INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
Published by: RISEJOURNALS.ORG | Online ISSN: 3028-032X | Print ISSN: 3028-0370
VOLUME 4, ISSUE NO. 7

Senior High School Teachers' TPACK Competency

DOI: 10.5281/zenodo.21424964

Karel Klein Medequillo Enad
Cebu Normal University
kkmenad@gmail.com

Abstract:

This study explored the Technological Pedagogical Content Knowledge (TPACK) competency of Senior High School (SHS) teachers in a private academic institution in Central Visayas, Philippines. Using an explanatory mixed-methods design, the research examined teachers' self-reported proficiency across the seven TPACK components Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK) and investigated teachers' lived experiences integrating these domains into instruction. A stratified random sample of 49 full-time SHS teachers with at least three years of teaching experience completed a validated 31-item Likert-scale survey adapted from Chai et al. (2013), and a subset participated in semi-structured interviews until data saturation was reached, using a guide adapted from Harris et al. (2012). Quantitative results showed moderate-to-high overall TPACK competency, with Content Knowledge rated highest ($M = 4.38$, $SD = 0.88$) and Pedagogical Content Knowledge rated lowest ($M = 3.60$, $SD = 0.87$). A one-way analysis of variance revealed a statistically significant difference among the seven components ($F = 4.819$, $p = .002$), and post-hoc Tukey HSD tests located that difference specifically between Content Knowledge and Pedagogical Content Knowledge ($p = .002$) and between Content Knowledge and Technological Pedagogical Content Knowledge ($p = .005$). Thematic analysis of the interview data produced five themes: TPACK Framework Awareness and Application, Engagement and Interaction, Adaptation to New Teaching Methods, Efficiency and Effectiveness, and Empowering Student-Centered Learning through Technology, alongside a recurring theme of Challenges and Learning Curves (connectivity gaps, assessment authenticity, and technical proficiency). The findings indicate that while SHS teachers possess a solid foundation across TPACK domains, a persistent gap remains in their ability to design lessons that integrate content, pedagogy, and technology specifically for student-centered learning. In response, the researcher proposed the KAREL Framework (Know, Apply, Reflect, Empower, Live Up) as a structured, five-stage professional development model to close this gap. The study contributes to educational management research by demonstrating how TPACK self-assessment data can be translated directly into an actionable, institution-level training plan.

Keywords: TPACK, Senior High School teachers, professional development, student-centered learning, teaching effectiveness

Introduction:

Globalization and the knowledge-based economy have placed new demands on education systems to prepare learners for productive citizenship. In the Philippines, the Enhanced Basic Education Act of 2013 (RA 10533) extended secondary education by two years, creating the Senior High School (SHS) program and requiring the Department of Education (DepEd) to hire instructors holding either an education degree or a bachelor's degree with 15 units of relevant specialization. The Philippine Professional Standards for Teachers (DepEd Order No. 42, s. 2017) subsequently articulated the competencies teachers are expected to demonstrate, with particular emphasis on the effective use of Information and Communication Technology (ICT) to enhance teaching and learning. Private academic institutions, which employ the same hiring standards as public schools, share this obligation to build teacher capacity in ICT-integrated instruction.

Technology use in the classroom is widely credited with accelerating educational advancement, moving instruction beyond memorization toward knowledge construction (Tinio, 2003). Fu (2013) links ICT integration to creative learning environments, collaborative learning, higher-order thinking, and improved teaching quality. Meeting these expectations requires teachers to master content, pedagogy, and technology simultaneously the premise underlying the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). While some studies report that practicing teachers feel reasonably confident integrating TPACK because of opportunities gained during teacher education (Ramos et al., 2020; Santos & Castro, 2021), other reviews point to a persistent gap between ICT skills and actual curriculum integration, and to unmet professional development needs among in-service teachers (Fernández-Batanero et al., 2020).

Given this tension between reported confidence and documented integration gaps, the study examined the TPACK competency and lived experiences of in-service SHS teachers in a single private institution, with the explicit intent of using the results to inform institutional action planning and professional development design.

The study is anchored in the TPACK framework, which extended Shulman's (1986) construct of Pedagogical Content Knowledge (PCK) by incorporating technology as a third interacting domain (Koehler & Mishra, 2005; Mishra & Koehler, 2006). The study is positioned within the broader national effort to equip teachers with 21st-century capacities in support of DepEd's nation-building goals (DepEd Order No. 36, s. 2013). Practically, its results were intended to inform institutional review of vision, policy, infrastructure, performance assessment, and professional development programming, and to contribute evidence toward a possible national standard for teachers' ICT competencies.

Literature Review:

Contemporary pedagogy increasingly favors active knowledge construction over rote memorization, drawing on constructivist principles (Gilakjani, 2013). ICT is positioned as a catalyst for this shift, giving learners access to digital resources that support inquiry-based learning, problem-solving, and critical thinking (Fu, 2013). Fu (2013) further catalogs the benefits of ICT integration: personalized and differentiated instruction, improved collaboration, and communication that transcends the boundaries of time and place. These claims are echoed across governmental policy: the Philippines' K-12 reform explicitly frames ICT integration as a vehicle for developing critical thinking, creativity, communication, collaboration, and digital literacy (DepEd Order No. 42, 2017).

Since Mishra and Koehler's (2005, 2006) formalization of TPACK, the framework has become the dominant lens for understanding how technology, pedagogy, and content interact in teacher knowledge (Koehler & Mishra, 2009). A recurring theme in the literature is that TPACK is not a simple additive sum of its three base domains but an integrated form of expertise: teachers must understand digital tools' capabilities and constraints, apply appropriate teaching methods and assessment practices, and hold a deep grasp of subject-matter concepts and theories, then blend all three to design engaging, effective instruction.

Despite the framework's conceptual appeal, both pre-service and in-service teacher education continue to show a gap between basic technological skill and genuine curriculum integration (Cortes et al., 2022). Pre-service programs often equip candidates with foundational technology skills but not with the pedagogical judgment to weave those skills into content-specific instruction. In-service teachers, meanwhile, frequently lack the sustained support, resources, and professional development opportunities needed to build TPACK further (Abenes & Caballes, 2020; Morales et al., 2022). The consequence, across multiple studies, is that many teachers struggle to move from technology use as a novelty to technology use as an instructional strategy.

Scholars have consistently argued that TPACK should anchor professional growth initiatives, given its centrality to preparing teachers for a knowledge-based, technology-driven society (Ndongfack, 2015). By harnessing digital tools deliberately, teachers can elevate student engagement, motivation, and achievement (Goradia, 2018). This has driven the development of self-efficacy instruments — most notably Schmidt et al. (2009) and Chai et al. (2013) —

that let teachers and institutions assess strengths and gaps across the seven TPACK components and translate that assessment directly into targeted training design.

The growing popularity of TPACK has driven the development of self-report instruments designed to measure teachers' perceived self-efficacy across the framework's seven components, most notably Schmidt et al. (2009) and Chai et al. (2013). These instruments give teachers structured insight into their relative strengths and areas for growth, and give institutions a systematic basis for designing and evaluating professional development initiatives rather than relying on informal observation alone. Because the instruments decompose TPACK into its constituent domains, they also make it possible as in the present study to statistically test whether teachers' competency differs meaningfully across domains, rather than treating TPACK as a single undifferentiated skill.

Taken together, the literature establishes TPACK as both a diagnostic framework and a design tool for professional development, but leaves two gaps that motivate the present study. First, most TPACK assessment studies in the Philippine context focus on pre-service teachers (e.g., Ramos et al., 2020; Santos & Castro, 2021), leaving in-service SHS teachers in private institutions comparatively understudied. Second, few studies pair quantitative component-level scoring with qualitative accounts of how teachers actually experience TPACK integration in the classroom, and fewer still translate those combined findings into a concrete, structured professional development plan. This study addresses both gaps through its mixed-methods design and its resulting KAREL Framework.

Methodology:

The study used an explanatory mixed-methods design, in which quantitative and qualitative data were collected and then integrated at the analysis stage. Descriptive statistics summarized closed-ended survey responses, while an inductive thematic analysis organized open-ended interview data into emergent patterns.

The study was conducted in a private academic institution in Cebu City, Philippines, that has offered a Senior High School program since 2016 in accordance with DepEd Order No. 3, s. 2016. Its faculty hold degrees from both education and non-education backgrounds, reflecting the varied specializations found across SHS strands nationally.

Eligible participants were full-time SHS teachers with at least three years of teaching experience across the Science, Technology, Engineering and Mathematics (STEM); Accountancy, Business and Management (ABM); Humanities and Social Sciences (HUMSS); and Arts and Design (AD) strands, who were willing to share both positive and negative aspects of their teaching experience. A stratified random sampling method was used, with sample size computed via Slovin's formula ($n = N / (1 + Ne^2)$) at a 5% margin of error. From a population of 52 teachers, this yielded a target sample of 46, and the study ultimately gathered 49 completed responses. Semi-structured interviews continued until data saturation was reached.

The instrument had three parts: (1) teacher background information; (2) a 31-item, five-point Likert-scale TPACK survey (Strongly Disagree to Strongly Agree) adapted from Chai et al. (2013), covering all seven TPACK components and previously validated for contextualized research; and (3) open-ended interview questions adapted from Harris et al. (2012), a publicly available protocol designed to capture how teachers describe technology-integrated lessons.

Following ethics clearance from the Cebu Normal University Research Ethics Committee (CNU-REC) and a formal request to the SHS Department, the survey was administered electronically via Google Forms, gated by institutional-email verification and a data-privacy consent checkbox, with responses locked after submission and a copy emailed back to each respondent. Interviews were conducted in a private, quiet campus room after informed consent was obtained, and were audio-recorded, with assurances that individual identities would not be disclosed and that data would be reported only in aggregate. All electronic and recorded data were encrypted upon collection.

Analysis proceeded according to each research question:

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
Published by: RISEJOURNALS.ORG | Online ISSN: 3028-032X | Print ISSN: 3028-0370
VOLUME 4, ISSUE NO. 7

● RQ1 (competency levels): mean and standard deviation per item and per component, interpreted against a five-band descriptive scale — Not Competent (1.00–1.80), Fairly Competent (1.81–2.60), Competent (2.61–3.40), Moderately Competent (3.41–4.20), and Very Competent (4.21–5.00).
● RQ2 (component differences): one-way analysis of variance (ANOVA) across the seven components, followed by a post-hoc Tukey Honest Significant Difference (HSD) test where the F-test was significant.
● RQ3 (experiences): thematic analysis following Braun and Clarke's (2006) six-step framework as operationalized by Maguire and Delahunt (2017) — familiarization, initial coding, theme searching, theme review, theme definition, and write-up.
● RQ4 (training design): synthesis of the quantitative gaps and qualitative themes into a structured professional development plan.

The study reported no conflicts of interest and received no external funding. Data privacy was maintained throughout collection, storage, and eventual destruction. Participation was voluntary and based on informed consent, with the explicit right to withdraw at any time without penalty or need for justification. Interviews were conducted respectfully and with attention to participant comfort, and respondents received a token gift in appreciation of their time. The CNU-REC granted an exemption from full ethical review for the study.

Results and Discussion:

RQ1: Level of TPACK Competency by Component
Table 1 summarizes the mean, standard deviation, and rank of each TPACK component across the 49 respondents, ordered from highest to lowest self-rated competency.

TPACK Component	N	Mean	SD	Descriptive Level	Rank
Content Knowledge (CK)	49	4.38	0.88	Very Competent	1
Technological Pedagogical Knowledge (TPK)	49	4.05	0.91	Moderately Competent	2
Technological Knowledge (TK)	49	4.03	0.81	Moderately Competent	3
Technological Content Knowledge (TCK)	49	3.99	0.94	Moderately Competent	4
Pedagogical Knowledge (PK)	49	3.96	0.80	Moderately Competent	5
Technological Pedagogical Content Knowledge (TPCK)	49	3.67	0.67	Moderately Competent	6
Pedagogical Content Knowledge (PCK)	49	3.60	0.87	Moderately Competent	7

Overall, the seven components clustered in the Moderately Competent to Very Competent range, with narrow standard deviations suggesting a fairly consistent level of proficiency across the teacher sample. Content Knowledge ranked highest (M = 4.38), driven by strong confidence in independently deepening subject-matter understanding (CK3: M = 4.53) and reasoning like a subject-matter expert (CK2: M = 4.51), though explicit confidence in "teaching" the subject (CK4: M = 4.14) lagged slightly behind. This aligns with Ward's (2009) observation that pre-service preparation alone does not guarantee mastery of subject matter sustained professional development remains necessary even where foundational confidence is high.

Technological Knowledge (TK, M = 4.03) showed particular strength in keeping up with new technologies (TK4: M = 4.45) but comparatively lower scores for ease of learning new tools (TK2: M = 3.73) and independent troubleshooting (TK3: M = 3.82) — consistent with Spiteri's (2018) point that teachers face an ongoing burden of continuously acquiring new technical skills as tools evolve.

Pedagogical Knowledge (PK, M = 3.96) was comparatively strong in stretching students' thinking (PK1: M = 4.08) and guiding learning strategies (PK2: M = 4.08), but weaker in facilitating effective group discussion (PK5: M = 3.61) — the single lowest-rated PK item. Technological Content Knowledge (TCK, M = 3.99) was strongest in knowledge of research-related technologies (TCK2: M = 4.08) and specialized inquiry software (TCK4: M = 4.27), consistent with

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
Published by: RISEJOURNALS.ORG | Online ISSN: 3028-032X | Print ISSN: 3028-0370
VOLUME 4, ISSUE NO. 7

Koh and Chai's (2014) framing of TCK as knowing how tools like GIS or statistical software can represent and generate discipline-specific content.

Pedagogical Content Knowledge (PCK) received the lowest overall rating (M = 3.60), with its weakest item concerning engaging students in real-world problem-solving without technology (PCK4: M = 3.47). Because PCK is, by definition, the integration point between subject expertise and teaching craft, this result echoes Loughran's (2020) observation that PCK is most visibly tested — and most likely to reveal gaps — when teachers must adapt unfamiliar or complex content for learners without relying on external tools.

Technological Pedagogical Knowledge (TPK, M = 4.05) was the second-highest-rated component, reflecting comfort using technology to introduce real-world scenarios (TPK1: M = 4.02) and to help students construct varied knowledge representations (TPK3: M = 4.14). Finally, the fully integrated Technological Pedagogical Content Knowledge (TPCK, M = 3.67) component was rated second-lowest overall. Within it, teachers were confident designing inquiry activities with ICT tools (TPCK4: M = 4.00) but markedly less confident designing lessons that appropriately integrate content, technology, and pedagogy specifically for student-centered learning (TPCK5: M = 2.94, SD = 1.39) — the single lowest mean score and highest variability recorded anywhere in the survey. This item is the clearest quantitative signal of the study's central finding: teachers are individually competent across the base and paired domains, but the fully synthesized, student-centered application of TPACK remains the weakest link.

Read together, the seven component means also illustrate a broader pattern noted in the TPACK literature: teachers' confidence tends to be highest in the base domains they experience most directly and continuously (subject-matter content, and hands-on technology use) and lowest in the domains that require deliberately combining those base domains into new instructional designs (PCK and TPCK). This is consistent with Gu et al. (2013) and Orlando and Attard's (2016) distinction between knowledge of traditional curricula and knowledge of technology-integrated curricula — the latter being demonstrably more complex to develop and sustain.

RQ2: Differences Among the Seven TPACK Components

A one-way ANOVA testing for differences among the seven component means was statistically significant, $F(6, 24) = 4.819$, $p = .002$, indicating that at least one component differed meaningfully from the others.

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.804	6	.301	4.819	.002
Within Groups	1.497	24	.062		
Total	3.301	30			

A post-hoc Tukey HSD test isolated the significant pairwise contrasts to Content Knowledge versus Pedagogical Content Knowledge (p = .002) and Content Knowledge versus Technological Pedagogical Content Knowledge (p = .005). In other words, the significant variance in the model is attributable almost entirely to the gap between teachers' strongest domain (subject mastery) and their two most integrative domains (PCK and TPCK) — reinforcing that the challenge is not technological literacy in isolation, but the synthesis of content with pedagogy, with or without technology in the mix. This pattern is consistent with recent literature on the difficulty of developing PCK: Kim, Park, and Lee (2019) describe PCK development among science teachers as requiring a delicate balance between subject mastery and pedagogical practice, while Loughran, Berry, and Mulhall (2019) emphasize those difficulties in pre-service contexts specifically. Niess (2005) and Valanides et al. (2009) further suggest that technology can facilitate PCK development by enabling interactive, reflective learning experiences but only with sustained training and support, which is precisely the intervention this study's findings point toward.

RQ3: Teachers' Experiences Integrating TPACK

Thematic analysis of the interview data produced five substantive themes plus a cross-cutting theme of challenges.

Theme 1: TPACK Framework Awareness and Application

Most teachers in the study recognized the practical importance of blending technology, pedagogy, and content knowledge, even when they were not explicitly familiar with the TPACK label itself. This pattern echoes a recurring observation in the literature: TPACK is often practiced intuitively by experienced teachers well before it is encountered as a named theoretical construct. Mishra and Koehler (2006) themselves framed TPACK not as a wholly new skill set but as a way of naming and formalizing the tacit, integrated knowledge that effective teachers already draw upon when they weave technology into subject-specific instruction.

The teachers' casual, secondhand familiarity with the term described as something "heard about" rather than deeply studied is therefore less a sign of deficiency than a predictable feature of how frameworks diffuse into practice: the underlying skill often precedes the formal vocabulary for it.
Several teachers noted encountering TPACK only through in-service training (INSET) or graduate coursework, suggesting that formal exposure to the framework, where it exists, arrives relatively late in a teacher's career rather than during initial preparation.

This is consistent with Baran, Chuang, and Thompson's (2011) characterization of TPACK as an "emerging" research and development tool whose uptake in teacher education programs has been uneven and whose fullest articulation is often reserved for graduate-level study or targeted professional development rather than undergraduate teacher training. Schmidt et al. (2009) similarly developed their TPACK assessment instrument specifically for preservice teachers, implying that structured exposure to the framework has historically been concentrated at that stage of training leaving many in-service teachers, including the ones in this study, to encounter the framework informally or belatedly.

The teachers' emphasis that using technology "nowadays" is simply an unavoidable part of good teaching reflects what Harris, Mishra, and Koehler (2009) describe as the reframing of technology integration around curriculum-based learning activity types rather than around technology as a novelty. Teachers in this study appear to have internalized technology as a routine instructional ingredient rather than as a discrete, separately-taught competency precisely the outcome Harris et al. (2009) argue TPACK-informed practice should produce. Chai, Ng, Li, Hong, and Koh's (2013) validation of the TPACK self-efficacy instrument among Asian preservice teachers likewise found that teachers could report confident, differentiated self-assessments of their technology-pedagogy-content integration even without formal framework instruction, supporting the interpretation that practical competence and theoretical labeling develop along loosely coupled timelines.

Multiple teachers linked their heightened technology use directly to the pandemic-era shift toward remote and hybrid instruction, describing TPACK-relevant practices as having been "highlighted during the pandemic." This is consistent with Hargreaves and Fullan's (2020) argument that the pandemic functioned as an accelerant for skills and dispositions that had previously been optional or peripheral, compressing years of gradual technology adoption into a matter of months and forcing rapid, often self-directed learning that later needs to be consolidated through structured professional development rather than treated as a completed process.

Taken together, this theme suggests that awareness of TPACK as a named framework lags behind the practical, integrated skill it describes, and that much of teachers' current competency was built reactively, under pandemic pressure, rather than through deliberate framework-based training. This has a direct implication for professional development design: rather than introducing TPACK as an entirely new concept, institutions may achieve more traction by explicitly naming and organizing the integrated practices teachers already perform, then building forward from that recognition an approach consistent with Koehler and Mishra's (2009) argument that TPACK's value lies partly in giving teachers a shared vocabulary for knowledge they already hold.

Theme 2: Engagement and Interaction
Teachers described using gamification, multimedia presentations, and interactive online tools specifically to sustain student attention and to offset the perceived "boredom" of some subject matter. This engagement-first framing of technology adoption is well supported in the literature on teacher beliefs and technology integration. Ertmer,

Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) found that teachers' technology integration practices are strongly mediated by their underlying pedagogical beliefs teachers who see technology chiefly as a tool for increasing student engagement, as this study's respondents do, will gravitate toward integration strategies that foreground interactivity and novelty rather than strategies aimed primarily at content delivery efficiency. The teachers' own descriptions students "do not sleep in class" and "get excited for games" are a direct, if informal, illustration of the belief-practice relationship Ertmer et al. (2012) describe.

The use of digital presentation tools to free teachers from the whiteboard and allow them to "roam around" the classroom reflects a subtler dimension of engagement that is less often captured in TPACK research but is consistent with Goradia's (2018) account of how educational technologies reshape the physical and relational dynamics of the classroom, not merely the content delivered within it. Goradia (2018) frames technology as enabling academics to redesign the learning environment itself including their own physical positioning and mode of interaction with students in service of 21st-century pedagogies. The teachers' preference for polished digital visuals over hand-drawn illustrations similarly aligns with Goradia's (2018) broader argument that technology substitutes for and extends teachers' own representational limitations, allowing subject matter to be visualized in ways that individual teachers might not otherwise be able to produce.

This theme also resonates with constructivist accounts of classroom technology use. Pourhosein Gilakjani, Mei Leong, and Nizam Ismail (2013) argue that teachers' use of technology is most effective, and most sustainable, when it is grounded in constructivist assumptions about learning that students build understanding through active engagement rather than passive reception. The gamified and interactive strategies teachers describe (motivation games at the start of class, multimedia-driven anticipation of "what's new" on the next slide) are consistent with this orientation: rather than using technology to transmit information more efficiently, teachers use it to generate conditions under which students actively construct their own engagement with content. Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, and García-Martínez's (2020) systematic review nonetheless cautions that engagement-oriented technology use represents only one dimension of digital competence and can develop unevenly relative to competences such as assessment design — a pattern worth verifying against the study's other themes.

Theme 3: Adaptation to New Teaching Methods

Teachers reported deliberately replacing traditional methods physical dice, paper-and-pen multiple choice, straight lecture with technology-enabled equivalents such as phone-based random generators projected to the class, live polling tools like Mentimeter, and phone-camera scanning of answer cards, primarily to increase efficiency, equity of participation, and student attention. Several teachers pegged sustained attention during straight lecture at roughly fifteen minutes, a number that functions in their accounts as a practical threshold justifying the switch to more interactive formats.

This pattern of substitution replacing an analog classroom routine with a digital one that serves the same pedagogical function but with added interactivity is precisely the kind of technology-pedagogy synthesis that Ndongfack (2015) identifies as central to sustainable technology adoption among teachers: adoption is more durable when technology is integrated into existing pedagogical routines rather than introduced as an entirely separate activity.

The specific tools teachers describe live polling software, phone-based scanning, digital randomization also illustrate what Davies and West (2014) call the integration of technology into the operational fabric of the classroom, as opposed to its use for isolated, one-off demonstrations. Davies and West (2014) note that technology integration tends to be most durable when it addresses a recurring instructional need (in this case, the need to distribute a randomized prompt, collect a poll response, or grade a multiple-choice check quickly) rather than when it is deployed for novelty alone. The teachers' consistent emphasis on efficiency and equitable participation for example, projecting a digital dice result to a television so "everyone can see the result," rather than crowding around a single physical die suggests that their adoption choices are driven by identifiable pedagogical problems (visibility, fairness, pacing) rather than by technology enthusiasm in the abstract.

This theme also connects to Jaipal-Jamani and Figg's (2015) account of the planning attributes required for effective technology-integrated lessons, including activity selection, sequencing, and contingency instruction — the capacity to adapt a lesson plan when a chosen technology does not work as expected. The teachers' adoption of phone-based tools as substitutes for physical classroom objects demonstrates exactly this contingency-aware planning: each substitution was chosen because it solved a specific classroom-management problem (space, visibility, pacing, or verification). Koh and Chai (2014) similarly describe how teacher "clusters" differ in how they enact TPACK-informed lesson design; the substitution pattern described here suggests these SHS teachers cluster toward a pragmatic, problem-solving orientation rather than a purely exploratory one.

The emergence of generative artificial intelligence use by students was described as a new and destabilizing pedagogical challenge, prompting at least one teacher to design deeper, less easily automatable questions to verify genuine understanding. This adaptive response is consistent with the broader argument, advanced across the TPACK literature from Mishra and Koehler (2006) onward, that technological knowledge is not static but must continually evolve alongside the technologies available to and used by students, not just those deployed by teachers.

Jaipal-Jamani and Figg (2015) make this point explicitly: teacher knowledge is dynamic and responsive to technological change, its context of use, and its impact on learners a description that applies directly to the teacher who restructured questioning strategy specifically because a student had used AI to answer a prior question. This suggests that adaptation, in this theme, extends beyond teachers adopting new tools themselves to teachers actively redesigning pedagogy in response to tools their students bring into the classroom unprompted.

Theme 4: Efficiency and Effectiveness

Teachers valued technology chiefly for accelerating information-gathering, replacing costly or unavailable textbooks with online learning management system resources, improving the visualization of difficult concepts, and enabling more direct monitoring of student output and progress compared to fully manual methods. This efficiency-oriented account aligns closely with Tinio's (2003) foundational argument that information and communication technology's core value in education, particularly in resource-constrained contexts, lies in expanding access to learning materials and improving the relevance and scalability of instruction.

The teachers' reliance on online learning management systems in place of physical textbooks is a direct, present-day instantiation of the access-expansion function Tinio (2003) describes at the policy level: where physical resources are limited or costly, digital resources substitute for them and, in the teachers' own framing, become "important resources to learn" rather than optional supplements.

The teachers' emphasis on improved visualization of difficult concepts also reflects Davies and West's (2014) discussion of technology integration as a means of representing content in ways not achievable through traditional instructional media alone. One teacher's comment that "if chalkboard, I am not good in drawing" is a concrete, individual-level illustration of the representational gap that Davies and West (2014) describe technology as filling at a systemic level: technology does not merely speed up existing teaching methods but extends what can be represented and taught in the first place, independent of an individual teacher's own technical or artistic skill.

Teachers' use of technology to monitor student output and progress more directly than manual methods allow speaks to a dimension of efficiency that is closely tied to accountability and formative assessment. Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, and García-Martínez (2020) identify monitoring and assessment-related digital competence as a distinct component of teacher digital competence, separate from competences related to content delivery or student engagement. That the teachers in this study describe monitoring ("I can also monitor their files"; "Technology allowed me to facilitate and monitor the students' output") as a clear, valued efficiency gain suggests that this particular digital competence monitoring and progress-tracking is comparatively

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
Published by: RISEJOURNALS.ORG | Online ISSN: 3028-032X | Print ISSN: 3028-0370
VOLUME 4, ISSUE NO. 7

well developed among this teacher population, even as other competences, such as the design of assessments that resist misuse (discussed further under the challenges surfaced elsewhere in the interviews), remain less resolved.

Considered alongside Theme 3, this theme reinforces a consistent thread: teachers' technology adoption decisions are driven less by abstract enthusiasm for digital tools than by concrete, recurring instructional problems costly materials, difficult-to-draw content, labor-intensive monitoring that technology visibly solves, consistent with Ndongfack's (2015) claim that sustainable adoption depends on technology being perceived as solving a real pedagogical problem.

Theme 5: Empowering Student-Centered Learning Through Technology
Several accounts described students using technology independently for ideation for example, researching market trends for a business plan for online collaboration during group projects, and for creative expression through digital platforms, including among students who, in one teacher's words, "do not know how to draw." Teachers framed these as instances where technology shifted greater ownership of the learning process to students themselves. This theme represents the clearest evidence in the interview data of technology being used not merely to support teacher-delivered instruction (as in Themes 2 and 4) but to enable student agency directly, which is the more demanding and, according to the survey component of the wider study, less consistently achieved application of TPACK.

The pattern of students using mobile devices and the internet independently to gather ideas and inspiration is consistent with Goradia's (2018) description of technology-enabled learning as extending beyond the classroom's physical and temporal boundaries, giving students access to a breadth of information and perspective that traditional, teacher-mediated instruction cannot easily replicate. Goradia (2018) frames this expanded access as central to 21st-century pedagogy's promise: technology does not just make existing teacher-led activities more efficient, it makes genuinely student-directed inquiry feasible at scale. The business-plan ideation example offered by teachers in this study is a direct illustration of that promise being realized in a specific, subject-grounded context.

Online collaboration during group projects, described by teachers as students collaborating "online" while co-writing a business plan, reflects what Angeli and Valanides (2009) identify as a key methodological consideration in developing ICT-integrated pedagogical content knowledge: technology's capacity to support distributed, asynchronous collaboration among learners, which reorganizes not just how content is delivered but how students interact with one another around that content. Angeli and Valanides (2009) argue that this reorganization of student interaction is one of the more conceptually demanding aspects of TPCK to develop, because it requires teachers to design activities around technology-mediated collaboration rather than simply digitizing an individual assignment a distinction that appears to be present, at least in emerging form, in the teachers' descriptions of structured, technology-supported group work.

The use of digital platforms to enable creative expression among students who lack traditional artistic skill echoes Jaipal-Jamani and Figg's (2015) emphasis on differentiation as a core planning attribute of effective technology-integrated lessons: technology, in this account, does not standardize student output but instead accommodates a wider range of student starting points and abilities than a single traditional medium (such as freehand drawing) would allow. Teachers' framing that technology "expands the creativity of the students" and gives students "a lot of things that they can do" suggests that, at least anecdotally, teachers perceive this differentiating function of technology as a meaningful pedagogical gain rather than a mere accommodation.

At the same time, this theme should be read in light of the broader study's quantitative finding that the specific TPACK survey item asking teachers to rate their ability to design lessons that appropriately integrate content, technology, and pedagogy for student-centered learning received the lowest mean score and the highest variability of any item in the instrument. The rich, positive examples captured under this theme are therefore best understood as instances of emergent practice among some teachers rather than as evidence of consistent, institution-wide competency.

This is consistent with Ramos, Babasa, Vergara, Manalo, Gappi, and Morfi's (2020) finding that teachers' TPACK confidence, even where present, is often unevenly distributed and shaped by individual opportunity and training history rather than uniformly held across a teaching population; and with Santos and Castro's (2021) observation that translating TPACK understanding into actual classroom application rather than confidence about TPACK in the abstract remains the more demanding and more variable step. Sapad and Caballes (2022) similarly argue, in the context of designing professional development for instructional leaders, that moving from isolated examples of strong practice to consistent, framework-guided application across a teaching staff requires deliberate, structured intervention rather than relying on organic diffusion of good practice from a few confident teachers to the wider faculty.

Read together with Theme 1's finding that TPACK awareness is often informal and reactive, this theme suggests a plausible explanation for the unevenness: teachers who happened to develop stronger comfort with student-directed, collaborative technology use through personal interest, subject-area demands, or prior exposure produced the strongest examples of student-centered integration, while teachers without that combination of circumstances remained comparatively less confident in this specific application, even if otherwise competent across other TPACK components.

Synthesis Across Themes

Across all five themes, a consistent pattern emerges: teachers' technology use is driven primarily by identifiable pedagogical needs sustaining attention, solving classroom-management problems, expanding access to resources, and, in its most developed form, enabling student-directed learning rather than by technology adoption for its own sake. This need-driven orientation is broadly consistent with Ertmer et al.'s (2012) argument that teacher beliefs about the purpose of technology shape integration practice more strongly than access to technology itself, and with Ndongfack's (2015) claim that sustainable adoption depends on technology being perceived as solving a genuine problem within existing pedagogical routines.

At the same time, the themes reveal a gradient of pedagogical sophistication, moving from technology as an attention-management tool (Theme 2), through a direct substitute for analog classroom routines (Theme 3) and an efficiency and monitoring aid (Theme 4), to a vehicle for genuine student agency and ownership (Theme 5). This gradient mirrors the distinction Angeli and Valanides (2009) and Jaipal-Jamani and Figg (2015) draw between technology that enhances existing, teacher-centered instruction and technology that reorganizes instruction around student-directed activity the latter consistently identified as the more difficult TPACK competency to develop. The comparative richness of Themes 2 through 4, contrasted with the more qualified, teacher-dependent character of Theme 5, offers a qualitative counterpart to the quantitative finding that the fully synthesized, student-centered application of TPACK remains the area most in need of structured support (Cortes et al., 2022; Morales et al., 2022; Abenes & Caballes, 2020).

Taken as a whole, these themes suggest that professional development would benefit from building explicitly on teachers' already-strong, needs-driven adoption habits (Themes 2–4) as a bridge toward the more demanding, less evenly distributed competency in Theme 5, rather than treating student-centered technology integration as a separate skill introduced from scratch — an approach aligned with Boud and Molloy's (2013) argument that effective professional learning should build on learners' existing practice through structured reflection and feedback rather than a deficit model.

Cross-Cutting Theme: Challenges and Learning Curves

Despite this generally positive orientation toward technology, teachers consistently flagged three recurring obstacles: unreliable classroom internet connectivity (prompting workarounds such as pre-downloading materials); concerns about academic integrity and authenticity in open-note online assessments; and gaps in technical proficiency with unfamiliar tools (for example, knowing how to connect an HDMI cable but not how to operate screen-sharing software), which some teachers described with resigned acceptance rather than active troubleshooting.

Collectively, the thematic findings mirror and help explain the quantitative results: teachers are enthusiastic, resourceful users of technology for engagement and efficiency (reflected in the comparatively high TK and TPK scores), but they encounter their sharpest limitations exactly where content, pedagogy, and technology must be synthesized into deliberately student-centered lesson design (reflected in the low TPCK5 item score and the significant CK–PCK and CK–TPCK contrasts from the ANOVA).

RQ4: The Proposed KAREL Professional Development Framework

In response to the identified gaps — particularly around PCK and the student-centered application of TPCK — the researcher proposed the KAREL Framework (Enad, 2024), a five-stage professional development model:

- Know — Conduct needs assessments to identify specific gaps and opportunities for each teacher or department before designing training.
- Apply — Provide hands-on workshops and ongoing support so teachers translate newly learned strategies into actual classroom practice (Ertmer & Ottenbreit-Leftwich, 2012).
- Reflect — Build in structured reflection and peer feedback mechanisms so teachers can critically evaluate and adapt their own methods (Boud & Molloy, 2013).
- Empower — Give teachers the resources, autonomy, and leadership opportunities needed to take ownership of their continued growth (Hargreaves & Fullan, 2020).
- Live Up — Sustain collaborative learning communities where best practices are shared on an ongoing basis, embedding continuous improvement into the institutional culture.

The full plan operationalizes each stage against specific competency targets surfaced by the data for example, structured KAREL-based interventions for digital literacy and fluency, for addressing common learning difficulties (tied to the PCK gap), and for facilitating effective group discussions (tied to the lowest-rated PK item, PK5). In each case, the plan pairs a concrete activity or strategy with an expected outcome, giving the institution a direct bridge from diagnostic survey data to actionable training design — addressing RQ4 and completing the study's applied, educational-management-oriented aim.

Conclusion:

This study set out to determine the TPACK competency of Senior High School teachers in a private Philippine institution, to test whether that competency differs meaningfully across TPACK's seven components, to understand teachers' lived experience of integrating TPACK, and to translate the resulting evidence into a professional development plan. Across all four aims, a consistent picture emerged: SHS teachers hold a solid, moderate-to-high foundation across every TPACK component, anchored by strong subject-matter confidence (Content Knowledge, the highest-rated domain) and by comfortable, resourceful use of technology for engagement, efficiency, and access to information. At the same time, the study identified a specific and statistically confirmed weak point — the integration of content and pedagogy, particularly the fully synthesized, student-centered application captured in Technological Pedagogical Content Knowledge — that both the survey data (via the significant ANOVA contrasts and the notably low TPCK5 item) and the interview data (via the Challenges and Learning Curves theme) converge on independently.

These findings are consistent with the broader literature on TPACK (Mishra & Koehler, 2006; Gu et al., 2013; Orlando & Attard, 2016) and on the particular difficulty of developing Pedagogical Content Knowledge (Cortes et al., 2022; Loughran, 2013; Kim, Park, & Lee, 2019), reinforcing that this is not an idiosyncratic finding of a single institution but part of a recognized, recurring challenge in teacher professional growth. The study's contribution lies less in identifying a novel problem than in demonstrating, through its mixed-methods design, exactly where the problem is located within the seven-component TPACK structure and in proposing the KAREL Framework as a concrete, stage-based response moving from institutional diagnosis (Know) through applied practice, reflection, empowerment, and sustained collaborative culture (Live Up). For educational management specifically, this offers a replicable template: administer a validated TPACK instrument, pair it with qualitative interviews, use ANOVA and post-hoc testing to locate the statistically weakest components, and design professional development that targets those components directly rather than offering generic technology training.

The study's scope was necessarily bounded a single private institution, 49 respondents, and self-reported rather than observed competency and the original thesis accordingly recommends further research into the specific mechanisms linking TPACK to student-centered learning outcomes, comparative studies of professional development approaches, and exploration of how emerging technologies such as artificial intelligence and virtual reality might reshape TPACK integration going forward. Within those bounds, however, the evidence supports a clear, actionable conclusion: SHS teachers in this setting are technologically capable and pedagogically competent individually, but require targeted, sustained institutional support to consistently fuse those capacities into student-centered, technology-integrated instruction.

Taken as a whole, the study reaffirms that TPACK competency is not a binary state of "having" or "lacking" the framework, but a differentiated profile in which some domains reach maturity well ahead of others. For this institution, and plausibly for comparable SHS settings, the practical implication is that professional development spending is better directed at the specific integrative domains shown to lag — PCK and student-centered TPCK — than spread evenly across generic technology training that largely reinforces skills teachers already possess.

References:

Abenes, F. M., & Caballes, D. (2020, March). Technological knowledge and technological pedagogical knowledge of science teachers: Basis for faculty development. Data Mining and Knowledge Engineering, 12(3), 41–47.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). Computers & Education, 52(1), 154–168.

Baran, E., Chuang, H.-H., & Thompson, A. (2011). TPACK: An emerging research and development tool for teacher educators. Turkish Online Journal of Educational Technology, 10(4), 370–377.

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. Assessment & Evaluation in Higher Education, 38(6), 698–712.

Chai, C. S., Ng, E. M., Li, W., Hong, H.-Y., & Koh, J. H. L. (2013). Validating and modelling technological pedagogical content knowledge framework among Asian preservice teachers. Australasian Journal of Educational Technology, 29(1). https://doi.org/10.14742/ajet.174

Cortes, S. T., Pineda, H. A., & Jugar, R. R. (2022). Alignment of the revised secondary teacher education curriculum and the hiring qualifications for SHS teachers in the Philippines: A theoretical gap analysis. Journal of Education Naresuan University, 24(1), 1–14.

Davies, R. S., & West, R. E. (2014). Technology integration in schools. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), Handbook of research on educational communications and technology (pp. 841–853).

Department of Education. (2013). DepEd Order No. 36, s. 2013.

Department of Education. (2016). DepEd Order No. 3, s. 2016.

Department of Education. (2017). DepEd Order No. 42, s. 2017: Philippine Professional Standards for Teachers.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education, 59(2), 423–435.

Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2020). Digital competences for teacher professional development: Systematic review. European Journal of Teacher Education, 45(4), 1–19.

Goradia, T. (2018). Role of educational technologies utilizing the TPACK framework and 21st century pedagogies: Academics' perspectives. IAFOR Journal of Education, 6(3), 43–61.

Hargreaves, A., & Fullan, M. (2020). Professional capital after the pandemic: Revisiting and revising classic understandings of teachers' work. Journal of Professional Capital and Community, 5(3/4), 327–336.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. Journal of Research on Technology in Education, 41(4), 393–416.

Jaipal-Jamani, K., & Figg, C. (2015). The framework of TPACK-in-practice: Designing content-centric technology professional learning contexts to develop teacher knowledge of technology-enhanced teaching (TPACK). In Technological pedagogical content knowledge: Exploring, developing, and assessing TPCK (pp. 137–163).

Kim, H., Park, S., & Lee, J. (2019). Developing pedagogical content knowledge of science teachers: A longitudinal case study. Journal of Science Teacher Education, 30(7), 725–743.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? Contemporary Issues in Technology and Teacher Education, 9(1), 60–70.

Koh, J. H. L., & Chai, C. S. (2014). Teacher clusters and their perceptions of technological pedagogical content knowledge (TPACK) development through ICT lesson design. Computers & Education, 70, 222–232.

Loughran, J. (2013). Pedagogy: Making sense of the complex relationship between teaching and learning. Curriculum Inquiry, 43(1), 118–141.

Loughran, J., Berry, A., & Mulhall, P. (2019). Exploring pedagogical content knowledge in science teacher education. International Journal of Science Education, 41(4), 449–466.

Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. All Ireland Journal of Higher Education, 9(3).

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054.

Morales, M. P. E., Avilla, R. A., Sarmiento, C. P., Anito, J. C., Elipane, L. E., Palisoc, C. P., Palomar, B. C., Ayuste, T. O. D., & Ramos-Butron, B. (2022). Experiences and practices of STEM teachers through the lens of TPACK. Journal of Turkish Science Education, 19(1), 233–252.

Ndongfack, M. N. (2015). TPACK constructs: A sustainable pathway for teachers' professional development on technology adoption. Creative Education, 6(16), 1697–1709.

Pourhosein Gilakjani, A., Mei Leong, L., & Nizam Ismail, H. (2013). Teachers' use of technology and constructivism. International Journal of Modern Education and Computer Science, 5(4), 49–63.

Ramos, R. A., Babasa, E. E., Vergara, I. B., Manalo, B. I., Gappi, L. L., & Morfi, T. G. (2020). The TPACK confidence of pre-service teachers in selected Philippine teacher education institutions. International Journal of Education, Psychology and Counseling, 5(37), 196–205.

Republic Act No. 10533. (2013). Enhanced Basic Education Act of 2013. Official Gazette of the Republic of the Philippines.

Santos, J. M., & Castro, R. D. R. (2021). Technological pedagogical content knowledge (TPACK) in action: Application of learning in the classroom by pre-service teachers (PST). Social Sciences & Humanities Open, 3(1), 100110.

Sapad, R., & Caballes, D. (2022, June). Initiation of a professional development program for science instructional leaders within the technological pedagogical content knowledge (TPACK) framework. The Palawan Scientist.

Schmidt, D., Baran, E., Thompson, A., Mishra, P., Koehler, M., & Shin, T. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. Journal of Research on Technology in Education, 42(2), 123–149.

Tinio, V. L. (2003). ICT in education. United Nations Digital Library System.

Ward, P. (2009). Content matters: Knowledge that alters teaching. In Historic traditions and future directions of research on teaching and teacher education in physical education (pp. 345–356).