Technology Leadership Of School Heads and Digital Literacy of Teachers and Learners

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Abstract — As educational systems transition into the digital era, the role of school leadership in fostering digital competence has become a primary focus. However, the direct impact of visionary leadership on the technical proficiency of stakeholders in rural public schools remains under-explored.

This study investigated the relationship between the technology leadership of school heads and the digital literacy levels of teachers and learners within the Schools Division of Northern Samar.

Utilizing a descriptive-correlational research design, data were gathered from a representative sample of school heads, teachers, and senior high school students. Standardized survey instruments were used to measure leadership dimensions (traits, technical, and soft skills) and digital literacy domains (content, pedagogy, ethics, and critical thinking). Data were analyzed using Mean, Pearson r, Spearman rho, and Mann-Whitney U tests.

Findings revealed that school heads demonstrate strong visionary leadership but face gaps in technical operational skills. Teachers showed high content knowledge but low confidence in technology-enhanced pedagogy. Notably, no statistically significant relationship was found between school heads' technology leadership and the digital literacy of teachers or learners ($p > 0.05$). However, age was a significant negative predictor of digital soft skills for leaders and technological knowledge for teachers. Conversely, the academic strand was the most significant predictor of digital literacy among students ($p < 0.001$).

The study concludes that while technology leadership is essential for institutional vision, it is not the primary driver of individual digital proficiency. Digital literacy is more closely tied to generational factors and curricular specialization. Recommendations include shifting professional

development toward subject-specific digital pedagogy and implementing reverse-mentoring programs to bridge the generational technical gap.

Keywords: Technology Leadership, Digital Literacy, Northern Samar, Senior High School Strands, Educational Management, TPACK.

I. INTRODUCTION

The integration of digital technologies has become central to educational transformation in the 21st century, enabling more flexible, inclusive, and student-centered learning environments. Globally, institutions have increasingly adopted digital tools to support instruction and ensure continuity of learning, particularly during disruptions such as the COVID-19 pandemic, which affected over 1.6 billion learners worldwide. However, this rapid shift also exposed significant disparities in access to technology and digital competencies, especially in developing and rural contexts.

In the Philippines, the Department of Education (DepEd) implemented several initiatives to sustain learning during the pandemic, including the Basic Education Learning Continuity Plan and increased investment in digital infrastructure. Despite these efforts, challenges persist, particularly in rural areas where access to devices, internet connectivity, and digital training remains uneven. These constraints highlight the critical need for strengthening digital literacy among both teachers and learners, as well as enhancing the capacity of school leaders to effectively guide technology integration.

School heads play a crucial role in driving digital transformation in schools. Through effective technology leadership, they can influence the adoption of digital tools, support teacher professional development, and create enabling environments for technology-enhanced learning. However, in resource-constrained settings, the extent to which leadership translates into improved digital literacy outcomes remains unclear.

In the context of Northern Samar, a predominantly rural province in the Philippines, schools face persistent challenges related to infrastructure, access, and capacity in integrating technology into teaching and learning. While efforts to improve literacy outcomes have shown progress, there is limited empirical evidence examining how school heads' technology leadership influences the digital literacy of teachers and learners.

This study addresses this gap by examining the relationship between technology leadership and digital literacy in public secondary schools in Northern Samar. Specifically, it investigates the level of technology leadership among school heads, the digital literacy of teachers and learners, and the relationships among these variables. The findings aim to inform policies and interventions that strengthen digital education in rural contexts.

Literature Review

1.1.1 Conceptual Literature

Technology plays a critical role in modern education, transforming teaching, learning, and school management. In the Philippines, initiatives such as the Department of Education's Alternative Learning System (ALS) eSkwela and digital content programs have expanded access to learning, particularly for underserved populations (European Commission, 2022). However, challenges such as limited infrastructure, device shortages, and unreliable internet connectivity persist, especially in rural areas, requiring strong leadership to ensure equitable technology integration (Chang et al., 2024).

Digital literacy has become an essential competence for both teachers and learners. It encompasses the skills needed to effectively access, evaluate, create, and communicate information using digital technologies. In educational settings, digital literacy enables teachers to design innovative instruction and supports learners in developing critical thinking and problem-solving skills necessary for the 21st century (Nguyen & Habók, 2023).

Teachers play a central role in developing students' digital literacy. Frameworks such as the Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006) and the European Digital Competence Framework for Educators (DigCompEdu) (Redecker, 2021) emphasize the integration of technology, pedagogy, and content knowledge. Teachers with strong digital competence are better equipped to integrate technology into instruction, enhance student engagement, and facilitate meaningful learning experiences.

School heads' technology leadership is a key factor in promoting effective ICT integration. Leaders who provide clear vision, allocate resources, and support professional development create environments where teachers can confidently use digital tools. Research indicates that strong leadership fosters teacher collaboration, enhances ICT self-efficacy, and improves classroom technology use (Hallinger & Wang, 2022; Chang et al., 2024). Leadership practices such as strategic planning, resource management, and modeling technology use are particularly important in strengthening digital learning environments.

Digital literacy among learners is also shaped by structured frameworks that include competencies such as information management, communication, content creation, and responsible technology use. These competencies align with global standards and are necessary in preparing learners for a technology-driven society (Fraillon et al., 2024).

In the Philippine context, technology leadership aligns with national priorities such as ICT integration and digital transformation in education (Department of Education, 2023). School heads play a crucial role in implementing these initiatives by supporting teacher training, promoting innovative practices, and ensuring access to digital resources.

Overall, existing literature suggests that while technology leadership is important in facilitating ICT integration, the development of digital literacy among teachers and learners is influenced by multiple factors, including access to resources, training opportunities, and curriculum integration. This highlights the need for context-specific studies, particularly in rural settings.

1.1.2 Research Literature

The global educational landscape has shifted toward a technology-dependent paradigm, placing Technology Leadership and Digital Literacy at the forefront of institutional success. Research consistently identifies a digital competence gap among educators. Internationally, Basilotta-Gómez-Pablos et al. (2022) and Mardiana (2024) noted that higher education faculty often possess only low-to-medium digital skills, highlighting a systemic need for personalized training. During the COVID-19 pandemic, this lack of confidence was further amplified, as seen in large-scale studies in Spain (Sánchez-Cruzado et al., 2021), where low self-efficacy became a primary barrier to effective instruction.

Digital literacy is increasingly viewed as a multidimensional construct. Feng and Sumettikoon (2024) identified core components—information, safety, and content creation—noting that mastery in one area often catalyzes growth in others. In the technical sphere, Hizam et al. (2021) found that these competencies directly dictate a teacher's ability to facilitate virtual instruction on platforms like Moodle.

In the Philippine context, research highlights significant demographic and leadership influences. Abella and Dela Rosa (2023) and Pizarro et al. (2024) established that age and years of experience are key predictors of literacy, with younger "digital native" teachers generally demonstrating higher proficiency. Locally, studies in Southern Mindanao and Digos City (Disonglo & Limpot, 2023; Galaraga & Alpuerto, 2022) reveal that digital literacy is the single strongest predictor of overall teacher effectiveness and readiness for digitized instruction.

Crucially, the role of the school head as a catalyst for this literacy is supported by Cantos and Callo (2022) and Maala and Lagos (2022), who found that strong technology leadership significantly improves both teacher proficiency and academic optimism. However, barriers such as limited infrastructure and insufficient training remain persistent (Olabiyi et al., 2025).

While existing literature often focuses on either teacher self-efficacy (Garzon, 2023) or leadership’s impact on job satisfaction (Tanucan, 2022), there is a distinct gap in research that simultaneously assesses the triadic relationship between school head leadership, teacher literacy,

and learner outcomes—particularly in rural, resource-constrained divisions like Northern Samar. This study addresses this gap by examining how leadership serves as an bridge for digital competence across the entire school ecosystem.

Theoretical Framework

This study is grounded in a triadic theoretical framework that examines the intersection of leadership, technology integration, and organizational innovation.

Transformational Leadership Theory (Bass & Riggio, 2006): This theory posits that leaders drive innovation through four dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. In this study, the school head is viewed as a catalyst for digital transformation, a role reinforced by DepEd Order No. 24, s. 2020 (PPSSH) and DepEd Order No. 44, s. 2021 (Digital Rise Program), which mandate ICT integration as a core leadership domain.

Technological Pedagogical Content Knowledge (TPACK) Framework (Mishra & Koehler, 2006): TPACK emphasizes that effective digital teaching occurs at the intersection of technology, pedagogy, and content knowledge. This framework provides the metric for teacher literacy, suggesting that a school head's leadership is successful only if it enhances a teacher's capacity to blend these three domains in the classroom.

Diffusion of Innovations Theory (Rogers, 2003): This theory explains how digital practices spread through an organization based on factors like relative advantage and compatibility. School heads act as "change agents" whose technical and soft skills determine the speed and success of ICT adoption. This process is supported by Republic Act No. 10929 (Free Internet Access in Public Places Act), which provide the necessary infrastructure for innovation to take root.

Together, these frameworks provide a robust lens for analyzing how a school head's leadership traits and skills influence the digital maturity of the school ecosystem.

Conceptual Framework

The conceptual framework of this study, illustrated in Figure 1, follows an Input-Process-Output (IPO) model to examine the dynamics of digital transformation within the school ecosystem.

Independent Variables (IV): The framework begins with the Demographic Profiles of school heads, teachers, and learners (age, sex, experience, and academic strand). These are hypothesized to influence the core variables of the study. Central to the input is the Technology Leadership of School Heads, categorized into leadership traits, technical skills, and soft skills.

Dependent Variables (DV): The study measures the Digital Literacy of two primary stakeholder groups. For teachers, literacy is assessed through the TPACK lens (Content, Pedagogical, and Technological Knowledge). For learners, it is measured across five 21st-century domains: Safe and Ethical Use, Information Management, Content Creation, Collaboration/Communication, and Critical Thinking.

Relationships: The framework assumes a reciprocal relationship (indicated by double-headed arrows) between a school head's leadership and the literacy levels of teachers and learners. It further explores how demographic variations correlate with these digital competencies.

Output: The synthesis of these relationships culminates in Proposed Policy Recommendations. This output is designed to provide a contextualized roadmap for the Schools Division of Northern Samar to enhance technology leadership and bridge digital literacy gaps.

II. METHODOLOGY

Research Design

This study employed a descriptive–correlational research design to examine the relationship between school heads' technology leadership and the digital literacy of teachers and

learners. This design is appropriate for describing variables and determining the strength and direction of relationships without manipulating any conditions, making it suitable for educational settings where experimental control is not feasible.

Participants and Sampling

The study involved 551 respondents from public secondary schools in the Central Area District, Schools Division of Northern Samar, Philippines. The participants consisted of 14 school heads, 163 senior high school teachers, and 374 senior high school learners.

Total enumeration was used for school heads due to the small population size. For teachers and learners, sample sizes were determined using Slovin's formula, and respondents were selected through stratified random sampling to ensure representation across schools and academic strands.

Research Instrument

Data were collected using a researcher-developed questionnaire consisting of two parts: demographic profile and main content areas.

The instrument for school heads measured technology leadership across three domains: leadership traits, technical skills, and soft skills. The teachers' questionnaire assessed digital literacy based on content, pedagogical, and technological knowledge. For learners, digital literacy was measured across five domains: safe and ethical use, information management, content creation, collaboration and communication, and critical thinking.

All items were rated using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument was adapted from established frameworks, including technology leadership standards, TPACK, and international digital competence frameworks.

Validity and Reliability

The instrument underwent pilot testing with respondents from a different district to ensure clarity and reliability. Cronbach's alpha coefficients indicated high internal consistency: 0.93 for school heads, 0.91 for teachers, and 0.89 for learners. These values confirm that the instrument is reliable for measuring the intended constructs.

Data Collection Procedure

Permission to conduct the study was obtained from the Schools Division Office and participating schools. Data were collected through a combination of face-to-face administration for school heads and online surveys for teachers and learners using Google Forms.

Participants were provided with clear instructions and informed consent prior to participation. Completed responses were encoded and prepared for statistical analysis.

Data Analysis

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to describe respondent characteristics and variable levels.

Inferential statistics were applied to examine relationships and differences among variables. Pearson's r correlation was used to assess the relationship between technology leadership and digital literacy. Independent samples t-tests and one-way analysis of variance (ANOVA) were used to determine differences based on demographic variables.

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS), with a significance level set at 0.05.

Ethical Considerations

The study adhered to ethical research standards. Participation was voluntary, and informed consent was obtained from all respondents. For learners under 18 years old, parental consent was secured.

Confidentiality and anonymity were strictly maintained, and no personally identifiable information was disclosed. Data were securely stored and used solely for academic purposes in compliance with the Data Privacy Act of 2012.

III. RESULTS AND DISCUSSION

The Generational Divide: Age as a Barrier to Digital Soft Skills

A critical finding of this study is the significant negative correlation between age and the digital competencies of educators. For school heads, age showed a moderate negative relationship with Soft Skills ($r = -0.533$, $p = 0.050$), while older teachers reported significantly lower Technological Knowledge ($p = 0.017$\$). This generational gap suggests that as educators progress in their careers, there is a risk of "technological stagnation," where established routines resist the adoption of fluid digital communication and technical troubleshooting. This confirms the "digital fluency divide" noted by Cosgun-Demirdag (2025) and Basilotta-Gómez-Pablos et al. (2022), who argue that younger "digital natives" possess a cognitive advantage in navigating non-linear digital environments. In the context of Northern Samar, this implies that experience, while valuable for general administration, may act as an anchor that slows the transition to digital-first school governance. Consequently, leadership development must move beyond administrative theory to focus on generational adaptability and the implementation of reverse-mentoring programs where younger staff assist senior leaders in technical operations.

The "Vision-Execution" Paradox: Leadership Without Modeling

The descriptive analysis reveals that school heads exemplify high Visionary Leadership, yet they exhibit a substantial gap in Technical Operational Skills, such as hardware troubleshooting. This creates a "Vision-Execution Paradox": leaders are effective at setting digital goals but lack the technical fluency to "model" the behavior they expect from teachers. According to the Transformational Leadership Theory, as applied in recent Philippine contexts by Cantos and Callo (2022), a leader's "Inspirational Motivation" is only effective if accompanied by "Intellectual Stimulation." If a school head cannot troubleshoot a basic software issue, their "vision" for a paperless school may be perceived by teachers as a top-down mandate rather than a shared journey. This disconnect highlights that in a rural division, "Digital Modeling" is more influential than "Administrative Issuances." For technology to truly diffuse, school heads must transition from being "Overseers of ICT" to "Active Practitioners of ICT."

Teacher Literacy: The Plateau of Pedagogical Integration

The data shows that while teachers have mastered the "Technology" (TK) of the TPACK framework, they struggle with the "Pedagogical Integration" (PK). This indicates a "competence plateau" where teachers use technology for administrative tasks (e.g., encoded grades) but fail to use it for high-order instructional strategies like digital assessment or collaborative virtual learning. Unlike Mardiana (2024), who suggested that general technical training leads to better platform use, this study reveals that in Northern Samar, technical knowledge does not automatically translate into instructional readiness. This "hierarchy of competence" suggests that current DepEd training programs—including those under the Digital Rise Program (DepEd, 2021)—have been too focused on the "how-to" of tools. To move forward, professional development must pivot toward Subject-Specific Digital Pedagogy, showing a Math teacher or a Filipino teacher exactly how to use digital tools to explain their specific content, rather than just how to navigate the software.

Curricular Specialization: The Real Driver of Student Literacy

For students, the Academic Strand was the only significant predictor of digital literacy ($p < 0.001$), outweighing both age and sex. Students in specialized tracks (STEM/TVL) demonstrated significantly higher scores in Content Creation ($r = 0.229$) and Critical Thinking. This underscores that digital literacy among learners is not a byproduct of general digital exposure (like social media use) but is directly shaped by disciplinary rigor. This supports the findings of Feng and Sumettikoon (2024), who identified that digital skills develop most effectively when integrated into discipline-specific problem-solving. This finding is vital for regional policy: the General Academic Strand (GAS), which has the highest enrollment, currently lags in technical production. To ensure equity, the Department of Education must "cross-pollinate" the curricula, bringing the content creation activities of the TVL and STEM tracks into the GAS curriculum to ensure all graduates are equally prepared for the digital workforce.

The Decoupling Effect: Reassessing Leadership Influence

One of the study's most significant contributions is the non-statistically significant relationship between school heads' technology leadership and stakeholder literacy ($p = 0.141$ for teachers; $p = 0.575$ for learners). This null result challenges the prevailing assumption that strong leadership automatically creates literate school populations. The moderate negative trend ($r = -0.414$) between leadership and teacher literacy suggests a "Decoupling Effect"—where the leader's vision and the teacher's daily classroom reality exist in two different spheres.

As noted by Pizarro et al. (2024), while leadership provides the foundation (resources and policy), the actual cultivation of literacy is driven by individual factors like self-efficacy and classroom-level constraints. This implies that in Northern Samar, increasing a school head's leadership score will not necessarily increase a teacher's literacy unless that leadership is specifically focused on "Instructional Support" (e.g., providing better internet and dedicated ICT time) rather than just "Strategic Planning."

Synthesis and Practical Implications

In summary, technology leadership in Northern Samar is currently "vision-heavy but technical-light." While the leaders are transformational in spirit, the digital maturity of teachers and learners is being inhibited by generational technical gaps and a lack of specialized pedagogical integration. For contemporary practice, this necessitates a move toward a "Community of Practice" model, where school heads, teachers, and learners are seen as co-learners in a digital ecosystem. Future interventions should prioritize bridging the Age-Tech gap through reverse mentoring and ensuring that Curricular Strands are utilized as the primary vehicles for digital literacy development.

IV. CONCLUSION

1. School leadership is stable but needs younger perspectives and continued equitable professional development. Teachers face barriers to advanced education and training, requiring greater support to enhance competence and retention. Student demographics show imbalances, highlighting the need for more inclusive curricula and diversified academic offerings.

2. School heads demonstrate strong interpersonal and visionary leadership but lack sufficient technical proficiency, highlighting the need for leadership development programs that strengthen technology competence.

3. Teachers show strong technical skills but struggle with integrating technology into instruction, indicating a need for professional development focused on technology-enhanced teaching.

4. Students have strong digital literacy in critical thinking and online safety but lack skills in evaluating sources and creating digital content, highlighting the need to develop higher-order digital competencies.

5. School heads' technology leadership does not significantly influence teachers' or students' digital literacy, indicating the need for broader interventions beyond leadership alone.

6. School heads' technology leadership is not significantly related to teachers' or students' digital literacy, indicating that other factors play a more critical role. This highlights the need for comprehensive, multi-dimensional strategies beyond leadership to improve digital literacy.

7. The small but significant relationship between academic strand and student digital literacy suggests that curricular exposure shapes digital skills. The minor gender-related difference in teachers' pedagogical knowledge indicates the potential for further research into gender-specific professional learning needs.

8. School heads' technology leadership does not significantly influence teachers' or students' digital literacy, indicating that other factors play a more direct role in developing digital competencies.

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