

The use of digital tools in education: Insights from students, teachers and school administrators in Bulacan, Philippines

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Abstract

Aim: This study assessed and compared the internet accessibility, challenges, effectiveness, and use of digital tools in education as perceived by students, teachers, and school administrators in selected schools in Bulacan, Philippines. It also determined significant differences in their perceptions to provide a basis for strengthening digital literacy and promoting inclusive and sustainable digital education.

Methodology: A quantitative descriptive-correlational design was employed involving 210 respondents composed of 70 students, 70 teachers, and 70 school administrators. Data were collected using a validated researcher-made survey questionnaire. Descriptive statistics such as frequencies, percentages, and median were used to summarize responses, while the Kruskal–Wallis H test and post hoc Mann–Whitney U tests with Bonferroni correction were applied to determine significant differences among groups at the 0.05 level of significance.

Results: Findings revealed that school administrators and teachers reported very high internet accessibility, while students reported high accessibility. All groups experienced moderate challenges in using digital tools. Teachers perceived digital tools as very effective in enhancing instruction, whereas school administrators and students rated them as effective for administrative and learning purposes. Overall, respondents demonstrated a highly positive perception of digital tool integration. Significant differences were found among the three groups in terms of perceived challenges, effectiveness, and use of digital tools.

Conclusion: Despite moderate challenges, digital tools are widely perceived as effective and valuable in improving instructional delivery, administrative efficiency, and student engagement. Differences in stakeholder perceptions highlight the need for targeted interventions, including expanded broadband access, device support, and strengthened digital literacy programs to ensure equitable and sustainable digital education.

Keywords: *Digital education, Digital literacy, Digital tools, Effectiveness, Stakeholder perception*

INTRODUCTION

The integration of digital tools has increasingly shaped contemporary educational practice by enhancing engagement among key school stakeholders, including students, teachers, and school administrators. As learning has extended beyond the traditional classroom, students have required structured guidance to address technology-enabled problems and real-world challenges (De Regla, 2025). In this context, technology has not merely served as an instructional aid but has contributed to the transformation of educational pedagogy by facilitating communication and supporting collaborative learning processes (Al-Rahmi et al., 2021). At the global level, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2021) reported that, particularly in developed countries, this shift has supported the establishment of technology-driven learning environments designed to cultivate 21st-century skills such as critical thinking, creativity, collaboration, and digital literacy.

In the Philippines, the Department of Education (DepEd Order No. 12, series of 2020) and the Commission on Higher Education (CHED Memorandum Order No. 4, series of 2020) recognized digital integration as part of broader efforts to advance national educational goals. This transition was substantially accelerated by the coronavirus (COVID-19) pandemic, which necessitated the rapid adoption of digital platforms across educational institutions (Oducado et al., 2022). Although this shift expanded access to learning modalities, it also exposed persistent structural constraints within the



education system. Schools in rural and resource-limited contexts continued to experience unequal access to digital resources, unstable internet connectivity, limited teacher training, and insufficient availability of digital devices (Frianeza, 2024). These conditions underscored enduring disparities in digital readiness and implementation capacity.

Comparable patterns were evident in Bulacan, one of the Philippines' rapidly developing provinces. Its educational landscape comprised both technologically equipped urban schools and rural institutions with limited infrastructure, reflecting broader national inequalities. Beyond issues of access and infrastructure, the accelerated integration of digital tools also carried cultural implications, as emerging digital practices interacted with established local traditions and long-standing values associated with teaching and learning (Eustaquio & Tandoc Jr., 2025). Consequently, examining how students, teachers, and school administrators in these varied contexts accessed, used, and evaluated digital tools remained essential for informing inclusive and sustainable digital education strategies.

Despite the expanding body of literature on digital tool integration during and after the COVID-19 pandemic, existing studies have largely focused on single stakeholder groups or national-level analyses, providing limited localized and comparative evidence across multiple educational actors. In the Philippine context, particularly in post-pandemic conditions, empirical research simultaneously examining students, teachers, and school administrators within a specific provincial setting remains limited. Moreover, while prior studies documented general challenges and benefits of digital tools, few investigations have integrated assessments of accessibility, perceived effectiveness, challenges, and actual use within a unified analytical framework. Addressing these gaps was necessary to generate context-sensitive evidence that more accurately reflects the diverse realities of educational stakeholders in Bulacan.

In response, this study examined the status, accessibility, challenges, and effectiveness of digital tool integration in education among students, teachers, and school administrators in Bulacan, Philippines. It analyzed differences in access, digital literacy, and perceptions, as well as key factors influencing the effective use of digital tools. By adopting a multi-stakeholder and localized analytical approach, this research contributes empirical evidence that extends existing literature beyond emergency remote teaching contexts toward a more sustainable, post-pandemic understanding of digital education integration. The findings are intended to inform school leaders, policymakers, and technology developers in designing contextually grounded, equitable, and sustainable digitalization initiatives, thereby supporting the development of a more inclusive learning environment regardless of learners' socioeconomic or geographic backgrounds.

Review of Related Literature and Studies

Digital tools have become central to contemporary education, particularly in contexts where systemic constraints and reform agendas shape adoption. In the Philippines, the COVID-19 pandemic accelerated the shift from traditional classroom instruction to remote and blended modalities. Provinces such as Bulacan provide a relevant lens through which to examine how students, teachers, and administrators adopt, experience, and evaluate these tools. The literature converges on three core insights: digital technologies are crucial for continuity and flexibility; their impact is mediated by infrastructural and human factors; and their educational value depends on alignment with pedagogical and institutional contexts.

The pandemic compelled schools to adopt learning management systems, online platforms, and communication tools to sustain instruction (Hodges et al., 2020). Beyond emergency response, these platforms enable learner-centered and flexible pedagogies, enhancing engagement when aligned with students' needs (Bond et al., 2020). International reports from the Organisation for Economic Co-operation and Development (OECD, 2023) and UNESCO (2023) further highlight their role in fostering resilient and inclusive systems. In the Philippine context, these findings resonate with the Department of Education's emphasis on flexible, technology-supported learning.

Effectiveness, however, remains constrained by persistent inequalities. Unequal internet access, limited devices, and inadequate school infrastructure shape both participation and outcomes (UNESCO, 2023). Teacher competence remains decisive, as limited digital pedagogical skills and insufficient professional development hinder meaningful integration (Trust & Whalen, 2020; OECD, 2023). Student engagement is also affected by platform misalignment and low self-regulation, suggesting that technology alone does not guarantee learning gains (Bond et al., 2021). These findings underscore the interdependence of access, capacity, and institutional support in determining digital learning outcomes.

Despite these constraints, perceptions of digital tools are largely positive. Teachers and administrators report enhanced lesson delivery, assessment efficiency, communication, and administrative coordination (OECD, 2023). Students demonstrate higher engagement when platforms are accessible and contextually relevant (Bond et al., 2021). Mobile applications and social media frequently serve as practical alternatives to overcome connectivity challenges, highlighting that perceived effectiveness emerges from usability and contextual fit rather than inherent technological features.

Integration studies indicate that pedagogical alignment is critical for realizing the benefits of technology. Platforms support differentiated instruction, timely feedback, and collaborative learning when driven by instructional objectives (Rafiq, Iqbal, & Afzal, 2024; Langelan et al., 2024). Effective integration also enhances school management through improved communication, data handling, and supervision (Ruloff & Petko, 2025). Collectively, these findings affirm that technology amplifies educational outcomes only when coherent with pedagogy and institutional structures.

In synthesis, digital tools in Philippine schools, including those in Bulacan, are both essential and contingent. Adoption has expanded rapidly; however, effectiveness depends on equitable access, teacher preparedness, and alignment with local contexts. Positive stakeholder perceptions indicate potential for enhanced instruction and management, but structural and capacity gaps constrain full impact. This evidence justifies localized empirical inquiry into how students, teachers, and administrators perceive the usefulness, effectiveness, and challenges of digital tools, thereby providing critical guidance for context-sensitive policies and practices.

Theoretical Framework

This study was anchored on established theories that explain the adoption, use, and effectiveness of digital tools in education among school administrators, teachers, and students. The framework integrated the Technology Acceptance Model (TAM), Constructivist Learning Theory, and Digital Divide Theory to examine how digital tools influence engagement, teaching, and learning while accounting for challenges related to access, connectivity, and training. Collectively, these frameworks guided variable selection, instrument development, and data analysis.

Technology Acceptance Model (TAM)

The Technology Acceptance Model in the earlier study by Fred Davis (1989) and extended in recent studies (Lee, Ramasamy, & Subbarao, 2025) posits that technology adoption is primarily influenced by perceived usefulness and perceived ease of use. In this study, TAM informed the measurement of stakeholders' perceptions, frequency of digital tool utilization, and preferences for accessible platforms. School administrators, teachers, and students were more likely to adopt digital tools that enhanced instruction, learning, communication, and school management, particularly in contexts with connectivity constraints. TAM guided the development of survey items and the interpretation of patterns in digital tool adoption.

Constructivist Learning Theory

Constructivist Learning Theory, advanced by Jean Piaget (1952) and Lev Vygotsky (1978), conceptualizes learning as an active and socially mediated process shaped by interaction, collaboration, and meaningful experiences. In this study, digital tools were viewed as instructional scaffolds that supported collaborative learning, teacher-student interaction, and engagement. This theory informed variables related to instructional integration, engagement strategies, and the pedagogical impact of technology. It guided the analysis of how digital tools facilitated knowledge construction across stakeholder groups.

Digital Divide Theory

Digital Divide Theory emphasizes inequalities in access to technology arising from socioeconomic, geographic, and infrastructural factors. In Bulacan, stakeholders experienced challenges such as limited device availability, unstable internet connectivity, and insufficient digital training. This theory informed variables related to internet accessibility, connectivity, and digital literacy. It provided a contextual lens for interpreting disparities and supported the formulation of recommendations aimed at promoting equitable technology integration.

Integration of Frameworks

By integrating TAM, Constructivist Learning Theory, and Digital Divide Theory, the study captured the interplay among technology acceptance, pedagogical engagement, and structural access barriers. TAM explained patterns of adoption, Constructivist Theory framed instructional and engagement-related benefits, and Digital Divide Theory contextualized infrastructural and socioeconomic constraints. Together, these frameworks guided the research design, survey instrument development, and analytical procedures, ensuring a comprehensive understanding of digital education practices in Bulacan.

Conceptual Framework

The study adopted a structured Input–Process–Output (IPO) model to examine the role of digital tools in education. An IPO diagram (Figure 1) illustrated the relationships among variables, guided instrument development, and informed statistical analysis.

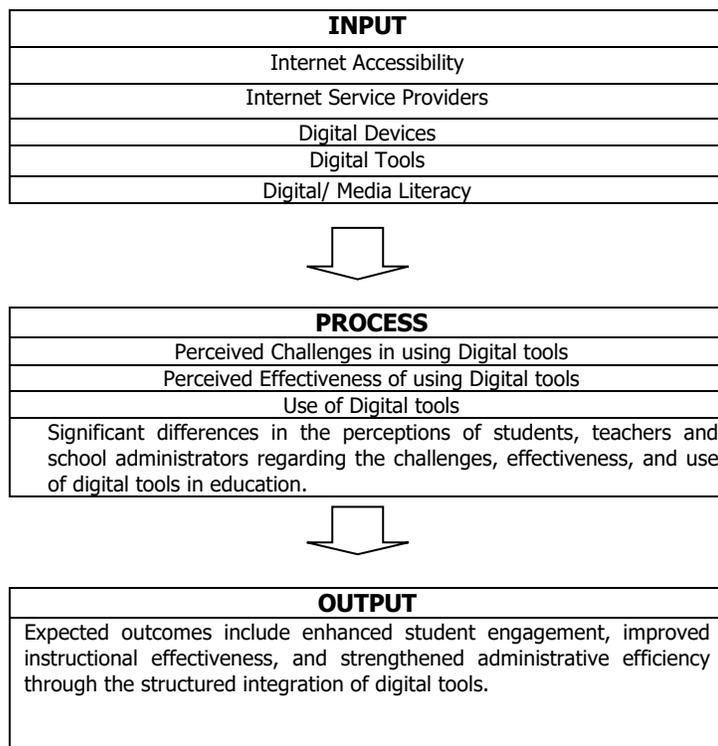


Figure 1. Conceptual framework of the study

Inputs included internet accessibility, internet service providers, digital devices and tools, and digital/media literacy. These variables served as foundational conditions for effective digital learning. They enabled student participation in online activities, supported teachers in instructional delivery and assessment, and facilitated administrative coordination and communication.

Processes focused on how digital tools were utilized in practice. These included perceived challenges, perceived effectiveness, and actual usage among students, teachers, and school administrators. Examining these processes allowed the study to capture variations in stakeholder experiences and perceptions and to determine whether statistically significant differences existed among groups.

Outputs reflected the outcomes of digital tool integration. For students, digital tools enhanced engagement and supported interactive and meaningful learning. For teachers, they improved instructional effectiveness through diverse teaching strategies and efficient content delivery. For administrators, digital tools optimized school management by streamlining communication, documentation, collaboration, and decision-making processes.

The IPO framework illustrated the progression from access conditions to utilization processes and educational outcomes. It guided the construction of survey instruments and aligned directly with the descriptive and inferential statistical analyses conducted to compare stakeholder perceptions and evaluate the impact of digital tools.

Statement of the Problem

Despite the increasing integration of digital technologies in Philippine education, disparities in access, digital literacy, and effective utilization remain evident among students, teachers, and school administrators. While national policies

promote digital transformation, variations in internet accessibility, device availability, and training opportunities continue to affect the quality and equity of educational delivery, particularly in provincial settings such as Bulacan. Previous studies have largely examined digital tool adoption from single stakeholder perspectives or during the emergency phase of the COVID-19 pandemic. However, limited empirical research has comparatively examined the post-pandemic experiences of students, teachers, and school administrators within a unified framework that integrates access, perceived challenges, effectiveness, and actual usage.

The absence of localized, multi-stakeholder analysis creates a gap in understanding how digital tools function across instructional and administrative contexts. Without such evidence, policy interventions and digital literacy programs may not adequately address the specific needs of each stakeholder group. Therefore, there is a need to systematically investigate the level of internet accessibility, commonly used digital platforms and devices, perceived challenges, effectiveness, and differences in perceptions among key educational stakeholders in Bulacan, Philippines.

This study sought to address these gaps by providing empirical evidence that may inform context-specific strategies for equitable, inclusive, and sustainable digital education.

Research Objectives

General Objective

To assess and compare the internet accessibility, perceived challenges, effectiveness, and usage of digital tools in education among students, teachers, and school administrators in Bulacan, Philippines as basis for strengthening digital literacy programs and promoting inclusive and sustainable digital education.

Specific Objectives

1. To determine the level of internet accessibility among students, teachers, and school administrators.
2. To identify the internet service providers, digital tools, and devices most commonly used for communication and educational purposes.
3. To assess the perceived challenges, effectiveness, and usage of digital tools in education among the three stakeholder groups.
4. To examine whether significant differences exist among students, teachers, and school administrators in terms of perceived challenges, effectiveness, and usage of digital tools.

Research Questions

1. What is the level of internet accessibility among students, teachers, and school administrators?
2. What internet service providers, digital tools, and devices are most commonly used by students, teachers, and school administrators?
3. What challenges do students, teachers, and school administrators experience in using digital tools in education?
4. How do students, teachers, and school administrators perceive the effectiveness of digital tools in communication, teaching, learning, and administrative performance?
5. How do students, teachers, and school administrators perceive the use of digital tools in education?
6. Are there significant differences among students, teachers, and school administrators in terms of perceived challenges, effectiveness, and usage of digital tools?

Hypotheses

H01: There is no significant difference among students, teachers, and school administrators in terms of perceived challenges in using digital tools.

H02: There is no significant difference among students, teachers, and school administrators in terms of perceived effectiveness of digital tools.

H03: There is no significant difference among students, teachers, and school administrators in terms of usage of digital tools.

METHODS

Research Design

This study employed a quantitative approach using a descriptive–correlational research design. The quantitative approach was appropriate because the investigation required the systematic collection of measurable data and the

application of statistical procedures to describe patterns and examine group differences among educational stakeholders (Creswell & Creswell, 2018). The descriptive component determined levels of internet accessibility, digital tool usage, perceived challenges, and perceived effectiveness, while the correlational component examined whether statistically significant differences existed among stakeholder groups regarding these variables. No variables were manipulated.

Participants and Sampling

The study involved 210 respondents, comprising 70 students, 70 teachers, and 70 school administrators from selected public and private schools in Bulacan, Philippines. A stratified purposive sampling technique was employed, with stratification based on stakeholder role and purposive selection applied within each group to ensure the inclusion of individuals with direct experience in digital tool implementation.

Recruitment and Inclusion Criteria

Participants were recruited through formal coordination with school heads upon institutional approval. Eligible respondents received invitations detailing the study's purpose and ethical safeguards. Inclusion criteria required that participants were currently enrolled or employed during data collection, had used digital tools for instructional or administrative purposes within the current or preceding academic year, and voluntarily provided informed consent. Schools were selected based on active digital tool implementation, accessibility, and willingness to participate. Equal allocation across stakeholder groups was maintained intentionally to support balanced comparative analysis and ensure systematic representation of primary users, implementers, and institutional decision-makers within the defined study scope.

Research Instrument

Data were gathered using a researcher-developed structured questionnaire grounded in a review of literature on digital learning environments and technology integration. The instrument was constructed to ensure direct alignment with the study's objectives and operational definitions. It comprised six sections: demographic profile (3 items), internet accessibility (3 items), digital tools and devices used (2 items), perceived challenges (10 items), perceived effectiveness (10 items), and perceived usage (10 items). The perception variables were measured using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), with higher scores indicating stronger agreement.

Validity and Reliability of the Instrument

Content validity was established through expert evaluation by three validators who held Doctor of Philosophy (PhD) degrees in Education, possessed formal training in Educational Technology, and had at least ten years of experience in teaching, research, or academic supervision. The instrument was reviewed for clarity, relevance, construct alignment, and logical sequencing. Based on their recommendations, ambiguous and redundant items were revised or removed, terminology was refined for clarity, and minor modifications were made to strengthen construct representation prior to pilot testing.

A pilot test was conducted with respondents similar to the target population but excluded from the final sample. Internal consistency was assessed using Cronbach's alpha. Subscale reliability coefficients were as follows: perceived challenges ($\alpha = .78$), perceived effectiveness ($\alpha = .82$), and perceived usage ($\alpha = .76$), indicating acceptable to good internal consistency across constructs. Reliability testing was completed prior to full-scale data collection to ensure measurement stability.

Data Collection Procedure

Data collection was conducted in September and October 2025, spanning eight weeks. Upon securing institutional approval, the validated questionnaire was administered electronically using Google Forms to facilitate efficient distribution and data management across multiple schools. The survey was implemented asynchronously, allowing respondents to complete it at their convenience within the designated data collection period. The survey link was disseminated through official school communication channels coordinated with designated school representatives. Follow-up reminders were issued at two-week intervals to maximize response rate and ensure balanced representation across stakeholder groups. Submitted responses were monitored regularly. Entries were screened for completeness and consistency prior to data consolidation. Incomplete submissions and duplicate responses were excluded from the final dataset.

Data Analysis

Valid data were coded and processed using IBM SPSS Statistics Version 26. Descriptive statistics addressed research questions related to respondent profile and digital tool utilization. Frequencies and percentages summarized

categorical variables, while medians were reported for Likert-scale responses due to the ordinal nature and non-normal distribution of the data (Gravetter & Wallnau, 2021).

To examine differences among students, teachers, and administrators in challenges, effectiveness, and usage perceptions, inferential analyses were conducted at a 0.05 level of significance. The Kruskal–Wallis H test was applied to compare the three independent groups. When significant results were obtained, post hoc Mann–Whitney U tests with Bonferroni adjustment were performed to determine which specific groups differed significantly. Statistical procedures were selected based on data type and distributional assumptions to ensure analytical rigor.

Ethical Considerations

Ethical standards were strictly observed throughout the study. Institutional permission was obtained from participating schools, and ethical clearance was secured from the appropriate review authority where applicable. Participation was voluntary, and informed consent was obtained from all respondents, who were informed of the study's purpose, their right to withdraw at any time without penalty, and the exclusive use of data for research purposes.

Anonymity and confidentiality were maintained by not collecting personally identifiable information and by coding responses numerically. Electronic data were stored in password-protected and encrypted files accessible only to the primary investigator. Data will be retained in accordance with institutional research guidelines and permanently deleted thereafter.

RESULTS and DISCUSSION

This section presents the findings on access, readiness, perceived challenges, perceived effectiveness, and overall perceptions of digital tool use in education among students, teachers, and school administrators in selected schools in Bulacan, Philippines. The findings are interpreted in light of the Technology Acceptance Model (TAM) and Digital Divide Theory and are situated within relevant empirical literature.

1. Demographic Profile of Respondents

Table 1 presents the demographic characteristics of respondents in terms of age, gender, and area of residence. School administrators were generally middle-aged (median = 40), teachers were in early to mid-adulthood (median = 30), and students were in young adulthood (median = 19). These distributions align with prior findings indicating that school leaders' technology-related perceptions commonly cluster within the 40–49 age range (Obert, 2022), while teachers' age and professional experience influence instructional technology integration (Mahat, 2024).

Table 1. Demographic Profile of Respondents

| Indicator | School Administrators | Teachers | Students |
|--------------------|-----------------------|----------------------|----------------------|
| Age (Median) | 40 | 30 | 19 |
| Gender Composition | Predominantly Female | Predominantly Female | Predominantly Female |
| Area of Residence | Mainly Urban | Mainly Rural | Mainly Rural |

From a readiness perspective, the age distribution suggested differentiated digital engagement patterns. Although students belonged to the "digital native" cohort, digital familiarity did not necessarily equate to academic digital competence. Research indicates that unstructured or excessive technology use may negatively influence learning outcomes (Kuş, 2025). Thus, digital familiarity should not be conflated with digital literacy readiness, reinforcing the importance of structured institutional support.

Across all groups, females outnumbered males, reflecting global educational workforce trends reported by the UNESCO (2025). Although prior studies suggest that gender may shape approaches to technology integration (Kusuma, 2023), empirical evidence indicates that gender does not significantly influence student learning outcomes in digital environments (Ayite, Aheto, & Nyagorme, 2022).

In terms of residence, most administrators lived in urban areas, whereas teachers and students predominantly resided in rural areas. This urban–rural distribution provided an important contextual lens for interpreting subsequent access and readiness findings, particularly regarding infrastructural disparities within Bulacan.

2. Access to Digital Infrastructure and Readiness

Table 2 summarizes internet accessibility, primary Internet Service Providers (ISPs), device usage patterns, and exposure to digital/media literacy training.



Administrators and teachers reported very high internet accessibility (median = 4.0), while students reported a high level (median = 3.0). Although overall access appeared strong, the disparity between institutional actors and learners indicated persistent structural inequality consistent with Digital Divide Theory. This divide extended beyond basic connectivity and reflected differences in stability, device quality, and effective utilization.

The Philippine Long Distance Telephone Company (PLDT) emerged as the dominant ISP among administrators and teachers, reflecting institutional coverage and market presence. In contrast, students relied on multiple providers, suggesting adaptive strategies to compensate for unstable connectivity. Such reliance implies infrastructure inconsistency and reflects a second-level digital divide involving quality and reliability of access.

Table 2. Access to Digital Infrastructure and Readiness

| Indicator | School Administrators | Teachers | Students |
|---|----------------------------|----------------------------|--|
| Internet Accessibility (Median; Interpretation) | 4.0 – Very High | 4.0 – Very High | 3.0 – High |
| Primary Internet Service Provider Pattern | Mainly PLDT | Mainly PLDT | Commonly multiple providers (2–3 ISPs) |
| Devices Commonly Used | Combination of 2–3 devices | Combination of 2–3 devices | Primarily cellphone |
| Received Digital/Media Literacy Training | 100% | ~60% | ~51% |

***3.26 – 4.00 Very High Level of Accessibility, 2.51 – 3.25 High Level of Accessibility, 1.76 – 2.50 Low Level of Accessibility, 1.00 – 1.75 Very Low Level of Accessibility*

Device usage patterns further illustrated structural disparities. Administrators and teachers used multiple devices, allowing flexibility in communication, instructional delivery, and administrative tasks. Students primarily relied on mobile phones, which, although accessible, may limit productivity for complex academic tasks requiring larger screens or multitasking capacity (Dorris et al., 2024).

The most pronounced disparity appeared in digital/media literacy training. All administrators reported receiving training, compared to approximately 60% of teachers and 51% of students. This uneven capacity development suggested potential misalignment between institutional digital planning and classroom implementation. Within TAM, perceived usefulness and perceived ease of use are shaped by competence and exposure; insufficient training may therefore constrain optimal adoption despite positive attitudes.

Overall, while infrastructure availability appeared relatively strong, qualitative inequalities in device access, training exposure, and connectivity stability indicated uneven digital readiness across stakeholder groups.

3. Perceived Challenges, Effectiveness, and Overall Use of Digital Tools in Education

Table 3 presents findings on perceived challenges, perceived effectiveness, and overall perceptions of digital tool use.

All respondent groups reported moderately perceived challenges (median = 3.0). These challenges included unstable connectivity, limited resources, and device constraints. The moderate rating suggests that digital integration had transitioned from emergency adoption toward stabilized, routine implementation (Hasim & Bakar, 2025).

Perceived effectiveness ratings were notably high. Teachers rated digital tools as very effective (median = 4.75), while administrators and students rated them as effective (median = 4.0). Teachers' higher ratings likely reflected direct instructional benefits, including improved lesson delivery, flexible assessment strategies, and enhanced classroom interaction. Within TAM, this indicates strong perceived usefulness, a central determinant of sustained adoption.

Administrators viewed digital tools as effective in enhancing communication efficiency, documentation, and institutional coordination (Nguyen-Anh et al., 2023). Students' slightly lower ratings may reflect experiential constraints related to connectivity and device limitations.



Table 3. Perceptions on Challenges, Effectiveness and Use of Digital Tools

| Measure | School Administrators | Teachers | Students |
|--|----------------------------|----------------------------|----------------------------|
| Perceived Challenges (Median; Interpretation) | 3.0 – Moderately Perceived | 3.0 – Moderately Perceived | 3.0 – Moderately Perceived |
| Perceived Effectiveness (Median; Interpretation) | 4.0 – Effective | 4.75 – Very Effective | 4.0 – Effective |
| Overall Perception of Use (Median; Interpretation) | 4.0 – High Positive | 4.0 – High Positive | 4.0 – High Positive |

**4.21 – 5.00=Very highly perceived challenge; 3.41 – 4.20=Highly perceived challenge; 2.61 – 3.40=Moderately perceived challenge; 1.81 – 2.60=Less perceived challenge; 1.00 – 1.80=Not perceived challenge.

**4.21 – 5.00=Very effective; 3.41 – 4.20=Effective; 2.61 – 3.40=Moderately effective; 1.81 – 2.60=Less effective, 1.00 – 1.80=Not effective.

**4.21 – 5.00=Very high positive perception; 3.41 – 4.20=High positive perception, 2.61 – 3.40=Moderate perception; 1.81 – 2.60=Low perception; 1.00 – 1.80=Very low perception.

Overall perception was uniformly high and positive (median = 4.0), indicating institutional normalization of digital integration. Importantly, positive perceptions persisted despite moderate challenges, suggesting adaptive capacity among stakeholders.

4. Significant Differences in the Perceived Challenges, Effectiveness, and Use of Digital Tools in Education among School Administrators, Teachers and Students.

Table 4 presents the results of the Kruskal–Wallis H test. Statistically significant differences were found at the 0.05 level across all examined variables including perceived challenges ($H(2) = 17.449, p < .001$), perceived effectiveness ($H(2) = 48.676, p < .001$), and use of digital tools ($H(2) = 34.888, p < .001$). These results indicate that stakeholder roles significantly influenced perceptions of digital tool integration.

Table 4: Kruskal–Wallis H Test Results for Differences in Perceived Challenges, Effectiveness, and Use of Digital Tools

| | Challenges | Effectiveness | Use of Digital Tools |
|------------------------|------------|---------------|----------------------|
| Kruskal–Wallis H | 17.449 | 48.676 | 34.888 |
| Df | 2 | 2 | 2 |
| Asymp. Sig. (2-tailed) | <.001 | <.001 | <.001 |

Significant at $\alpha = .05$.

Post hoc Mann–Whitney U tests (Table 5) identified specific group differences.

Administrators differed significantly from both teachers and students in perceived challenges. However, no significant difference was found between teachers and students regarding challenges. This suggests that administrators' macro-level responsibilities—such as budgeting, infrastructure oversight, and policy compliance—may heighten awareness of systemic constraints (Masrukhi et al., 2026).

Students differed significantly from both administrators and teachers in perceived effectiveness and use of digital tools. Students evaluated digital tools primarily based on usability and learning impact, whereas administrators and teachers assessed them within broader institutional and instructional frameworks.

These findings provide empirical support for TAM, particularly its assertion that user experience shapes perceived usefulness. Simultaneously, they reinforce Digital Divide Theory by demonstrating how structural inequalities translate into perceptual disparities. The large effect size observed for perceived effectiveness further indicates that stakeholder role substantially shapes how digital tools are evaluated within institutional contexts. This finding extends the Technology Acceptance Model by demonstrating that perceived usefulness varies not only by individual experience but also by organizational responsibility and structural positioning. The moderate effect sizes for usage and challenges likewise suggest that institutional roles influence both engagement patterns and perceived barriers, reinforcing the importance of differentiated digital integration strategies.

Table 5: Post Hoc Mann-Whitney U Test Results for Pairwise Comparisons

| Comparison | Variable | U | Z | p-value |
|-----------------------------------|---------------|---------|-------|---------|
| School Administrators vs Teachers | Challenges | 1693.00 | -3.16 | .002 |
| | Effectiveness | 2352.50 | -0.41 | .682 |
| | Use | 1926.00 | -2.20 | .028 |
| School Administrators vs Students | Challenges | 1511.00 | -3.92 | < .001 |
| | Effectiveness | 869.50 | -6.62 | < .001 |
| | Use | 1117.00 | -5.58 | < .001 |
| Teachers vs Students | Challenges | 2242.50 | -0.87 | .386 |
| | Effectiveness | 1157.00 | -5.40 | < .001 |
| | Use | 1479.50 | -4.06 | < .001 |

Significant at $\alpha = .05$.

Conclusions

This study examined digital tool utilization, associated challenges, perceived effectiveness, usage, and stakeholder perceptions in selected schools in Bulacan, Philippines.

Findings indicate that digital infrastructure appeared relatively established, particularly among administrators and teachers; however, disparities in student access and training exposure indicate uneven digital readiness across stakeholder groups. Digital tools were embedded in instructional, administrative, and learning processes, and perceptions across stakeholder groups were predominantly positive.

Although moderate challenges persisted, they did not substantially diminish overall confidence in digital tool effectiveness. However, statistically significant differences among administrators, teachers, and students confirm that digital integration is experienced differently depending on stakeholder role.

Overall, the findings underscore that digital adoption reflects institutional readiness but is shaped by stakeholder-specific contexts, capacities, and responsibilities. Differentiated strategies are therefore necessary to promote equitable and sustainable digital integration.

Recommendations

In light of the findings, schools may prioritize targeted infrastructure enhancement to address access disparities, particularly among students who demonstrated comparatively lower levels of connectivity stability and digital literacy training. Strategic investments in reliable internet access, expanded device availability, and sustained technical support systems are recommended to promote equitable participation in digital learning environments. Institutional digital planning should incorporate differentiated stakeholder needs to ensure that technological resources effectively support instructional delivery and administrative functions.

Capacity-building initiatives should be strengthened through continuous professional development programs for teachers and structured digital literacy interventions for students. Addressing gaps in training exposure may enhance technological competence, improve perceived ease of use and usefulness, and sustain long-term digital tool adoption consistent with established technology acceptance frameworks. Structured and systematic digital literacy integration within school improvement plans may further institutionalize best practices.

Future investigations may extend this research by examining the relationship between digital tool utilization and measurable academic performance outcomes to generate stronger evidence for data-driven policy formulation. Broader regional sampling and longitudinal designs are also recommended to enhance generalizability and to monitor evolving patterns of digital integration across diverse educational contexts.

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