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A Predictive Analysis on the Technological Pedagogical and Content Knowledge of Public Elementary Teachers: A Basis for An Action Plan

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Abstract

This study aimed to determine the level of Technological Pedagogical and Content Knowledge (TPACK) of elementary teachers in the Alcala East District Hillside Cluster as a basis for an action plan. Utilizing a descriptive comparative-correlational design, data were collected from 145 Kindergarten to Grade 6 teachers using a standardized TPACK questionnaire. Findings revealed that the teachers, predominantly experienced female master's degree holders, demonstrated a high level of knowledge across most TPACK domains, including pedagogical, content, and technological-content knowledge. However, their technological-pedagogical knowledge was at a moderate level. Significant differences and relationships were found primarily in relation to the teachers' number of years in teaching and their attendance at relevant TPACK trainings, which were also identified as significant predictors of their overall TPACK. The foremost issue encountered was a lack of funding for technology integration. Based on these results, a comprehensive action plan titled "Project TARGET" (Train, Assess, Resource Guide, Engage, Transform) was developed to systematically enhance teachers' TPACK competencies through targeted professional development, resource allocation, and sustained support mechanisms.

Keywords: *TPACK, Technological Pedagogical Content Knowledge, Teacher Competencies, Professional Development, Predictive Analysis, Action Plan*

INTRODUCTION

In the 21st-century educational landscape, the integration of technology is no longer an optional enhancement but a fundamental component of effective teaching and learning. The rapid evolution of digital tools demands that educators possess more than just isolated technological skills; they require a sophisticated, interconnected knowledge base that blends technology with deep pedagogical understanding and content expertise. This necessity is encapsulated in the Technological Pedagogical and Content

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Knowledge (TPACK) framework, which posits that effective technology integration occurs at the intersection of these three core knowledge domains. For elementary education, where foundational skills are established, mastering TPACK is critical to creating engaging, relevant, and impactful learning experiences for young students.

Despite national initiatives and the heightened reliance on technology during the recent pandemic, a significant gap often exists between the availability of digital tools and teachers' capacity to wield them effectively within their specific subject areas and teaching contexts. In the Philippines, particularly within public elementary schools, teachers face unique challenges, including diverse learner needs, limited resources, and varying levels of professional development access. Understanding the current state of teachers' TPACK is therefore essential for designing meaningful interventions that move beyond basic digital literacy toward the transformative use of technology in the classroom.

This study was conducted to assess the TPACK levels of elementary teachers in the Alcala East District Hillside Cluster. It sought to not only gauge their self-assessed competencies across the seven TPACK domains but also to investigate how these competencies relate to key demographic and professional profile variables such as age, years of experience, and training attendance. Furthermore, the study employed predictive modeling to identify which factors most significantly influence a teacher's TPACK, providing a data-driven foundation for strategic planning. The findings of this investigation, including the identified issues such as lack of funding and inadequate equipment, directly inform the development of "Project TARGET," a targeted action plan designed to empower teachers, optimize resource allocation, and foster a culture of continuous professional growth in technology integration for the School Year 2024-2025.

Statement of the Problem

This study aims to determine the technological pedagogical and content knowledge of elementary teachers of Alcala East District Hillside Cluster, Alcala, Cagayan, as a basis for an action plan for the School Year 2024-2025

Specifically, it seeks to answer the following questions:

1. What is the profile of the respondents in terms of:
   1.1 Age
   1.2 Sex
   1.3 Civil Status
   1.4 Highest Educational Attainment
   1.5 Number of Years in Teaching
   1.6 Number of relevant TPACK trainings
2. What is the level of technological pedagogical and content knowledge of the respondents relative to:
   2.1 Technological knowledge
   2.2 Pedagogical knowledge
   2.3 Content knowledge
   2.4 Technological-Content knowledge
   2.5 Pedagogical-Content knowledge
   2.6 Technological-Pedagogical knowledge

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2.7 Technological Pedagogical, and Content Knowledge

3. Is there a significant difference on the technological pedagogical and content knowledge of the respondents when grouped according to profile variables?
4. Is there a significant relationship between the technological pedagogical and content knowledge of the respondents to their profile variables?
5. What predictive model can be deduced from the Technological Pedagogical and Content Knowledge to the profile variables in the study?
6. What are the issues and concerns encountered by the respondents relative to technological pedagogical and content knowledge?
7. What action plan can be proposed to address the issues and concerns encountered by the respondents relative to technological pedagogical and content knowledge?

Hypotheses

This study was guided by the following hypotheses that:

- There is no significant difference on the technological pedagogical and content knowledge of the respondents when grouped according to profile variables;
- There is no significant relationship between the technological pedagogical and content knowledge of the respondents to their profile variables; and
- The profile variables of the respondents are not significant predictors of their Technological Pedagogical and Content Knowledge.

Scope and Delimitation of the Study

The primary objective of this research was to determine the TPACK of teachers and their profile variables in the Alcala East District during the 2024–2025 academic year. A total enumeration method was employed to include all 145 participants currently teaching Kindergarten through Grade 6.

The respondents were surveyed regarding their profiles and seven domains: technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge.

This study utilized a self-report questionnaire consisting of 28 items developed by Schmid, Brianza, and Petko (2020). Additionally, the checklist items in the final section of the questionnaire were adapted from the research of Johnson et al. (2016).

METHODS

Research Design

The researcher utilized a quantitative research design, specifically a descriptive comparative-correlational design, to determine the intricate difference and relationship of teachers' knowledge on the

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seven domains of TPACK and their profile variables. The researcher aimed to describe and measure the degree of association between two or more variables or sets of scores (Creswell, 2012).

Respondents of the Study

The respondents of this study were elementary teachers teaching Kindergarten to Grade 6 in the Alcala East District for the school year 2024–2025 school year. Total enumeration was used; however, only those who gave their consent were included in the study. Participation was voluntary.

Table 1. Respondents of the Study

Respondents	Population (N)
Alcala East Central School	15
Agani E/S	8
Angkiray E/S	9
Arana-ar E/S	9
Baculod E/S	9
Baybayog E/S	12
Calantac E/S	8
Dalaoig E/S	8
DalaoigCataraoan Annex E/S	6
Damurog E/S	8
Jurisdiccion E/S	8
Maraburab E/S	8
Masin E/S	6
Pinopoc E/S	8
Piggatan E/S	8
Pussian E/S	8
San Esteban E/S	7
Tupang E/S	8
TOTAL	**145**

Data Gathering Tool

The researcher utilized a survey questionnaire to collect data for this study. The questionnaire was adopted from the study by Schmid, Brianza, and Petko (2020) titled “Developing a short assessment

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instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model." It consists of 28 items and employs a five-point Likert scale.

The questionnaire consisted of three parts. Part 1 gathered information on the respondents' profile variables, including age, sex, civil status, highest educational attainment, number of years in teaching, and number of relevant TPACK trainings.

Part 2 assessed the respondents' level of knowledge across the seven domains of TPACK: technological knowledge, pedagogical knowledge, content knowledge, technological- content knowledge, pedagogical-content knowledge, technological-pedagogical knowledge, and technological pedagogical content knowledge.

Part 3 determined the issues and concerns encountered by the respondents relative to technological pedagogical and content knowledge. The items in this checklist were adapted from Johnson et al.'s (2016) study titled "Challenges and Solutions when Using Technologies in the Classroom," published in the book Adaptive Educational Technologies for Literacy Instruction.

This instrument allowed the researcher to comprehensively assess both the demographic profile and the multidimensional TPACK competencies of the respondents, as well as to identify challenges they face in integrating technology, pedagogy, and content knowledge in their teaching practice.

Data Gathering Procedure

The following steps were followed in gathering the data in pursuit of this study.

First, the researcher presented his proposal to the panel of experts with the guidance of his adviser. Afterward, he incorporated the comments and suggestions of the panelists into the manuscript. Then, the researcher wrote a letter requesting the University President's permission to submit the manuscript and to secure Institutional Review Board (IRB) forms. Upon acceptance of the application, the researcher completed the forms and submitted them along with the manuscript to the IRB office for review by a team of professional and expert researchers. These steps were undertaken to secure ethical clearance from the IRB.

The researcher also sent a letter to the Office of the Schools Division Superintendent of Cagayan, requesting permission to conduct data collection among elementary teachers in the Alcala East District.

Upon approval of the permission letter by the Superintendent, the researcher administered the questionnaire to the participants of the study. At the same time, the Public Schools District Supervisor was informed of the data collection through a formal letter. Data were collected from April 2 to 4, 2025, at 4:00 P.M., during the respondents' off-teaching hours and Collaborative Expertise Sessions, under the guidance and approval of the Public Schools District Supervisor. The data collection was originally planned during the In-Service Training of Teachers (INSET) for the Alcala East District but was deferred due to the pending ethical clearance. Consequently, the researcher informed the IRB Office in writing about the change in data collection procedures, which was promptly approved by the IRB Chair.

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Before the respondents answered the questionnaire, the UCV IRB Informed Consent Form was provided, informing them of their rights, dignity, and freedom regarding participation in the study and explaining the nature of the research. The anonymity of the participants and the confidentiality of the data collected were strictly observed and adhered to, as stated in the Informed Consent Form.

After the respondents completed the questionnaires, the researcher collected them and handed the responses over to the statistician for tallying, collating, processing, and analysis. Upon completion of this phase, the researcher interpreted the data and wrote the implications of the results under the guidance and advice of his adviser.

Statistical Tools

The researcher analyzed the data gathered from the respondents using JAMOVI software and applied the following statistical treatments:

Frequency count and percentage distribution were employed to determine the profile variables of the respondents.

Weighted mean was used to determine the teachers' knowledge of teaching and technology. The data were further analyzed using the 5-point Likert scale below.

Scale	Weighted Mean	Description	Interpretation
5	4.21–5.00	Strongly Agree	Very High
4	3.41–4.20	Agree	High
3	2.61-3.40	Neither Agree or Disagree	Moderate
2	1.81-2.60	Disagree	Low
1	1.00-1.80	Strongly Disagree	Very Low

Independent samples t-test and one-way ANOVA were used to test the difference in the knowledge of teaching and technology when grouped according to their profile variables. Data were subjected to Normality Test using the Kolmogorov-Smirnov Test.

Chi-Square following Cramer's V correlation analysis was used to analyze the relationship between knowledge of teaching and technology to the profile variables of the respondents.

Multinomial logistic Regression was used to analyze the extent to which the profile variables of the respondents significantly predict their knowledge of teaching and technology. This was used for PREDICTIVE MODELLING. In turn, the Cox and Snell, Nagelkerke, and Mcfadden were used to analyze the parameter estimates in the predictive modeling together with the Wald test.

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The issues and problems encountered by the respondents relative to technological pedagogical and content knowledge were analyzed with the use of frequency percentage and rank.

RESULTS AND DISCUSSION

Summary of Findings

Based on the results and discussions, the study yielded several key findings. The demographic profile of the respondents indicates a mature and experienced teaching force, with the majority being female, married, master's degree holders between 40 and 49 years of age, possessing 20 to 24 years of teaching experience, and having attended an average of four TPACK-related trainings.

An assessment of the teachers' knowledge revealed high levels of competency across most TPACK domains, including technological knowledge, pedagogical knowledge, content knowledge, technological-content knowledge, pedagogical-content knowledge, and the integrated technological, pedagogical, and content knowledge. However, a notable area for development was identified in technological-pedagogical knowledge, which was reported at a moderate level. Further analysis showed that the teachers' knowledge demonstrated consistency across most profile variables, with significant differences emerging primarily in relation to the number of years in teaching for pedagogical knowledge and pedagogical-content knowledge, and for the overall TPACK in relation to both teaching experience and relevant training.

The correlation analysis reinforced that a significant relationship exists between the teachers' TPACK and their professional experience and training, specifically their number of years in teaching and the number of relevant TPACK trainings attended. No such significant relationship was found with other demographic variables such as age, sex, civil status, or highest educational attainment. This finding was substantiated by the predictive model, which identified teaching experience and TPACK training as significant predictors of overall competency. The model particularly highlighted that mid-career educators with 15–19 years of experience and those who had completed four TPACK trainings were the most confident in their integrated knowledge, indicating that a combination of substantial classroom experience and targeted professional development is crucial for building technological pedagogical competence.

Finally, the study identified several pressing issues hindering effective technology integration. The most critical concern reported by teachers was a lack of funding, which was closely followed by insufficient equipment or connectivity and inadequate professional training related to technology. Other significant challenges included a lack of time for preparing technology-enhanced lessons and for teaching foundational student skills, inadequate technical and administrative support, a lack of confidence and knowledge in integrating technology, and, as the least cited issue, a lack of personal interest or motivation.

Conclusions

Based on the findings, it can be concluded that the teachers in the Alcala East District represent a mature and professionally stable group, well-equipped to integrate pedagogical and technological knowledge into their teaching. Their years of teaching experience and participation in technology-related training form a strong foundation for effectively applying TPACK principles. Teachers demonstrate high

confidence and proficiency in using technology to enhance instruction, with their knowledge largely consistent across demographic and professional backgrounds. Importantly, both teaching experience and targeted TPACK training significantly influence their overall technological pedagogical content knowledge, underscoring the value of practical classroom experience and focused professional development over personal or academic factors. To further empower educators and maximize the benefits of technology integration, sustained investment, improved infrastructure, and continuous, specialized training are essential components for supporting effective teaching and learning.

Recommendations

- In the light of the forgoing findings, the researcher offers the following recommendations to create a more supportive technological environment for both school heads and teachers.
- Educational institutions and professional development providers may prioritize and increase access to high- quality TPACK training, especially for early- and mid- career teachers. Schools may offer mentorship and use mid-career educators' expertise to help less experienced instructors build their technological pedagogical skills.
- Training programs may be adapted to meet the needs of teachers at different career levels, with advanced, application-focused TPACK training being particularly beneficial for mid-career educators.
- Schools may promote lifelong learning by holding organized technology integration seminars that build on prior TPACK expertise.
- School leaders may foster collaboration and best practices sharing among educators by creating a supportive environment. Technology knowledge and confidence can be improved through peer learning and mentoring. School leaders and education professionals may evaluate training programs and provide beneficial feedback to educators to help discover areas for growth and meet training goals.
- Forge partnerships with LGU's, private agencies and individuals, civic-minded people to get involved in the provisions of technology tools and free trainings.
- Future researchers may examine the influence of external factors such as funding, infrastructure, and administrative support on the effective use of technology in education, particularly in relation to teachers' Technological Pedagogical Content Knowledge (TPACK).

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