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TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) AND LEARNER ACHIEVEMENT: EXAMINING THE DIGITAL TEACHING PRACTICES OF ELEMENTARY TEACHERS

Ramir S. Austria, PhD
Dean, College of Teacher Education
University of the Cordilleras
Baguio City, Philippines
Email: rsaustria@uc-bcf.edu.ph

Samuel D. Lachica
School Principal I
Department of Education - Baguio City; University of the Cordilleras
Baguio City, Philippines
Email: samuel.lachica@deped.gov.ph

Lynlyn M. Bawagan-Daluping
Assistant Professor IV
Kalinga State University; University of the Cordilleras
Baguio City, Philippines
Email: lmbawagan@ksu.edu.ph

Corresponding Author

Samuel D. Lachica
School Principal I
Department of Education - Baguio City; University of the Cordilleras
Baguio City, Philippines
Email: samuel.lachica@deped.gov.ph

ABSTRACT

This study examined elementary school teachers' Technological Pedagogical Content Knowledge (TPACK), their digital teaching practices, and the relationship between TPACK and learner achievement in District IX of Baguio City. A quantitative descriptive-correlational design was employed among public elementary school teachers from four participating schools selected through total enumeration. Data were collected using an adapted TPACK questionnaire administered through Google Forms, while learner achievement was measured using Grade 6 regional assessment results. Descriptive statistics and Pearson's product-moment correlation were used to analyze the data. Findings revealed generally favorable self-reported TPACK competencies across the schools. Pedagogical Knowledge and Pedagogical Content Knowledge consistently emerged as the strongest dimensions, whereas Technological Knowledge was comparatively lower, indicating a need to improve teachers' independent use and adaptation of digital technologies. Teachers also demonstrated favorable Technological Pedagogical Knowledge, with an overall mean of 3.950, suggesting that they perceived themselves as capable of selecting and adapting technologies according to instructional approaches, learning objectives, and learners' needs. However, the relationship between school-level integrated TPACK and learner achievement was very weak and positive (r = .152, R^2 = .023), indicating that higher TPACK was only minimally associated with higher achievement. Because the correlation was based on four aggregated school-level observations, the result was treated as preliminary and noncausal. The study recommends sustained, practical, and school-based professional development that strengthens Technological Knowledge while connecting digital tools with content, pedagogy,

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assessment, and learner needs. Future research should use larger samples, teacher-level data, and direct classroom evidence to clarify how TPACK relates to learner outcomes.

Keywords: *digital teaching practices, elementary education, learner achievement, technology integration, Technological Pedagogical Content Knowledge, TPACK*

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INTRODUCTION

Background of the Study

The continuing development of digital technologies has transformed the educational landscape and expanded the range of resources available for teaching, assessment, communication, collaboration, and learner engagement. Digital platforms, multimedia materials, productivity applications, learning management systems, and online assessment tools provide teachers with opportunities to make instruction more interactive, differentiated, and responsive to learners' needs. Nevertheless, the availability of technology does not automatically improve instructional quality or produce better learning outcomes. Its educational value largely depends on teachers' ability to select and use appropriate digital tools in ways that are consistent with the subject matter, instructional objectives, pedagogical approaches, learner characteristics, and classroom context.

The importance of teachers' digital competence is recognized in the ICT Competency Framework for Teachers developed by UNESCO (2018). The framework emphasizes that teachers need appropriate competencies to integrate digital technologies into curriculum implementation, assessment, pedagogy, classroom organization, administration, and professional development. It also recognizes that effective technology integration requires an enabling environment characterized by institutional leadership, appropriate policies, continuing professional development, and adequate technological support.

The need for digital competence is particularly important in elementary education, where teachers are responsible for developing learners' foundational knowledge, skills, values, and learning habits. Elementary school teachers must understand the content they teach and determine how that content can be presented in developmentally appropriate and meaningful ways. When technology is incorporated into instruction, teachers must make additional decisions concerning which digital tools are suitable, how these tools support particular teaching strategies, and how their use can contribute to intended learning outcomes.

Evaluating teachers' technological skills alone may therefore provide an incomplete understanding of effective digital instruction. A teacher may know how to operate a digital tool but may not necessarily know how to use it to explain a particular concept, facilitate learner interaction, assess understanding, or address differences in learners' abilities. Effective digital teaching consequently requires the purposeful integration of technological, pedagogical, and content knowledge.

Theoretical Framework: The TPACK Framework

The Technological Pedagogical Content Knowledge (TPACK) framework provides a theoretical basis for examining the knowledge teachers need to integrate technology effectively into instruction. Mishra and Koehler (2006) developed the framework by extending Shulman's concept of pedagogical content knowledge to include technological knowledge. The framework treats technology integration as a complex, contextualized, and interconnected process rather than as the isolated acquisition of technical skills (Koehler & Mishra, 2009).

The framework consists of three primary knowledge domains: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). Content Knowledge refers to teachers' understanding of the subject matter they teach. Pedagogical Knowledge concerns their understanding of teaching methods, classroom management, assessment, instructional planning, and how learners acquire knowledge. Technological Knowledge refers to teachers' ability to understand, operate, evaluate, and adapt to traditional and emerging technologies (Mishra & Koehler, 2006).

The interaction of the three primary domains produces four additional areas of knowledge. Pedagogical Content Knowledge (PCK) refers to teachers' understanding of how particular subject matter can be taught effectively. Technological Content Knowledge (TCK) concerns how technology can be used to represent, explore, or transform subject-matter content. Technological Pedagogical Knowledge (TPK) involves understanding how particular technologies can support or influence teaching and learning strategies. At the intersection of the three

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primary domains is Technological Pedagogical Content Knowledge (TPACK), which represents teachers' integrated understanding of how appropriate technologies, pedagogical methods, and subject content can be combined to facilitate meaningful learning (Koehler et al., 2013; Mishra & Koehler, 2006).

TPACK has become an important framework in teacher education and professional development because it shifts attention from simply knowing how to operate technology toward designing instruction in which technology serves a clear pedagogical and curricular purpose. Koehler et al. (2013) viewed teachers not merely as users of digital tools but as designers of learning experiences who must consider learners' prior knowledge, curricular requirements, instructional approaches, available resources, and classroom conditions.

Related Literature

Research in elementary education suggests that teachers' TPACK can be strengthened through sustained, collaborative, practical, and reflective professional development. Rahayu et al. (2024), for example, reported that professional development activities combining collaboration, classroom application, and structured reflection strengthened elementary teachers' TPACK, particularly their Technological Pedagogical Knowledge. Similarly, Wardan (2024) reviewed studies concerning TPACK-based learning in elementary education and emphasized the importance of professional development programs that help teachers connect technological skills with pedagogical and content-related decisions. The review also indicated that teachers' ability to integrate technology into classroom instruction has not consistently reached optimal levels.

Recent studies likewise indicate that teachers may demonstrate stronger pedagogical and content knowledge than technological or integrative knowledge. Insufficient digital resources, limited training, technical problems, and inadequate preparation time may prevent teachers from translating their TPACK into meaningful classroom practices (Vijayatheepan, 2025).

Teachers' knowledge and their actual classroom practices must also be distinguished. Teachers may report that they possess technological knowledge while using technology primarily for presentations, information delivery, or administrative tasks. More meaningful integration occurs when teachers use technology to encourage active participation, collaboration, critical thinking, problem-solving, differentiated instruction, formative assessment, feedback, and learner-centered knowledge construction.

Research Gaps

Although considerable research has examined teachers' TPACK, several gaps remain. First, many studies have focused on teachers' self-reported knowledge, attitudes, or readiness to use technology without sufficiently examining how these competencies are reflected in actual teaching practices. Because perceived competence does not always translate into meaningful classroom application, there is a need to investigate both what teachers report knowing and how they integrate technology into instruction.

Second, existing studies frequently examine TPACK in relation to instructional effectiveness, teacher preparation, professional development, or attitudes toward technology. Comparatively less attention has been given to its relationship with measurable learner outcomes, particularly the academic achievement of elementary school learners (cf. Christensen, 2002, on technology integration and student achievement in a specific subject area). This distinction is important because effective technology integration should ultimately be evaluated not only through teachers' competence or frequency of technology use but also through its association with learners' educational performance.

Third, technology integration is context-dependent. Teachers' practices may be influenced by access to digital devices, internet connectivity, technical support, professional development opportunities, school leadership, teaching assignments, learner characteristics, and the availability of localized digital resources. Findings obtained from other educational systems, grade levels, or institutional settings may not fully explain the conditions experienced by elementary school teachers in the context of the present study.

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Conceptual Framework

This study is anchored in the TPACK framework developed by Mishra and Koehler (2006), which proposes that effective technology integration emerges from the dynamic interaction of Content Knowledge, Pedagogical Knowledge, and Technological Knowledge. Effective digital teaching is therefore not achieved by acquiring these knowledge domains independently. Teachers must understand how technology, pedagogy, and content influence one another within a particular subject area, instructional goal, group of learners, and educational context.

In the present study, the TPACK dimensions constitute the principal teacher-related variable. These dimensions include Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006). Teachers' digital teaching practices represent the practical application of these knowledge domains and may include using technology for instructional planning, content presentation, learner engagement, collaboration, differentiated instruction, assessment, feedback, and access to learning resources. The regional achievement results serve as the outcome variable.

Conceptually, the study proposes that teachers with stronger TPACK are more capable of selecting and applying technologies aligned with curricular content and sound pedagogical principles. Such alignment may contribute to more responsive assessment and more meaningful learning experiences, which may in turn be associated with higher learner achievement.

The study does not assume that technology use alone causes improved academic performance. Learner achievement may also be influenced by prior achievement, motivation, attendance, socioeconomic conditions, parental support, access to learning resources, and the school environment. Therefore, any relationship identified between teachers' TPACK and learner achievement is interpreted as an association rather than a causal effect, consistent with the descriptive-correlational research design.

Objectives of the Study

These concerns establish the need for context-specific research on elementary school teachers' TPACK. The present study addresses these gaps by investigating teachers' TPACK, their application of digital technologies in elementary classrooms, and the relationship between teachers' TPACK levels and learners' academic achievement. Specifically, it sought to: (a) determine the level of elementary school teachers' TPACK; (b) describe their digital teaching practices; and (c) examine the relationship between their TPACK levels and learner achievement in District IX of Baguio City.

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METHODS

Research Design

The study used a quantitative descriptive-correlational research design to determine the level of elementary school teachers' TPACK, describe their digital teaching practices, and examine the relationship between their TPACK levels and learner achievement. This design was appropriate because it allowed the researchers to describe the variables and determine the strength and direction of their relationship without manipulating the participants or the research setting.

Research Setting

The study was conducted in four public elementary schools in Public Schools District IX, Schools Division of Baguio City. These schools were selected because they implemented technology integration initiatives as part of a pedagogical program. The setting was appropriate for examining how elementary school teachers combined technological knowledge, pedagogical strategies, and subject-matter content in their teaching. To maintain confidentiality, the participating schools are identified as School A, School B, School C, and School D in the presentation of the findings.

Participants

The participants were public elementary school teachers from the four participating schools. Total enumeration was employed, and all participants voluntarily consented to participate. The teacher served as the primary unit of analysis for the TPACK data; for the correlational analysis, teachers' responses were aggregated into school-level means and paired with the schools' Grade 6 achievement results.

Research Instruments

The study used an adapted TPACK questionnaire based on the instrument developed and validated by Schmidt et al. (2009). The questionnaire assessed teachers' Content Knowledge, Pedagogical Knowledge, Technological Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge. Responses were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

A separate section of the questionnaire described teachers' digital teaching practices in terms of instructional planning, content presentation, learner engagement, collaboration, differentiated instruction, assessment, and feedback. Responses to this section were measured using a five-point scale ranging from 1 (never) to 5 (always). Learner achievement was measured using the latest available official regional assessment test results.

Data Gathering Procedure

Before data collection, the researchers obtained ethical clearance from the appropriate research ethics committee. A formal communication letter was submitted to the Schools Division Superintendent of the Schools Division of Baguio City. Permission was also secured from the public schools district supervisor and the school heads of the participating schools. After the necessary approvals had been obtained, the researchers explained the purpose, procedures, confidentiality safeguards, and voluntary nature of the study to the participating teachers.

The questionnaire was administered through Google Forms. An informed consent statement was presented before the questionnaire, and only teachers who voluntarily agreed to participate were allowed to proceed with the survey. Clear instructions were provided to ensure that respondents understood how to answer the questionnaire. After the survey responses had been collected, the required achievement results were obtained from official school records with the assistance of authorized school personnel.

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Data Analysis

Frequency and percentage were used to describe the relevant characteristics of the participants. The mean and standard deviation were used to determine teachers' overall TPACK levels, their scores in the different TPACK domains, and the frequency of their digital teaching practices. Pearson's product-moment correlation coefficient was used to determine the strength and direction of the relationship between teachers' TPACK scores and learner achievement results when the data met the assumptions for parametric analysis.

Ethical Considerations

The study observed the principles of informed consent, voluntary participation, confidentiality, data privacy, and research integrity. Participants received clear information regarding the purpose, procedures, possible risks, and expected benefits of the study before giving their consent. Participation was voluntary, and teachers were allowed to refuse to participate or withdraw from the study. The researchers analyzed, interpreted, and reported the findings honestly and accurately.

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RESULTS

This section presents the findings on elementary school teachers' level of TPACK, their integration of technology into teaching practices, and the relationship between their TPACK levels and learner achievement in District IX of Baguio City. The results are presented according to the objectives of the study.

Level of TPACK Dimensions

Table 1 presents the levels of the TPACK dimensions of elementary school teachers by school. The findings revealed generally favorable self-reported TPACK competencies across the four participating schools, although variations were observed among the individual dimensions and schools.

Table 1. Level of TPACK Dimensions of Elementary Teachers by School

TPACK Dimension	School A	School B	School C	School D
Technological Knowledge (TK)	3.444	3.375	3.494	3.378
Content Knowledge (CK)	3.806	3.375	3.624	3.544
Pedagogical Knowledge (PK)	4.262	3.839	4.169	3.971
Pedagogical Content Knowledge (PCK)	4.292	3.969	4.000	3.833
Technological Content Knowledge (TCK)	4.000	3.562	3.727	3.617
Technological Pedagogical Knowledge (TPK)	4.148	3.750	4.081	3.881
Integrated TPACK	4.083	3.750	3.932	3.683
Overall Mean	**3.978**	**3.620**	**3.849**	**3.697**

Note. Means are based on a five-point scale (1 = strongly disagree, 5 = strongly agree).

For School A, Pedagogical Content Knowledge obtained the highest mean ($M = 4.292$), followed by Pedagogical Knowledge ($M = 4.262$) and Technological Pedagogical Knowledge ($M = 4.148$). The integrated TPACK dimension obtained a mean of 4.083, while Technological Knowledge received the lowest mean ($M = 3.444$).

For School B, Pedagogical Content Knowledge was also the highest-rated dimension ($M = 3.969$), followed by Pedagogical Knowledge ($M = 3.839$). Technological Pedagogical Knowledge and integrated TPACK both obtained a mean of 3.750, while Technological Knowledge and Content Knowledge received the lowest means ($M = 3.375$).

For School C, Pedagogical Knowledge emerged as the highest-rated dimension ($M = 4.169$), followed by Technological Pedagogical Knowledge ($M = 4.081$) and Pedagogical Content Knowledge ($M = 4.000$). Integrated TPACK obtained a mean of 3.932, while Technological Knowledge was the lowest-rated dimension ($M = 3.494$).

For School D, the highest mean was obtained in Pedagogical Knowledge ($M = 3.971$), followed by Technological Pedagogical Knowledge ($M = 3.881$) and Pedagogical Content Knowledge ($M = 3.833$). Integrated TPACK obtained a mean of 3.683, while Technological Knowledge recorded the lowest mean ($M = 3.378$). Although this integrated TPACK mean remained generally favorable, it was descriptively lower than the corresponding means of the other participating schools.

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A common pattern emerged across the four schools: Pedagogical Knowledge and Pedagogical Content Knowledge were consistently among the strongest dimensions, whereas Technological Knowledge was consistently among the lowest (and, in School B, tied with Content Knowledge for the lowest).

Technological Pedagogical Knowledge in Teaching Practice

Table 2 presents teachers' Technological Pedagogical Knowledge (TPK), which reflects their perceived ability to select, adapt, and use technology in relation to appropriate teaching strategies. The respondents obtained an overall TPK mean of 3.950, indicating a generally favorable level of perceived competence in using technology to support their pedagogical practices. By school, School A obtained the highest TPK mean ($M = 4.148$), followed by School C ($M = 4.081$), School D ($M = 3.881$), and School B ($M = 3.750$). Although descriptive differences were observed, all four schools reported generally favorable TPK levels.

Table 2. Technological Pedagogical Knowledge (Technology Integration in Teaching Practices) by School

School	TPK Mean	Descriptive Interpretation
School A	4.148	Agree
School B	3.750	Agree
School C	4.081	Agree
School D	3.881	Agree
Overall	**3.950**	**Agree**

Note. Means are based on a five-point scale (1 = strongly disagree, 5 = strongly agree).

Relationship between TPACK and Learner Achievement

Table 3 presents the schools' mean integrated TPACK scores alongside Grade 6 learner achievement results, and Table 4 presents the correlation between the two. The Pearson correlation coefficient of $r = .152$ indicated a very weak positive relationship between the schools' mean integrated TPACK scores and learner achievement ($R^2 = .023$). Schools with higher average TPACK levels therefore tended to have only minimally higher learner achievement results.

Table 3. Integrated TPACK Means and Grade 6 Achievement Test Results by School

School	TPACK Mean	Achievement Test General Average	Achievement Level
School A	4.083	58.314	Nearly Proficient
School B	3.750	60.690	Nearly Proficient
School C	3.932	53.966	Nearly Proficient
School D	3.683	53.534	Nearly Proficient

Note. TPACK means are based on a five-point scale; achievement figures are from the latest official regional assessment.

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Table 4. **Relationship between Teachers' Integrated TPACK and Learner Achievement**

Variables Correlated	Pearson r	R^2	Interpretation
Integrated TPACK and Learner Achievement	.152	.023	Very weak positive relationship

Note. $N = 4$ school-level observations.

The observed pattern was not consistent across the participating schools. In particular, the school with the highest learner achievement result (School B) did not obtain the highest integrated TPACK mean (School A).

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DISCUSSION

TPACK Dimensions

The common pattern of strong Pedagogical Knowledge and Pedagogical Content Knowledge alongside lower Technological Knowledge indicated that the teachers were more confident in applying pedagogical principles, adapting instruction to learners' needs, and connecting teaching strategies with subject matter than in independently operating, evaluating, and adapting to digital technologies. For School A, the findings indicated that teachers perceived themselves as highly capable of selecting appropriate teaching strategies, presenting subject matter effectively, and integrating technology into pedagogical practice, although their comparatively lower Technological Knowledge suggested that confidence in independently operating, exploring, and adapting to technologies was less developed. In School B, teachers were more confident in the pedagogical application of subject content than in their independent technological and content-related knowledge, yet their integrated TPACK mean indicated that they generally perceived themselves as capable of combining technology, pedagogy, and content in classroom instruction. Teachers in School C were particularly confident in selecting and implementing appropriate teaching approaches and in using technology to support their pedagogical practices, but their lower Technological Knowledge score suggested a continuing need to develop their independent ability to use and adapt to digital technologies. Teachers in School D likewise perceived their pedagogical competencies more favorably than their independent technological competence.

This finding corroborated the discussion in the Introduction that technology availability or technical knowledge alone does not ensure effective technology integration. The TPACK framework emphasizes that meaningful digital instruction results from the interaction of Content Knowledge, Pedagogical Knowledge, and Technological Knowledge rather than from mastery of each area in isolation (Mishra & Koehler, 2006). It also supports the view that effective technology integration requires teachers to connect their knowledge of digital tools with appropriate teaching strategies, curricular content, learning objectives, and classroom conditions (Koehler et al., 2013).

The comparatively strong Pedagogical Knowledge and Pedagogical Content Knowledge results suggested that the respondents possessed a solid foundation for instructional planning, lesson delivery, classroom management, and the presentation of subject matter. These competencies are important because teachers need to determine not only what content should be taught but also which methods are most appropriate for making that content understandable to elementary school learners. The results therefore supported the study's rationale that elementary teachers' pedagogical and content-related decisions remain central to the effective use of technology.

At the same time, the consistently lower Technological Knowledge scores highlighted a possible gap between the teachers' established pedagogical competencies and their confidence in using technology independently. This finding was consistent with the literature discussed in the Introduction, which indicated that teachers' ability to integrate technology may be affected by limited training, insufficient digital resources, technical difficulties, preparation time, and unequal access to technological support (Vijayatheepan, 2025). Studies of elementary teachers have likewise shown that technological and integrative competencies may require more targeted development than traditional pedagogical and content knowledge (Rahayu et al., 2024; Wardan, 2024).

The finding also reinforced the distinction between technological knowledge and meaningful digital teaching practice. Teachers may be capable of operating basic digital tools, but effective integration requires them to select technologies that fit the lesson content, instructional approach, learners' developmental needs, and intended outcomes. Therefore, improving Technological Knowledge should not be limited to training teachers in the technical operation of digital tools. Professional development activities should also provide opportunities for teachers to apply technology in lesson planning, differentiated instruction, assessment, feedback, learner collaboration, and content presentation.

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Technological Pedagogical Knowledge

The results indicated that the participating teachers generally perceived themselves as capable of selecting and adapting technologies according to their instructional approaches, learning objectives, and learners' needs. In particular, they reported confidence in choosing technologies that supported what they taught, how they taught, and what learners were expected to learn, and in adjusting technologies to suit different teaching activities. These findings suggested that the respondents viewed technology integration as part of instructional decision-making rather than merely as the operation or presence of digital tools in the classroom.

The findings corroborated the argument that access to technology or the ability to operate digital tools does not automatically result in effective technology-enhanced instruction. As explained by Mishra and Koehler (2006), effective technology integration requires a dynamic interaction among technological, pedagogical, and content knowledge. Within this framework, Technological Pedagogical Knowledge specifically involves understanding how teaching and learning approaches may be supported or transformed through the appropriate use of technology.

The favorable TPK results also supported the distinction between technological competence and meaningful digital teaching. Teachers need more than technical knowledge because they must determine whether a particular digital tool is developmentally appropriate, pedagogically suitable, and aligned with the intended learning outcomes. Koehler et al. (2013) emphasized that teachers function as designers of technology-supported learning experiences by considering instructional strategies, learners' prior knowledge, curricular requirements, available resources, and classroom conditions. Thus, the overall TPK mean of 3.950 suggested that the respondents generally recognized and applied, at least at the level of perceived competence, the connection between technology and pedagogy.

Moreover, the result complemented the findings in Table 1. Despite reporting less confidence in Technological Knowledge considered independently, the teachers obtained a favorable overall TPK mean. This pattern suggested that they may have been more confident in using familiar technologies for instructional purposes than in independently exploring, troubleshooting, or adapting to a wider range of emerging digital tools. In other words, their strength appeared to lie in connecting available technologies with established teaching practices rather than in technological expertise alone.

This finding was consistent with Rahayu et al. (2024), who reported that collaborative, practical, and reflective professional development activities strengthened elementary school teachers' TPACK, particularly their Technological Pedagogical Knowledge. It also supported Wardan's (2024) conclusion that professional development programs should help elementary teachers connect technological skills with pedagogical and content-related decisions rather than treating technology as a separate instructional competence.

TPACK and Learner Achievement

The very weak positive correlation indicated that schools with higher average TPACK levels had only minimally higher learner achievement results. The findings therefore provided only limited descriptive evidence that differences in teachers' reported TPACK were associated with corresponding differences in learner achievement.

This result partially supported the conceptual argument presented in the Introduction. The TPACK framework proposes that effective teaching with technology requires the purposeful interaction of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). It was therefore reasonable to expect that teachers with stronger integrated TPACK would be more capable of designing technology-supported learning experiences that enhanced content presentation, learner engagement, assessment, and feedback. However, the very weak correlation indicated that this theoretical relationship was not strongly reflected in the aggregated achievement data.

The finding also reinforced the position that technology use or favorable TPACK alone does not automatically lead to higher learner achievement. Koehler et al. (2013) emphasized that technology integration is a complex and

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context-dependent process involving the interaction of technology, pedagogy, content, learner characteristics, curriculum requirements, and classroom conditions. Teachers' knowledge of technology integration may therefore support instruction, but its contribution to achievement may depend on how consistently and effectively that knowledge is applied in actual classroom practice. Teachers may have perceived themselves as knowledgeable about integrating technology while differing in the frequency, quality, purpose, and consistency of their actual classroom implementation.

Moreover, learner achievement is influenced by several factors beyond teachers' TPACK, including learners' prior achievement, motivation, attendance, access to learning resources, parental support, socioeconomic circumstances, class size, school leadership, availability of digital devices, internet connectivity, and the amount of instructional time. The UNESCO (2018) framework similarly recognizes that effective technology integration requires an enabling environment that includes institutional leadership, professional development, appropriate policies, infrastructure, and technical support. Consequently, variation in learner achievement cannot be attributed to teachers' TPACK alone.

Overall, the findings did not provide strong support for the study's assumption that higher TPACK would be associated with higher learner achievement. Instead, they suggested that the relationship was weak, context-dependent, and possibly influenced by other related factors. Nevertheless, the result did not establish that TPACK was unimportant. It indicated that favorable TPACK must be translated into sustained and pedagogically appropriate classroom practices before it can reasonably be expected to contribute to measurable learner outcomes. The findings thus addressed the research gap identified in the Introduction by showing that teachers' perceived competence in integrating technology and learners' achievement were not strongly related at the aggregated school level.

Limitations

Several limitations should be considered. First, the TPACK and TPK findings represent teachers' perceived ability to integrate technology pedagogically; they did not independently demonstrate how frequently or effectively technology was used during actual classroom instruction. Classroom observations, lesson plan analyses, and learner performance measures would be necessary to confirm whether the reported competence was consistently demonstrated in practice. Second, the correlation was based on only four aggregated school-level observations, so the result is preliminary and noncausal and should be interpreted with caution. Third, achievement was drawn from a single Grade 6 regional assessment and was not adjusted for the contextual factors discussed above.

Policy Implications

Schools and district officials should strengthen continuing professional development in TPACK, particularly in Technological Knowledge. Training should emphasize the meaningful use of technology for lesson delivery, learner engagement, differentiated instruction, assessment, and feedback rather than focusing only on operating digital tools. Schools should also provide adequate devices, internet connectivity, digital resources, and technical support. TPACK and achievement results should be used for instructional improvement, not for ranking teachers or schools.

Conclusion

The study found that elementary teachers in District IX generally demonstrated favorable TPACK competencies. Pedagogical Knowledge and Pedagogical Content Knowledge were among their strongest dimensions, while Technological Knowledge was consistently lower. The teachers also reported favorable Technological Pedagogical Knowledge, suggesting that they could select and adapt technologies to support their teaching strategies and learners' needs. However, the relationship between school-level integrated TPACK and learner achievement results was very weak and positive (r = .152), indicating that higher TPACK levels were only minimally associated with higher achievement.

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Recommendations

The district should provide sustained, practical, and school-based TPACK training, particularly in strengthening teachers' Technological Knowledge and their ability to connect digital tools with appropriate content, teaching strategies, and learners' needs. School heads should incorporate technology-enhanced instruction into Learning Action Cell sessions and school improvement plans while ensuring adequate access to digital resources, reliable internet connectivity, and technical assistance. Teachers should continue developing their technological competencies and use digital tools purposefully for lesson delivery, learner engagement, differentiated instruction, assessment, and feedback.

Future studies should involve larger samples, use teacher- or classroom-level data, and supplement self-reported questionnaires with classroom observations, lesson plans, and learner outputs. Researchers should also consider other factors that may influence learner achievement, including prior performance, attendance, parental support, motivation, and access to learning resources.

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REFERENCES

Christensen, R. (2002). Effects of technology integration on students' achievement in high school history classes. *Journal of Research on Technology in Education, 34*(4), 411–423. https://doi.org/10.1080/15391523.2002.10782388

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

Koehler, M. J., Mishra, P., Akcaoglu, M., & Rosenberg, J. M. (2013). The technological pedagogical content knowledge framework for teachers and teacher educators. In M. G. Moore (Ed.), *Handbook of distance education* (3rd ed., pp. 101–111). Routledge.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Rahayu, A. H., Widodo, A., Saud, U. S., & Muslim. (2024). Improving technological pedagogical content knowledge (TPACK) of elementary school teachers through training with a collaborative, practical and reflective approach. *Mimbar Sekolah Dasar, 11*(4), 642–658. https://doi.org/10.53400/mimbar-sd.v11i4.78644

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (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. https://doi.org/10.1080/15391523.2009.10782544

UNESCO. (2018). *UNESCO ICT competency framework for teachers* (Version 3). UNESCO.

Vijayatheepan, R. (2025). The application of TPACK model in teachers' teaching practices: A study on integration and effectiveness. *International Journal of Research and Innovation in Social Science*. https://doi.org/10.47772/IJRISS.2024.8120328

Wardan, N. N. (2024). TPACK learning in improving teacher skills in elementary school: A systematic literature review. *Mimbar Sekolah Dasar, 11*(2), 422–440. https://doi.org/10.53400/mimbar-sd.v11i2.71832

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