment, remediation, flexible grouping, scaffolding	"Fast learners get enrichment; struggling learners get guidance..." (R10)	Instruction is responsive and adaptive, highlighting Pedagogical Content Knowledge (PCK).
3. Functional and Practical Use of Technology	Use of basic ICT tools	PowerPoint, YouTube, Canva, laptops, TV	"I am confident in using PPT, Word, and Excel..." (R10)	Teachers utilize accessible technologies effectively, demonstrating practical Technological Knowledge (TK).
	Sources of learning technology	training, self-learning, peer support	"I learned from trainings, colleagues, and online tutorials..." (R3)	Technology skills are developed through formal and informal learning pathways.
4. Technology for Visualization and Engagement	Enhancing understanding	videos, simulations, interactive apps, visualization	"Animated videos helped learners understand better..." (R1)	Technology helps translate abstract concepts into concrete understanding (TCK).
	Increasing motivation	engagement, participation, interest, enjoyment	"Students were more engaged and excited..." (R2)	Technology boosts learner motivation and active participation.
5. Technology-Enhanc ed Interactive and Collaborative Learning	Digital collaboration	online quizzes, shared platforms, group tasks	"Students collaborate using online tools..." (R2)	Technology supports interactive and collaborative learning environments (TPK).
	Gamification and participation	Kahoot, Quizizz, games, polls	"Kahoot made learning interactive and fun..." (R3)	Gamified tools increase engagement and participation.
6. Reflective and Adaptive Integration of TPACK	Instructional adjustment	shifting strategies, modifying lessons, responsive teaching	"I changed from lecture to videos and games..." (R10)	Teachers dynamically integrate technology, pedagogy, and content (Full TPACK).
	Continuous improvement	feedback, observation, reflection	"I adjust based on students' understanding..." (R9)	Teaching is reflective and continuously improved.

7. Challenges and Contextual Constraints	Resource limitations	poor internet, lack of materials, technical issues	“Limited internet connection and lack of IMS...” (R11)	TPACK implementation is influenced by contextual and infrastructural constraints.
	Coping strategies	backup materials, flexibility, improvisation	“I prepare backup materials...” (R11)	Teachers demonstrate resilience and adaptability in overcoming challenges.

The thematic analysis of teachers’ responses reveals how DepEd teachers in Kidapawan City Division experience and enact TPACK through interconnected practices involving content delivery, pedagogy, and technology integration. The following themes emerged:

3.1 Contextualized and Learner-Centered Content Delivery

Teachers emphasized making lessons meaningful and relatable by connecting them to learners’ real-life experiences and local contexts. They simplify complex ideas using concrete examples, visual aids, and familiar situations.

“I use real-life examples like money and real-life experiences...” (R10)

“I use analogies, memes and other engaging materials...” (R1)

This indicates strong Content Knowledge (CK), where teachers ensure understanding through contextualization. Their approach reflects constructivist teaching, allowing learners to build knowledge from prior experiences.

3.2 Differentiated and Adaptive Pedagogical Practices

Teachers employ a variety of strategies and adjust instruction based on learner needs, demonstrating flexibility in teaching.

“I use cooperative learning... inquiry-based learning...” (R1)

“Fast learners get enrichment... struggling learners get extra guidance...” (R10)

This highlights strong Pedagogical Knowledge (PK) and Pedagogical Content Knowledge (PCK). Teachers are responsive to learner diversity and actively differentiate instruction to improve learning outcomes.

3.3 Functional and Practical Use of Technology

Teachers described their use of accessible and commonly available technologies to support instruction.

“I am confident in using PPT, Word and Excel...” (R10)

“I learned from training, self-practice, and colleagues...” (R3)

This reflects Technological Knowledge (TK) that is practical and experience-based. Teachers rely on both formal training and informal learning, showing adaptability in technology use.

3.4 Technology for Visualization and Engagement

Technology is primarily used to enhance understanding and make abstract concepts more concrete.

“Animated video... helped learners understand the process...” (R1)

“Students were more engaged... scores went up...” (R2)

This demonstrates strong Technological Content Knowledge (TCK), where technology serves as a bridge between content and comprehension. It also enhances motivation and engagement.

3.5 Technology-Enhanced Interactive and Collaborative Learning

Teachers use technology to promote participation, collaboration, and active learning.

“Students can respond through digital polls or shared documents...” (R3)

“Online tools where students can share ideas and complete group activities...” (R2)

This reflects Technological Pedagogical Knowledge (TPK). Technology reshapes classroom practices into more interactive and collaborative environments.

3.6 Reflective and Adaptive Integration of TPACK

Teachers continuously adjust their strategies based on student needs and classroom situations.

“I changed from lecture to videos and games...” (R10)

“I adjust based on students’ understanding...” (R9)

This reflects full TPACK integration, where teachers dynamically combine content, pedagogy, and technology. Their practice is reflective and responsive.

3.7 Challenges and Contextual Constraints

Teachers acknowledged challenges such as limited resources and technical issues.

“Limited internet connection... lack of IMS...” (R11)

“I prepare backup materials...” (R11)

TPACK implementation is influenced by contextual realities. Despite limitations, teachers demonstrate resilience and adaptability.

The findings reveal that DepEd teachers in Kidapawan City Division enact TPACK as a dynamic, learner-centered, and adaptive practice. They integrate technology, pedagogy, and content by contextualizing instruction,

differentiating strategies, and using technology to enhance understanding, engagement, and collaboration. While their practices demonstrate strong TPACK integration, implementation is shaped by contextual challenges such as limited resources and infrastructure.

Table 10. Joint Display of Quantitative and Qualitative Findings on Teachers' TPACK

TPACK Dimension / Focus	Quantitative Findings (QUAN)	Qualitative Themes (QUAL)	Integration / Meta-Inference
Overall TPACK Level Across Demographics	No significant differences in sex ($p = 0.945$), age ($p = 0.911$), educational attainment ($p = 0.742$), and teaching level ($p = 0.996$)	Theme 1: Contextualized and learner-centered teaching; Theme 2: Differentiated pedagogy	Convergence: Teachers demonstrate similar TPACK practices regardless of demographic profile, indicating a generally uniform level of competence.
Influence of Teaching Experience	Significant difference in years of service ($F = 1.578$, $p = 0.005$)	Theme 6: Reflective and adaptive integration of TPACK	Convergence: Experience enhances teachers' ability to refine and adapt TPACK practices over time.
Content and Pedagogical Practices	High and consistent TPACK levels (no variation across groups)	Theme 1: Contextualized content delivery; Theme 2: Differentiated instruction	Convergence: Teachers consistently apply effective pedagogical and content strategies, supporting uniform quantitative results.
Technology Utilization	Implied adequate technological competence across groups	Theme 3: Functional use of technology; Theme 4: Technology for visualization	Convergence: Teachers use practical and accessible technologies effectively to support instruction.
Student Engagement and Collaboration	Not directly measured quantitatively	Theme 5: Technology-enhanced interactive and collaborative learning	Complementarity: Qualitative data expand quantitative findings by showing how TPACK improves engagement and collaboration.
Instructional Adaptability	Significant variation linked to years of service	Theme 6: Reflective and adaptive teaching practices	Convergence: Adaptability develops through experience, explaining the quantitative significance of years of service.
Contextual Challenges	Not captured in quantitative data	Theme 7: Challenges and contextual constraints	Complementarity: Qualitative findings provide deeper insight into real-world barriers affecting TPACK implementation.

The joint display reveals a strong convergence between the quantitative and qualitative findings of the study. The quantitative results indicate that teachers' TPACK levels are generally consistent across demographic variables, while the qualitative findings support this by showing that teachers employ similar practices such as contextualized teaching, differentiated instruction, and practical use of technology. Both data sets also align in highlighting the role of years of service, where experience contributes to more reflective and adaptive integration of TPACK. Moreover, the qualitative findings provide complementary insights by explaining how teachers implement TPACK in actual classroom settings, particularly in promoting student engagement and collaboration through technology. They also reveal contextual challenges, such as limited resources, which were not captured in the quantitative data.

Overall, the integration of findings suggests that while teachers demonstrate a uniform level of TPACK competence, their ability to effectively apply it is shaped by experience and contextual factors, confirming the strength and validity of the study's results. These integrated findings are supported by mixed-methods literature, which emphasizes that convergence between quantitative and qualitative data strengthens the validity of research conclusions. According to John W. Creswell and Vicki L. Plano Clark (2021), the convergent parallel design enables researchers to confirm results through triangulation while also providing deeper contextual understanding. The alignment of quantitative consistency and qualitative practices in this study reflects this principle, demonstrating that teachers' TPACK competence is both measurable and observable in practice. Furthermore, the complementary insights on contextual challenges support the view that TPACK is influenced by environmental factors, reinforcing the idea that effective technology integration depends not only on teacher competence but also on available resources and support systems.

4. Conclusions

DepEd teachers in the Schools Division Office of Kidapawan City demonstrated a very high level of Technological, Pedagogical, and Content Knowledge (TPACK), indicating strong competencies in integrating technology, pedagogy, and content in classroom instruction. Overall TPACK did not significantly differ according to sex, age, educational attainment, or teaching level; however, teachers with longer years of service exhibited significantly higher TPACK, while participation in trainings and seminars significantly enhanced several individual TPACK domains, highlighting the complementary roles of teaching experience and professional development in strengthening technology integration competencies. Qualitative findings further revealed that teachers enacted TPACK by contextualizing instruction, employing differentiated pedagogical strategies, and purposefully integrating technology to enhance student engagement and learning. The integration of the quantitative and qualitative findings demonstrated convergence between teachers' reported TPACK competencies and their actual instructional practices, while also revealing contextual challenges that continue to influence the effective integration of technology in teaching.

5. Recommendations

Based on the findings of the study, teachers are encouraged to continuously strengthen their technological competencies, particularly in subject-specific technology integration, through self-directed learning, peer mentoring, and the use of interactive, learner-centered digital tools. School heads and administrators should provide sustained ICT-related professional development, strengthen instructional supervision focused on TPACK integration, and promote professional learning communities that facilitate the sharing of effective technology integration practices. Schools should likewise improve access to technological resources by investing in digital devices, reliable internet connectivity, and instructional technologies that support technology-enhanced teaching. At the policy level, the Department of Education may reinforce continuous professional development programs on TPACK, strengthen the implementation of ICT integration initiatives aligned with curriculum goals, ensure equitable distribution of technological resources across schools, and establish monitoring mechanisms to evaluate teachers' application of TPACK in classroom instruction. Future researchers are encouraged to replicate this study in other school divisions or regions, examine the relationship between TPACK and student learning outcomes, investigate specific TPACK domains such as Technological Content Knowledge (TCK), employ longitudinal research designs to examine the development of TPACK over time, and incorporate school-level variables, including leadership, technological infrastructure, and institutional support, to provide a more comprehensive explanation of variations in teachers' TPACK.

6. Limitations of the Study

This study has several limitations that should be considered when interpreting its findings. First, the study was conducted exclusively among public school teachers in the Schools Division Office of Kidapawan City; therefore, the findings may not be generalizable to teachers in private schools or other educational divisions with different institutional contexts and technological resources. Second, the quantitative findings were based on teachers' self-reported responses using a TPACK self-efficacy instrument, which may be influenced by social desirability and self-perception biases. Third, the study employed a cross-sectional design that captured teachers' TPACK competencies and experiences at a single point in time, limiting the ability to examine changes in TPACK development or establish causal relationships. Finally, although the qualitative strand provided rich contextual insights into teachers' technology integration practices, the experiences were drawn from a relatively small group of participants and may not represent the perspectives of all teachers within the division. Despite these limitations, the convergent parallel mixed-methods design strengthened the study by integrating quantitative and qualitative evidence, thereby providing a more comprehensive understanding of teachers' Technological Pedagogical Content Knowledge and instructional practices in the Schools Division Office of Kidapawan City.

Supplementary Details

Supplementary Materials & Data Availability Statement

Supplementary materials include the TPACK quantitative questionnaire and semi-structured interview guide used in the study. The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical, confidentiality, and institutional restrictions. The datasets are not publicly available because they contain information obtained from human participants.

Author Contributions (CRediT Taxonomy)

Gary N. Juntarciego: Conceptualization; Methodology; Investigation; Data Curation; Formal Analysis; Writing - Review & Editing.

Arlene P. Navos: Conceptualization; Investigation; Data Collection; Validation; Writing - Review & Editing.

Ferdinand A. Failano, Jr.: Conceptualization; Methodology; Investigation; Validation; Writing - Original Draft; Writing - Review & Editing.

Marilyn S. Mantiquilla: Investigation; Data Collection; Validation; Writing - Review & Editing.

Katty H. Planco: Investigation; Data Collection; Validation; Writing - Review & Editing.

Juliet G. Tabaldo: Investigation; Data Collection; Validation; Writing - Review & Editing.

Marites L. Contayoso: Investigation; Data Collection; Validation; Writing - Review & Editing.

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The study was conducted in accordance with established ethical standards for research involving human participants and was reviewed/approved by Central Mindanao Colleges, Protocol/Approval No. REC-E-2026-GSE-023A, approved on March 16, 2026. Permission to conduct the study was also obtained from the appropriate Department of Education authorities.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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Conflicts of Interest

The authors declare no conflict of interest.

Disclosure Statement - Use of AI Tools

Generative artificial intelligence tools, including ChatGPT by OpenAI, were used during manuscript preparation for language refinement, grammar checking, organization, and improvement of clarity and academic presentation. AI tools were not treated as authors and were not used as substitutes for the authors' scholarly judgment. All AI-assisted content was critically reviewed, verified, revised, and approved by the authors, who take full responsibility for the accuracy, integrity, originality, analysis, interpretation, and final content of the manuscript.

Formal Photo Submission

Formal author photographs are attached separately for promotional use in accordance with the journal's instructions and Republic Act No. 10173 (Data Privacy Act of 2012).

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