



TEACHERS' TECHNOLOGICAL PEDAGOGICAL COMPETENCE AND LEARNERS' ACHIEVEMENT IN TECHNOLOGY AND LIVELIHOOD EDUCATION

Jeanette S. Mercado

*Institute of Graduate and Professional Studies, Lyceum-Northwestern University, Dagupan City,
Pangasinan, Philippines*

ABSTRACT

This study determined the teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education (TLE) in the Schools Division Office of Nueva Ecija during the School Year 2025–2026. Specifically, it examined the level of teachers' technological pedagogical competence across the dimensions of Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge (TPACK); determined the level of learners' achievement in TLE; established the significant relationship between teachers' technological pedagogical competence and learners' achievement; identified the dimensions that significantly predict learners' achievement; and proposed a Technology-Enhanced Professional Development Program based on the findings. A descriptive-correlational research design was employed. The respondents consisted of TLE 6 teachers and learners from selected public elementary schools in the Schools Division Office of Nueva Ecija. A validated researcher-made questionnaire based on the TPACK framework was utilized to assess teachers' technological pedagogical competence, while learners' final grades in TLE for the School Year 2025–2026 were used to determine their academic achievement. Data were analyzed using frequency and percentage distribution, weighted mean, standard deviation, Pearson Product-Moment Correlation, and Multiple Linear Regression Analysis. The findings revealed that teachers demonstrated a High level of technological pedagogical competence. Among its dimensions, Technological Pedagogical Content Knowledge obtained the highest competence, while Technological Knowledge and Pedagogical Knowledge showed comparatively lower levels, indicating areas for further professional development. Learners attained a Very Satisfactory level of achievement in Technology and Livelihood Education. Moreover, teachers' technological

pedagogical competence had a significant positive relationship with learners' achievement. Among the dimensions, Technological Pedagogical Content Knowledge (TPACK) emerged as the strongest significant predictor of learners' academic achievement in Technology and Livelihood Education. Based on the findings, the study concluded that teachers' competence in integrating technology, pedagogy, and content knowledge plays a vital role in enhancing learners' academic achievement. Consequently, the TECH-TLE 360: Technology-Enhanced Professional Development Program was proposed to strengthen teachers' technological pedagogical competence, promote effective technology integration in instruction, and further improve learners' achievement in Technology and Livelihood Education.

Keywords: *technological pedagogical competence, Technology and Livelihood Education, learners' achievement*

INTRODUCTION

Education in the 21st century has undergone significant transformation due to rapid technological advancements, globalization, and the increasing demand for a digitally competent workforce. These developments have redefined the role of teachers from being transmitters of knowledge to facilitators of learning who effectively integrate technology into instruction to promote meaningful, learner-centered educational experiences (Mishra & Koehler, 2006). As digital technologies continue to reshape teaching and learning processes, teachers are expected to possess technological pedagogical competence that enables them to integrate technology appropriately with pedagogy and subject matter. Such competence has become increasingly important in Technology and Livelihood Education (TLE), where learners are expected to develop technical skills, problem-solving abilities, creativity, and entrepreneurial competencies necessary for lifelong learning and future employment (UNESCO, 2023).

From an international perspective, educational organizations consistently recognize technology integration as one of the major drivers of quality education. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023), technology has the potential to improve learner engagement, participation, collaboration, and academic achievement when teachers possess the necessary competencies to integrate digital tools effectively into classroom instruction. UNESCO further emphasized that educational technology alone does not improve learning outcomes; rather, its effectiveness depends on teachers' ability to make sound pedagogical decisions and employ appropriate instructional strategies.

Similarly, the Organisation for Economic Co-operation and Development (OECD, 2023) reported that education systems with high-performing learners invest not only in digital infrastructure but also in strengthening teachers' technological and pedagogical competencies through continuous professional development. The OECD Programme for International Student Assessment (PISA) 2022 Results further revealed that effective technology integration supports personalized learning, immediate feedback, collaborative

learning, and the development of higher-order thinking skills when facilitated by competent teachers (OECD, 2023).

Moreover, the emergence of Industry 4.0 and Industry 5.0 has transformed workforce requirements, emphasizing digital literacy, innovation, technical competence, and adaptability as essential competencies for future employment (World Economic Forum, 2025). Consequently, educational institutions are expected to prepare learners for these changing workplace demands through technology-enhanced instruction. In Technology and Livelihood Education, teachers are expected to integrate emerging technologies, digital simulations, virtual demonstrations, and productivity applications into classroom instruction to develop learners' practical competencies and workplace readiness (UNESCO-UNEVOC, 2024).

The educational disruptions brought about by the COVID-19 pandemic further underscored the importance of teachers' technological pedagogical competence. During the pandemic, schools worldwide adopted online, blended, and distance learning modalities, compelling teachers to utilize various digital learning platforms and instructional technologies. Studies have shown that teachers with stronger technological pedagogical competence demonstrated greater instructional effectiveness and adaptability during this transition (Trust & Whalen, 2020). Although face-to-face instruction has resumed, many technology-enhanced teaching practices adopted during the pandemic continue to shape classroom instruction today.

From a national perspective, the Philippine educational system continues to pursue digital transformation initiatives to improve teaching quality and learner outcomes. The Basic Education Development Plan (BEDP) 2030 identifies digital transformation as a strategic priority in building a resilient, inclusive, and learner-centered education system (Department of Education [DepEd], 2022). The plan emphasizes the integration of digital technologies, continuous teacher professional development, and the enhancement of instructional delivery to improve learner achievement.

Likewise, the MATATAG Agenda highlights the importance of strengthening teacher quality through professional development, curriculum refinement, and technology-enhanced teaching practices to improve foundational learning competencies among Filipino learners (DepEd, 2023). This reform recognizes that teachers remain the most influential school-based factor affecting learners' academic performance.

The Philippine Professional Standards for Teachers (PPST) likewise institutionalizes technology integration as an essential teacher competency. Specifically, teachers are expected to demonstrate proficiency in selecting, developing, organizing, and utilizing ICT resources that support effective teaching and learning while fostering creativity, collaboration, and critical thinking among learners (DepEd Order No. 42, s. 2017).

To support these initiatives, the Department of Education has implemented numerous programs such as the DepEd Computerization Program, DepEd Commons, Learning Resource Portal, Learning Action Cells (LACs), and various ICT-related professional

development programs that strengthen teachers' digital competence and instructional effectiveness (DepEd, 2022). Despite these efforts, studies conducted in the Philippines continue to reveal disparities in teachers' technological pedagogical competence due to differences in ICT infrastructure, internet connectivity, professional training, availability of digital resources, and teachers' digital readiness (Marcial 2011).

Technology and Livelihood Education presents unique instructional demands because it emphasizes competency-based learning, laboratory activities, technical demonstrations, entrepreneurship, and practical skill acquisition. Effective TLE instruction requires teachers to combine content knowledge, pedagogical expertise, and technological competence to facilitate authentic learning experiences (Mishra & Koehler, 2006). Digital tools such as instructional videos, virtual laboratories, computer-aided design software, interactive presentations, simulation applications, and online assessment platforms have become valuable instructional resources that enhance learners' conceptual understanding and practical skills (UNESCO-UNEVOC, 2024).

At the local level, the Schools Division Office of Nueva Ecija continuously implements professional development initiatives such as Learning Action Cells (LACs), In-Service Training for Teachers (INSET), coaching and mentoring programs, classroom observations, ICT integration workshops, and curriculum enhancement activities aimed at improving instructional quality and teachers' technological competence. These initiatives are aligned with the Department of Education's commitment to strengthening teachers' professional growth and improving learners' educational outcomes (DepEd, 2023).

However, despite these continuing efforts, teachers within the division demonstrate varying levels of technological pedagogical competence due to differences in teaching experience, access to digital resources, professional development opportunities, and availability of technological facilities. Such variations may influence instructional effectiveness and learners' academic achievement, particularly in Technology and Livelihood Education, where technology plays a central role in demonstrating practical skills and facilitating authentic learning experiences.

Learners' academic achievement in TLE remains an important indicator of instructional effectiveness because it reflects the successful acquisition of technical knowledge, practical competencies, entrepreneurial skills, and problem-solving abilities required in the 21st-century workplace. Numerous studies have established that teacher competence significantly influences learners' academic performance, engagement, motivation, and skill development (Darling-Hammond, 2017; Hattie, 2023). Consequently, strengthening teachers' technological pedagogical competence may contribute to improving learners' academic achievement in Technology and Livelihood Education.

Although numerous international and Philippine studies have examined technology integration, digital competence, teacher effectiveness, and academic achievement separately, there remains limited empirical research specifically investigating the relationship between teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education within the Schools Division Office

of Nueva Ecija. Most existing studies have focused on Mathematics, Science, English, or general classroom instruction, leaving a gap regarding TLE, which uniquely combines theoretical instruction with practical and technical skill development.

Therefore, this study sought to determine the level of teachers' technological pedagogical competence and the level of learners' achievement in Technology and Livelihood Education in the Schools Division Office of Nueva Ecija during the School Year 2025–2026. Specifically, it aimed to examine whether teachers' technological pedagogical competence significantly influenced learners' academic achievement. The findings of the study provided empirical evidence that guided school administrators, education supervisors, curriculum planners, and policymakers in designing responsive professional development programs, improving technology integration initiatives, strengthening instructional support systems, and enhancing the quality of TLE instruction, thereby contributing to improved learner achievement and supporting the realization of the Department of Education's goals for quality, equitable, and future-ready basic education.

Research Questions

This study aimed to determine the relationship between teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education (TLE) in the Schools Division Office of Nueva Ecija during the School Year 2025–2026.

Specifically, it sought to answer the following research questions:

1. What is the level of teachers' technological pedagogical competence in terms of:
 - 1.1 Technological Knowledge (TK);
 - 1.2 Pedagogical Knowledge (PK);
 - 1.3 Content Knowledge (CK);
 - 1.4 Technological Pedagogical Knowledge (TPK);
 - 1.5 Technological Content Knowledge (TCK);
 - 1.6 Pedagogical Content Knowledge (PCK); and
 - 1.7 Technological Pedagogical Content Knowledge (TPACK)?
2. What is the level of learners' achievement in Technology and Livelihood Education as measured by their final grades during the School Year 2025–2026?
3. Is there a significant relationship between teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education?
4. Which dimension of teachers' technological pedagogical competence significantly predicts learners' achievement in Technology and Livelihood Education?
5. Based on the findings of the study, what Technology-Enhanced Professional Development Program may be proposed to strengthen teachers' technological pedagogical competence and improve learners' achievement in Technology and Livelihood Education?

METHODOLOGY

Research Design

This study employed a descriptive-correlational research design. The descriptive method was utilized to determine the level of teachers' technological pedagogical competence across the dimensions of Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). It also described the level of learners' achievement in Technology and Livelihood Education (TLE) as measured by their final grades during the School Year 2025–2026.

The correlational method was employed to examine the significant relationship between teachers' technological pedagogical competence and learners' achievement in TLE. Furthermore, multiple linear regression analysis was used to identify which dimensions of teachers' technological pedagogical competence significantly predicted learners' academic achievement in Technology and Livelihood Education.

The descriptive-correlational design was considered appropriate because it enabled the researcher to describe the existing conditions of the variables and determine the degree of relationship among them without manipulating any of the study variables. The design also facilitated the identification of the most influential dimensions of teachers' technological pedagogical competence that contributed to learners' achievement. Based on the findings, a Technology-Enhanced Professional Development Program (TECH-TLE 360) was proposed to strengthen teachers' technological pedagogical competence and improve learners' achievement in Technology and Livelihood Education.

Instrumentation and Data Collection

The primary instrument used in this study was a researcher-made questionnaire designed to determine the level of teachers' technological pedagogical competence based on the Technological Pedagogical Content Knowledge (TPACK) framework. The instrument consisted of two parts. Part I gathered the respondents' profile information, while Part II assessed teachers' technological pedagogical competence across seven dimensions: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). Each dimension contained ten indicators measured using a five-point Likert scale, where 5 indicated Very High Competence, 4 indicated High Competence, 3 indicated Moderate Competence, 2 indicated Low Competence, and 1 indicated Very Low Competence.

The questionnaire underwent content validation by a panel of experts in educational management, research, and Technology and Livelihood Education to establish its validity. Their comments and recommendations were incorporated to improve the clarity,

relevance, and appropriateness of the instrument. A pilot test was subsequently conducted among respondents who were not included in the actual study to determine the instrument's reliability. The computed Cronbach's alpha coefficient indicated that the questionnaire possessed a high level of internal consistency, making it suitable for data collection.

To determine learners' achievement in Technology and Livelihood Education, documentary analysis was employed. The learners' official final grades for the School Year 2025–2026 were obtained from the schools' academic records with the approval of the concerned school heads and in compliance with the provisions of the Data Privacy Act of 2012 and existing Department of Education policies. These final grades served as the basis for determining the learners' level of academic achievement.

Prior to the conduct of the study, the researcher secured permission from the Schools Division Superintendent, Public Schools District Supervisors, and school heads of the participating schools. After obtaining the necessary approvals, the researcher personally administered the questionnaire to the respondents. The purpose of the study was explained, and the respondents were informed that their participation was voluntary. They were likewise assured that the information they provided would be treated with utmost confidentiality and used solely for academic and research purposes.

Upon retrieval of the accomplished questionnaires and collection of the learners' final grades, the data were checked for completeness, organized, encoded, and tabulated. Appropriate statistical tools were then applied to analyze the data and answer the specific problems of the study. The results served as the basis for formulating conclusions, recommendations, and the proposed Technology-Enhanced Professional Development Program.

Tools for Data Analysis

The data gathered in this study were analyzed using appropriate statistical tools to answer the specific problems of the study.

For research question 1, which sought to determine the level of teachers' technological pedagogical competence, the weighted mean and standard deviation were used. The weighted mean was utilized to determine the average rating of teachers' technological pedagogical competence across the seven dimensions: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). The standard deviation was computed to determine the variability of the responses.

The following scale was used in interpreting the weighted mean:

Weighted Mean	Descriptive Rating
4.21–5.00	Very High Competence
3.41–4.20	High Competence
2.61–3.40	Moderate Competence
1.81–2.60	Low Competence
1.00–1.80	Very Low Competence

For research question 2, which determined the level of learners' achievement in Technology and Livelihood Education, frequency and percentage distribution were used to describe the distribution of learners according to their final grades. The mean and standard deviation were likewise computed to determine the overall level of learners' academic achievement and the variability of their grades.

The learners' achievement was interpreted using the Department of Education grading scale:

Grade	Descriptive Rating
90–100	Outstanding
85–89	Very Satisfactory
80–84	Satisfactory
75–79	Fairly Satisfactory
Below 75	Did Not Meet Expectations

For research question 3, which determined the significant relationship between teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education, the Pearson Product-Moment Correlation Coefficient (Pearson's r) was employed. This statistical tool determined the strength and direction of the relationship between the variables. The null hypothesis was tested at the 0.05 level of significance.

For research question 4, which identified the dimension of teachers' technological pedagogical competence that significantly predicted learners' achievement in Technology and Livelihood Education, Multiple Linear Regression Analysis was employed. This statistical technique determined the extent to which each dimension of technological pedagogical competence contributed to learners' academic achievement and identified the most significant predictor while controlling for the influence of the other dimensions. The null hypothesis was likewise tested at the 0.05 level of significance.

RESULTS

Table 1.1
Level of Teachers' Technological Knowledge

Indicators	Mean	Descriptive Rating
1. Operates computers, laptops, tablets, and other digital devices needed in TLE instruction.	3.48	High Competence
2. Uses presentation software (e.g., PowerPoint, Canva, Google Slides) effectively during instruction.	3.54	High Competence
3. Utilizes online learning platforms (e.g., Google Classroom and Microsoft Teams) in teaching TLE.	3.35	Moderate Competence
4. Troubleshoots basic technical problems encountered during instruction.	3.08	Moderate Competence
5. Uses internet resources to support classroom instruction.	4.25	Very High Competence
6. Uses productivity software such as Microsoft Word, Excel, and Google Workspace efficiently.	3.46	High Competence
7. Evaluates and selects appropriate digital tools for classroom instruction.	3.18	Moderate Competence
8. Updates technological skills through professional learning and training.	3.11	Moderate Competence
9. Uses multimedia resources to enhance learners' understanding.	3.22	Moderate Competence
10. Demonstrates confidence in using educational technologies during instruction.	3.33	Moderate Competence
Average Weighted Mean	3.20	Moderate Competence

Table 1.2
Level of Teachers' Pedagogical Knowledge

Indicators	Mean	Descriptive Rating
1. Employs learner-centered teaching strategies during TLE instruction.	4.24	Very High Competence
2. Prepares lesson plans that address learners' diverse needs.	4.22	Very High Competence
3. Applies appropriate classroom management strategies.	3.68	High Competence
4. Encourages active learner participation during classroom activities.	3.59	High Competence
5. Uses varied assessment strategies to evaluate learners' performance.	3.51	High Competence

6. Provides timely and constructive feedback to learners.	3.43	High Competence
7. Integrates collaborative learning activities into classroom instruction.	3.42	High Competence
8. Modifies instructional strategies based on learners' needs.	3.37	Moderate Competence
9. Facilitates practical and laboratory activities effectively.	3.31	Moderate Competence
10. Motivates learners to participate actively in classroom learning.	3.15	Moderate Competence
Average Weighted Mean	3.33	Moderate Competence

Table 1.3
Level of Teachers' Content Knowledge

Indicators	Mean	Descriptive Rating
1. Demonstrates knowledge of the TLE curriculum and learning competencies.	4.36	Very High Competence
2. Demonstrates mastery of TLE concepts and principles.	4.29	Very High Competence
3. Relates TLE concepts to real-life applications.	4.23	Very High Competence
4. Explains technical concepts clearly and accurately.	4.18	High Competence
5. Uses appropriate instructional resources to explain TLE concepts.	4.09	High Competence
6. Keeps updated with current trends and innovations in TLE.	3.98	High Competence
7. Integrates entrepreneurship concepts into TLE instruction.	3.85	High Competence
8. Demonstrates practical skills required in TLE.	3.74	High Competence
9. Responds accurately to learners' questions related to TLE.	3.40	Moderate Competence
10. Enhances professional knowledge through seminars, training, and professional reading.	2.88	Moderate Competence
Average Weighted Mean	3.90	High Competence

Table 1.4
Level of Teachers' Technological Pedagogical Knowledge (TPK)

Indicators	Mean	Descriptive Rating
1. Uses technology to increase learner engagement.	4.32	Very High Competence
2. Integrates digital tools into classroom discussions.	4.28	Very High Competence
3. Facilitates collaborative learning through technology.	4.24	Very High Competence
4. Provides immediate feedback using digital technologies.	4.22	Very High Competence
5. Uses online assessment tools to evaluate learners.	4.21	Very High Competence
6. Selects technologies appropriate to instructional strategies.	4.12	High Competence
7. Adjusts teaching methods when integrating technology.	4.03	High Competence
8. Uses digital resources to promote active learning.	3.89	High Competence
9. Manages technology-supported classroom activities effectively.	3.74	High Competence
10. Integrates technology into instruction without disrupting the learning process.	3.65	High Competence
Average Weighted Mean	3.67	High Competence

Table 1.5
Level of Teachers' Technological Content Knowledge (TCK)

Indicators	Mean	Descriptive Rating
1. Uses appropriate technologies to present TLE concepts and skills effectively.	5.00	Very High Competence
2. Utilizes digital simulations and multimedia resources to explain TLE concepts.	5.00	Very High Competence
3. Integrates industry-based technologies relevant to TLE competencies.	5.00	Very High Competence
4. Selects digital tools that appropriately represent TLE content.	4.20	High Competence
5. Uses technology to demonstrate technical procedures and practical skills.	4.20	High Competence
6. Enhances learners' understanding of complex TLE concepts through technology.	4.20	High Competence

7. Uses digital resources that align with the prescribed TLE curriculum.	4.20	High Competence
8. Demonstrates proficiency in operating specialized technologies used in TLE instruction.	4.20	High Competence
9. Keeps updated with emerging technologies related to TLE specialization.	3.40	Moderate Competence
10. Adapts instructional content to newly emerging digital technologies.	3.40	Moderate Competence
Average Weighted Mean	3.67	High Competence

Table 1.6
Level of Teachers' Pedagogical Content Knowledge (PCK)

Indicators	Mean	Descriptive Rating
1. Aligns TLE teaching strategies with the learning competencies.	4.80	Very High Competence
2. Selects appropriate instructional strategies for specific TLE content.	4.60	Very High Competence
3. Explains difficult TLE concepts using appropriate pedagogical approaches.	4.40	Very High Competence
4. Adapts instructional methods to learners' needs and abilities in TLE.	4.30	Very High Competence
5. Designs learning activities that promote mastery of TLE competencies.	4.20	High Competence
6. Uses assessment strategies aligned with TLE learning outcomes.	4.20	High Competence
7. Provides appropriate remediation and enrichment activities.	4.10	High Competence
8. Integrates real-life applications into TLE instruction.	4.00	High Competence
9. Encourages active learner participation during TLE lessons.	3.90	High Competence
10. Differentiates instruction based on learners' readiness and interests.	3.10	Moderate Competence
Average Weighted Mean	4.16	High Competence

Table 2
Level of Learners' Achievement in Technology and Livelihood
Education (TLE) as Measured by Their Final Grades
During the School Year 2025–2026
(n = 155)

Final Grade	Frequency	Percentage	Descriptive Rating
90–100	45	29.03	Outstanding
85–89	58	37.42	Very Satisfactory
80–84	42	27.10	Satisfactory
75–79	10	6.45	Fairly Satisfactory
Total	155	100.00	
Mean Final Grade	86.38		Very Satisfactory

Table 3
Significant Relationship Between Teachers' Technological Pedagogical
Competence and Learners' Achievement in Technology
and Livelihood Education
(N = 155)

Teachers' Technological Pedagogical Competence	Pearson r	p-value	Decision	Interpretation
Technological Knowledge (TK)	0.481	<0.001	Reject H_0	Moderate Positive Significant Relationship
Pedagogical Knowledge (PK)	0.553	<0.001	Reject H_0	Moderate Positive Significant Relationship
Content Knowledge (CK)	0.517	<0.001	Reject H_0	Moderate Positive Significant Relationship
Technological Pedagogical Knowledge (TPK)	0.641	<0.001	Reject H_0	Strong Positive Significant Relationship
Technological Content Knowledge (TCK)	0.604	<0.001	Reject H_0	Strong Positive Significant Relationship
Pedagogical Content Knowledge (PCK)	0.587	<0.001	Reject H_0	Moderate Positive Significant Relationship
Technological Pedagogical Content Knowledge (TPACK)	0.708	<0.001	Reject H_0	Strong Positive Significant Relationship

Overall Technological Pedagogical Competence	0.692	<0.001	Reject H_0	Strong Positive Significant Relationship
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Table 4
Multiple Linear Regression Analysis on the Dimensions of Teachers' Technological Pedagogical Competence as Predictors of Learners' Achievement in Technology and Livelihood Education (n= 155)

Predictor Variables	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (β)	t	p-value	Decision
Technological Knowledge (TK)	0.438	0.351	0.086	1.25	0.214	Not Significant
Pedagogical Knowledge (PK)	0.927	0.396	0.173	2.34	0.021	Significant
Content Knowledge (CK)	0.562	0.382	0.104	1.47	0.144	Not Significant
Technological Pedagogical Knowledge (TPK)	1.148	0.417	0.224	2.75	0.007	Significant
Technological Content Knowledge (TCK)	0.713	0.401	0.136	1.78	0.077	Not Significant
Pedagogical Content Knowledge (PCK)	0.694	0.389	0.128	1.79	0.075	Not Significant
Technological Pedagogical Content Knowledge (TPACK)	2.315	0.452	0.401	5.12	<0.001	Significant

Model Summary

R	R ²	Adjusted R ²	F-value	p-value	Decision
0.771	0.594	0.575	30.68	<0.001	Significant Model

DISCUSSION

Table 1.1 illustrates the level of teachers' technological knowledge. The findings revealed an average weighted mean of 3.20, interpreted as Moderate Competence, indicating that teachers moderately demonstrate the technological knowledge necessary to support Technology and Livelihood Education (TLE) instruction. This finding suggests that while teachers possess the fundamental skills needed to utilize technology in teaching, they do not consistently demonstrate advanced technological competencies, particularly in selecting digital tools, troubleshooting technical problems, and continuously updating their technological skills. Technological knowledge is a vital component of effective technology integration, as it enables teachers to maximize digital resources and enhance classroom instruction.

Among the indicators, "Uses internet resources to support classroom instruction" obtained the highest mean ($M = 4.25$, Very High Competence), followed by "Uses presentation software (e.g., PowerPoint, Canva, Google Slides) effectively during instruction" ($M = 3.54$, High Competence), "Operates computers, laptops, tablets, and other digital devices needed in TLE instruction" ($M = 3.48$, High Competence), and "Uses productivity software such as Microsoft Word, Excel, and Google Workspace efficiently" ($M = 3.46$, High Competence). Conversely, "Troubleshoots basic technical problems encountered during instruction" obtained the lowest mean ($M = 3.08$, Moderate Competence), while updating technological skills, evaluating digital tools, using multimedia resources, utilizing online learning platforms, and demonstrating confidence in educational technologies also received Moderate ratings. These findings indicate that although teachers are proficient in utilizing common digital tools and internet resources, they require further capacity-building in technical troubleshooting, technology evaluation, and continuous professional development in educational technology.

Table 1.2 shows the level of teachers' pedagogical knowledge. The data yielded an average weighted mean of 3.33, interpreted as Moderate Competence, indicating that teachers moderately demonstrate pedagogical competencies in delivering effective instruction. This finding suggests that teachers generally apply sound instructional practices, classroom management techniques, and assessment strategies; however, opportunities remain to strengthen differentiated instruction, learner motivation, and the facilitation of practical learning experiences.

The highest-rated indicator was "Employs learner-centered teaching strategies during TLE instruction" ($M = 4.24$, Very High Competence), followed by "Prepares lesson plans that address learners' diverse needs" ($M = 4.22$, Very High Competence). Other indicators receiving High Competence ratings included applying classroom management strategies, encouraging learner participation, using varied assessment strategies, providing timely feedback, and integrating collaborative learning. In contrast, "Motivates learners to participate actively in classroom learning" obtained the lowest mean ($M = 3.15$, Moderate Competence), while modifying instructional strategies and facilitating practical activities also received Moderate ratings. These findings indicate that teachers effectively

implement learner-centered instruction but may further strengthen instructional differentiation and learner motivation to enhance classroom learning outcomes.

Table 1.3 reveals the level of teachers' content knowledge. The findings obtained an average weighted mean of 3.90, interpreted as High Competence, indicating that teachers frequently demonstrate strong mastery of Technology and Livelihood Education content. This finding implies that teachers possess substantial knowledge of the curriculum, learning competencies, and practical applications of TLE concepts, enabling them to provide accurate and meaningful instruction that supports learners' academic and technical development.

Among the indicators, "Demonstrates knowledge of the TLE curriculum and learning competencies" obtained the highest mean ($M = 4.36$, Very High Competence), followed by "Demonstrates mastery of TLE concepts and principles" ($M = 4.29$, Very High Competence) and "Relates TLE concepts to real-life applications" ($M = 4.23$, Very High Competence). Other indicators, including explaining technical concepts, using instructional resources, keeping updated with innovations, integrating entrepreneurship concepts, and demonstrating practical skills, received High Competence ratings. Conversely, "Enhances professional knowledge through seminars, training, and professional reading" obtained the lowest mean ($M = 2.88$, Moderate Competence), while responding accurately to learners' questions also received a Moderate Competence rating. These findings indicate that although teachers possess strong content mastery, continuous professional learning and subject-related development activities remain essential to sustain and enhance their expertise.

Table 1.4 indicates the level of teachers' Technological Pedagogical Knowledge (TPK). The findings revealed an average weighted mean of 3.67, interpreted as High Competence, indicating that teachers frequently integrate technology with appropriate pedagogical strategies to facilitate effective instruction. This finding suggests that teachers possess the capability to use technology in ways that enhance learner engagement, collaboration, assessment, and classroom interaction while supporting meaningful learning experiences.

Among the indicators, "Uses technology to increase learner engagement" obtained the highest mean ($M = 4.32$, Very High Competence), followed by "Integrates digital tools into classroom discussions" ($M = 4.28$, Very High Competence), "Facilitates collaborative learning through technology" ($M = 4.24$, Very High Competence), "Provides immediate feedback using digital technologies" ($M = 4.22$, Very High Competence), and "Uses online assessment tools to evaluate learners" ($M = 4.21$, Very High Competence). Conversely, "Integrates technology into instruction without disrupting the learning process" obtained the lowest mean ($M = 3.65$, High Competence). Other indicators, including selecting appropriate technologies, adjusting teaching methods, promoting active learning, and managing technology-supported classroom activities, also received High Competence ratings. These findings indicate that teachers effectively combine technology with pedagogy, particularly in enhancing learner engagement and assessment practices.

Table 1.5 demonstrates the level of teachers' Technological Content Knowledge (TCK). The results yielded an average weighted mean of 3.67, interpreted as High Competence, indicating that teachers frequently integrate technology to support the delivery of Technology and Livelihood Education content. This finding implies that teachers effectively utilize digital technologies to represent concepts, demonstrate technical procedures, and support learners' understanding of TLE competencies.

The highest-rated indicators were "Uses appropriate technologies to present TLE concepts and skills effectively," "Utilizes digital simulations and multimedia resources to explain TLE concepts," and "Integrates industry-based technologies relevant to TLE competencies," each obtaining a perfect mean score of 5.00 (Very High Competence). Other indicators related to selecting digital tools, demonstrating technical procedures, enhancing understanding of complex concepts, aligning digital resources with the curriculum, and operating specialized technologies all received High Competence ratings ($M = 4.20$). In contrast, "Keeps updated with emerging technologies related to TLE specialization" and "Adapts instructional content to newly emerging digital technologies" obtained the lowest means ($M = 3.40$, Moderate Competence). These findings indicate that while teachers effectively use technology to deliver existing TLE content, continued professional development is needed to keep pace with emerging technologies and innovations within the field.

Table 1.6 reflects the level of teachers' Pedagogical Content Knowledge (PCK). The findings revealed an average weighted mean of 4.16, interpreted as High Competence, indicating that teachers frequently demonstrate the ability to integrate appropriate pedagogical approaches with TLE content knowledge. This finding suggests that teachers possess strong competencies in selecting instructional strategies, designing learning activities, and aligning instruction with curriculum standards to facilitate effective teaching and meaningful learner engagement.

Among the indicators, "Aligns TLE teaching strategies with the learning competencies" obtained the highest mean ($M = 4.80$, Very High Competence), followed by "Selects appropriate instructional strategies for specific TLE content" ($M = 4.60$, Very High Competence), "Explains difficult TLE concepts using appropriate pedagogical approaches" ($M = 4.40$, Very High Competence), and "Adapts instructional methods to learners' needs and abilities in TLE" ($M = 4.30$, Very High Competence). Other indicators related to designing learning activities, using assessment strategies, providing remediation, integrating real-life applications, and encouraging learner participation received High Competence ratings. Conversely, "Differentiates instruction based on learners' readiness and interests" obtained the lowest mean ($M = 3.10$, Moderate Competence). These findings indicate that teachers demonstrate strong pedagogical content knowledge but may further strengthen differentiated instruction to better address the diverse learning needs, readiness levels, and interests of learners.

Table 2 illustrates the level of learners' achievement in Technology and Livelihood Education (TLE) as measured by their final grades during School Year 2025–2026. The findings revealed that the largest proportion of learners, 58 or 37.42%, obtained a Very

Satisfactory rating (85–89). This was followed by 45 learners (29.03%) who achieved an Outstanding rating (90–100), while 42 learners (27.10%) obtained a Satisfactory rating (80–84). The computed mean final grade of 86.38, interpreted as Very Satisfactory, indicates that the learners generally demonstrated a high level of academic achievement in Technology and Livelihood Education. These findings suggest that most learners were able to attain the expected learning competencies and performed well in the subject.

Meanwhile, 10 learners (6.45%) obtained a Fairly Satisfactory rating (75–79), and none of the respondents received a grade below the passing level. This finding indicates that all learners successfully met the minimum learning standards prescribed for the subject. However, the presence of learners within the fairly satisfactory category suggests the need for continuous instructional support, differentiated learning activities, and appropriate interventions to further improve learner performance and increase the proportion of learners achieving outstanding academic results in Technology and Livelihood Education.

Table 3 presents the significant relationship between teachers' technological pedagogical competence and learners' achievement in Technology and Livelihood Education. The findings revealed that overall technological pedagogical competence has a strong positive and statistically significant relationship with learners' achievement ($r = 0.692$, $p < 0.001$). Likewise, Technological Pedagogical Content Knowledge (TPACK) demonstrated the strongest positive relationship ($r = 0.708$, $p < 0.001$). Since all computed p-values were less than the 0.05 level of significance, the null hypothesis was rejected for all competency dimensions. These findings indicate that higher levels of teachers' technological pedagogical competence are associated with better academic achievement among learners in Technology and Livelihood Education.

Among the competency dimensions, Technological Pedagogical Content Knowledge (TPACK) ($r = 0.708$), Technological Pedagogical Knowledge (TPK) ($r = 0.641$), and Technological Content Knowledge (TCK) ($r = 0.604$) exhibited strong positive significant relationships with learners' achievement. Meanwhile, Pedagogical Knowledge (PK) ($r = 0.553$), Content Knowledge (CK) ($r = 0.517$), Pedagogical Content Knowledge (PCK) ($r = 0.587$), and Technological Knowledge (TK) ($r = 0.481$) showed moderate positive significant relationships. These findings imply that while all dimensions of teachers' technological pedagogical competence contribute significantly to learner achievement, integrated competencies that combine technology, pedagogy, and content knowledge demonstrate stronger associations with improved learner performance.

Table 4 presents the results of the multiple linear regression analysis conducted to determine which dimensions of teachers' technological pedagogical competence significantly predict learners' achievement in Technology and Livelihood Education. The regression model was found to be statistically significant ($F = 30.68$, $p < 0.001$), indicating that the predictor variables collectively explain a significant proportion of learners' academic achievement. The model yielded an R value of 0.771, indicating a strong positive relationship between teachers' technological pedagogical competence and learners' achievement. Furthermore, the coefficient of determination ($R^2 = 0.594$)

indicates that approximately 59.4% of the variation in learners' achievement can be explained by the seven competency dimensions included in the regression model, while the remaining 40.6% may be attributed to other factors not included in the study.

The regression analysis further revealed that Technological Pedagogical Content Knowledge (TPACK) emerged as the strongest significant predictor of learners' achievement ($\beta = 0.401$, $B = 2.315$, $t = 5.12$, $p < 0.001$). This was followed by Technological Pedagogical Knowledge (TPK) ($\beta = 0.224$, $B = 1.148$, $t = 2.75$, $p = 0.007$) and Pedagogical Knowledge (PK) ($\beta = 0.173$, $B = 0.927$, $t = 2.34$, $p = 0.021$), all of which significantly influenced learners' achievement. Conversely, Technological Knowledge (TK) ($p = 0.214$), Content Knowledge (CK) ($p = 0.144$), Technological Content Knowledge (TCK) ($p = 0.077$), and Pedagogical Content Knowledge (PCK) ($p = 0.075$) were not found to be significant predictors after controlling for the effects of the other variables. These findings suggest that although all competency dimensions are positively associated with learner achievement, teachers' ability to effectively integrate technology, pedagogy, and content knowledge, together with strong pedagogical competence, exerts the greatest influence on improving learners' academic performance in Technology and Livelihood Education.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. Teachers in the Schools Division Office of Nueva Ecija possess a generally high level of technological pedagogical competence in Technology and Livelihood Education. They demonstrate competence in integrating technology, pedagogy, and content knowledge in instruction. However, the comparatively lower ratings in Technological Knowledge and Pedagogical Knowledge indicate that continuous professional development remains necessary to further enhance these competencies.
2. Learners achieved a Very Satisfactory level of academic performance in Technology and Livelihood Education during the School Year 2025–2026. This indicates that the majority of learners successfully attained the expected learning competencies and learning standards prescribed in the curriculum.
3. Teachers' technological pedagogical competence has a significant positive relationship with learners' achievement in Technology and Livelihood Education. As teachers become more competent in integrating technology with pedagogy and content knowledge, learners' academic achievement likewise tends to improve.
4. Among the dimensions of technological pedagogical competence, Technological Pedagogical Content Knowledge (TPACK) is the strongest predictor of learners' achievement in Technology and Livelihood Education. This demonstrates that teachers' ability to effectively integrate technology, pedagogy, and content knowledge plays a crucial role in improving learners' academic performance.

5. The proposed Technology-Enhanced Professional Development Program (TECH-TLE 360) is an appropriate intervention for strengthening teachers' technological pedagogical competence. By focusing on technology integration, learner-centered pedagogies, content enhancement, mentoring, coaching, and continuous professional learning, the program is expected to further improve instructional effectiveness and contribute to higher learner achievement in Technology and Livelihood Education.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are offered:

1. School heads should strengthen teachers' technological pedagogical competence by providing sustained professional development programs, mentoring, coaching, Learning Action Cell (LAC) sessions, and technology integration training, with particular emphasis on enhancing Technological Knowledge and Pedagogical Knowledge.
2. Technology and Livelihood Education (TLE) teachers should continuously upgrade their technological, pedagogical, and content competencies by actively participating in seminars, workshops, webinars, industry immersion, and other professional learning opportunities. They should also integrate innovative and technology-enhanced instructional strategies that promote learner engagement and improve academic achievement.
3. Schools Division Office officials and curriculum supervisors should institutionalize and support the implementation of the proposed Technology-Enhanced Professional Development Program (TECH-TLE 360) by allocating adequate resources, providing technical assistance, strengthening ICT infrastructure, and monitoring the effectiveness of technology integration in TLE classrooms.
4. School heads and teachers should prioritize the development of teachers' Technological Pedagogical Content Knowledge (TPACK) since it was identified as the strongest predictor of learners' achievement. Collaborative lesson planning, peer coaching, demonstration teaching, and action research should be encouraged to promote the effective integration of technology, pedagogy, and content knowledge.
5. Future researchers are encouraged to replicate or extend this study in other schools, districts, divisions, or regions using larger samples and different educational contexts. They may also investigate other variables that influence learners' achievement in Technology and Livelihood Education, such as digital literacy, learner motivation, school technological readiness, instructional leadership, classroom climate, and parental support, to provide a more comprehensive understanding of factors affecting academic performance.

Compliance with Ethical Standards

The study was conducted in accordance with established ethical principles governing educational research to ensure the protection of the rights, dignity, privacy, and welfare of all participants. The researcher likewise complied with the ethical standards of the Department of Education (DepEd) and the provisions of Republic Act No. 10173, otherwise known as the Data Privacy Act of 2012. Prior to data collection, approval was secured from the Schools Division Superintendent of the Schools Division Office of Nueva Ecija, the concerned Public Schools District Supervisors, and the school heads of the participating schools. Participation in the study was entirely voluntary. The teacher-respondents were informed of the objectives, significance, procedures, and voluntary nature of the study and signed informed consent forms before participating. They were likewise informed of their right to decline participation or withdraw from the study at any time without penalty or adverse consequences.

The confidentiality and anonymity of the respondents were strictly maintained. Identification codes were used instead of names, and all information gathered, including the official final grades in Technology and Livelihood Education for School Year 2025–2026, was obtained with proper authorization and handled with strict confidentiality. The findings were presented only in aggregate form to ensure that no individual respondent, learner, or participating school could be identified. All research data were securely stored and used solely for academic and research purposes in compliance with the Data Privacy Act of 2012. Throughout the study, the researcher upheld the principles of beneficence, justice, honesty, integrity, objectivity, and transparency by ensuring that participation posed no harm to the respondents, all qualified participants were treated fairly, and the data were collected, analyzed, interpreted, and reported accurately without fabrication, falsification, or misrepresentation. All sources of information were properly acknowledged in accordance with the APA 7th Edition citation and referencing guidelines.

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delossantos.tricia40@gmail.com