

Bridging the gap: Enhancing digital literacy and access among rural students in Nueva Ecija, Philippines



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Abstract This study investigates the digital literacy levels and access to technology among rural students in Nueva Ecija, Philippines, in response to growing concerns over educational equity in the digital age. Specifically, it aims to (1) describe the demographic profile of students in terms of sex, access to digital devices, and internet connectivity; (2) assess their digital literacy across key skill areas; (3) evaluate access to digital infrastructure and learning resources; and (4) propose intervention activities to bridge the digital divide. A descriptive-quantitative research design was employed, with 109 Junior and Senior High School students selected through purposive sampling. Data were gathered through a homemade, validated survey questionnaire and analysed using descriptive statistics. Findings revealed that while students generally demonstrate strong foundational digital skills—particularly in basic operations, online communication, and information retrieval—gaps persist in problem-solving, troubleshooting, and reliable access to digital infrastructure. Nearly all respondents owned smartphones, but fewer had access to laptops or computers. Internet connectivity was more reliable at home than in school, and access to educational platforms and school-based digital resources was uneven. Despite high self-reported confidence in using technology, limitations in infrastructure and support mechanisms hinder students' ability to fully participate in digital learning. In light of these findings, targeted interventions are proposed, including digital literacy training, infrastructure development, teacher capacity-building, and community-based access hubs. These initiatives aim to enhance students' digital competencies and ensure equitable access to technology-enhanced education, aligning with the goals of inclusive and quality education as promoted in Sustainable Development Goal 4.

Keywords: educational technology, digital divide, quality education, rural education, SDG 4

1. Introduction

Despite the rapid advancement of digital technology, significant disparities in access continue to hinder inclusive education, particularly in underserved regions. Studies of digital inclusion highlight that these disparities are not only rooted on infrastructural inequalities but are also reinforced by digital literacy gaps, sociocultural barriers, and stark urban-rural divides (Mavangere et al., 2022; Aini, 2025; Waqar et al., 2024). According to the United Nations Educational, Scientific and Cultural Organization's (UNESCO) 2023 Global Education Monitoring Report presented in a UNESCO article, only 40% of primary, 50% of lower secondary, and 65% of upper secondary schools worldwide are connected to the internet, underscoring the persistent global digital divide (UNESCO, 2023; 2024). Addressing these challenges requires holistic strategies that extend beyond infrastructure to include teacher preparation, community engagement, and digital literacy development (Danial et al., 2022; Aini, 2025).

In the context of the Philippines, more than 35% of public schools still lack internet connectivity (Ceballos, 2024), approximately 20% do not have functional computers (Sevallos, 2023), and most students have minimal exposure to artificial intelligence, automation, and digital tools—figures cited by Ragaza (2025) to highlight the ongoing challenges in achieving digital equity in rural education. These gaps in infrastructure and access not only reinforce the digital divide but also limit opportunities for developing essential digital literacy skills, placing rural learners at a disadvantage in both academic and future employment contexts.

In Nueva Ecija, the government—through the Department of Science and Technology Region III—has initiated efforts to narrow this gap by providing digital libraries in selected municipalities to increase student access to learning resources (Tecson, 2023). Additionally, the rollout of internet resources in several remote public schools across the province aims to support more equitable access to digital learning environments (Ruba, 2024). While these initiatives mark critical steps forward, many rural students in Nueva Ecija continue to face persistent challenges—including unreliable internet connectivity, outdated or unavailable digital devices, and limited exposure to technology-based learning platforms—that hinder the development of essential digital literacy skills. Adding to these difficulties is the Department of Education's delay in constructing essential



facilities in remote areas, as reported by Javier (2024), which reflects the deepening crisis in the education sector and further hinders the development of students' digital literacy.

However, despite these efforts and ongoing programs, there remains a clear lack of focused, evidence-based interventions aimed at addressing both digital access and digital literacy skills among rural students in provinces such as Nueva Ecija. This gap in practice and research underscores the urgent need for targeted strategies that directly respond to the lived educational realities of these communities.

As a result, these learners are often unable to fully engage in technology-enhanced education, exacerbating existing educational inequalities and leaving them ill equipped for an increasingly digital world. This gap also poses a direct challenge to Sustainable Development Goal 4, which seeks to guarantee inclusive and equitable quality education while fostering lifelong learning opportunities for all (Boeren, 2019). Responding to this need requires targeted and sustainable interventions that extend beyond infrastructure—initiatives that actively foster digital literacy and empower rural students with the necessary skills and opportunities to succeed in the 21st-century learning environment.

In response to these pressing challenges, this study aims to investigate and understand the specific conditions shaping digital literacy and access among rural students in Nueva Ecija. It begins by examining the demographic profile of these learners to contextualize their educational experiences within the broader socioeconomic landscape of the province. The study then assesses the current level of digital literacy among rural students, identifying specific skill gaps that hinder their ability to navigate and utilize digital tools effectively. In addition, it evaluates the extent of access to technology and infrastructure, including the availability of digital devices, internet connectivity, learning resources, and school-based technological facilities. Building on these insights, this study ultimately seeks to propose targeted and practical interventions designed to enhance digital literacy and improve access to educational technology—contributing to closing the digital divide and ensuring that rural students are equipped with the competencies and resources necessary for academic and lifelong success in an increasingly digital world.

This study is significant because it addresses a critical and timely issue in Philippine education: the persistent digital divide in rural communities. By focusing on rural students in selected public junior and senior high schools in Nueva Ecija from 2024–2025, this research provides localized, data-driven insights into how digital literacy and access barriers affect educational participation and equity. The study intentionally excludes private schools to concentrate on the conditions and challenges faced by public school students, who are often more vulnerable to disparities in technological access and support.

In doing so, the research contributes valuable empirical evidence to the broader discourse on the digital divide—particularly within the rural Philippine context—which remains underrepresented in the global and national digital education literature. It also supports education stakeholders, including policymakers, school administrators, and development organizations, in designing more responsive, inclusive, and context-specific interventions. By identifying specific gaps in digital skills, infrastructure, and access, the findings will inform practical strategies for bridging the divide and promoting digital inclusion. Most importantly, this research highlights the voices and experiences of rural learners, adding critical depth and perspective to digital divide scholarship and reinforcing the need for equity-focused educational reforms.

1.1. Research questions

This study aimed to answer the following research questions:

1. How may the demographic profile of rural students be characterized in terms of
 - 1.1. Sex;
 - 1.2. Access to Digital Devices; and
 - 1.3. Internet Access?
2. How may the current level of digital literacy among rural students be described in terms of
 - 2.1. Basic digital literacy skills;
 - 2.2. Internet Navigation and Information Retrieval;
 - 2.3. Communication and Collaboration;
 - 2.4. Problem-solving and troubleshooting; and
 - 2.5. Access to Technology and Resources?
3. How may access resources and infrastructure among rural students be described in terms of
 - 3.1. Access to digital devices;
 - 3.2. Internet connectivity;
 - 3.3. Availability of Learning Resources; and
 - 3.4. School Technology Infrastructure?
4. What intervention activities can be implemented to improve digital literacy and bridge the digital divide among rural students?

2. Review of Related Literature

2.1. Digital divide in rural vs. urban education settings

The integration of digital technology into education has transformed learning environments globally. However, disparities in access, resources, and digital literacy have deepened the divide between rural and urban educational settings. Urban schools are generally better positioned to incorporate technology into teaching and learning, benefitting from greater access to digital tools and more frequent opportunities for teacher training (Kaur, 2025). This access advantage translates into improved student outcomes and readiness for a digital future, whereas rural schools often lag behind due to systemic limitations.

Multiple studies have documented this growing digital gap. In Pakistan, for instance, the rural–urban digital divide has posed significant challenges to educational inclusivity, with rural learners often excluded from digital learning advancements (Waqar et al., 2024). Similarly, research in West Virginia revealed that limited access to Web 2.0 technologies in rural schools restricts teachers' ability to innovate and integrate digital tools into instruction (Goh & Kale, 2015). Wang (2013) also reported significant discrepancies in technology availability and the extent to which teachers in rural schools are able to effectively integrate digital resources into their pedagogy.

International studies echo these patterns. In China, rural and migrant students exhibit lower autonomy, self-efficacy, and access to internet use, further exacerbating their educational disadvantage compared with their urban peers (Li & Ranieri, 2012). Garland and Wotton (2001) warned of the long-term negative consequences that this divide can have for disadvantaged learners, particularly in underfunded schools. Furthermore, Zhao et al. (2021) reported that rural students demonstrate lower behavioral engagement in e-learning, attributing this to disparities in cultural capital and social support. In the context of India, the COVID-19 pandemic amplified these inequalities, making digital education a privilege afforded only to certain groups.

Despite these challenges, research suggests that thoughtful government policies and the strategic use of information technology can help mitigate the rural–urban knowledge gap (Chen & Liu, 2013).

While these studies offer valuable insights into the digital divide across various international contexts, most of the literature centers on broad infrastructural disparities or teacher-related challenges, often overlooking the nuanced experiences of students—particularly in rural communities within the Philippines. There remains a lack of localized, data-driven research that holistically examines how demographic factors, digital literacy competencies, and access to educational technology intersect to shape learning outcomes in rural settings. This gap is especially evident in provinces such as Nueva Ecija, where socioeconomic and geographic factors may uniquely influence students' digital engagement. To address this void, the present study seeks to provide an in-depth analysis of the digital landscape experienced by rural students in Nueva Ecija, with the aim of informing practical and targeted interventions that promote digital equity and educational inclusion.

2.2. Challenges in teaching digital skills in low-resource environments

The ability to teach digital skills in low-resource educational settings presents a complex array of challenges, often shaped by inadequate infrastructure, teacher capacity gaps, socioeconomic barriers, and systemic policy limitations. These difficulties not only hinder the integration of digital technologies into teaching and learning but also widen existing educational disparities, especially in underserved regions.

One of the most persistent barriers is the lack of infrastructure, including limited access to digital devices, insufficient internet connectivity, and poor maintenance of existing technologies. Patrobas et al. (2023) emphasized that without foundational infrastructure, even well-intentioned digital literacy programs fail to reach their potential. Similarly, Purmayanti (2022) reported that both teachers and students in low-resource English as foreign language (EFL) contexts struggle with limited digital tools and skills, making digital integration in classrooms difficult.

Compounding the issue is the scarcity of qualified and digitally literate educators. In many low-resource schools, teachers are expected to teach digital skills despite having minimal training themselves. For example, Kaminskienė et al. (2022) reported that both preservice and in-service teacher training programs often lag behind in addressing emerging digital competencies, creating new skills gaps that challenge traditional education systems. In Zambia, although teachers possess basic digital literacy skills, Chama and A (2023) reported that integration into the curriculum remains problematic due to poor alignment, high costs, and inadequate access to technology.

Professional development and curriculum integration are further complicated by motivational and contextual barriers. Tusiime et al. (2020) highlighted how Ugandan art and design teacher educators, despite recognizing the value of digital tools, faced challenges related to material scarcity and low motivation. They relied on peer collaboration and improvisation as coping strategies. Similarly, teachers working with students with disabilities, such as those in blind schools in India, value digital games for their educational potential but remain constrained by overburdened workloads and poor infrastructure (India et al., 2021).

The broader educational ecosystem and stakeholder relationships also influence the implementation of technology-enhanced learning. Goshtasbpour et al. (2023) argued that challenges in low-resource settings are not solely technological but are embedded within sociocultural and institutional ecology. Without collaborative stakeholder engagement—from policymakers to school communities—efforts to teach digital skills may remain fragmented or unsustainable.

At the policy level, gaps remain in crafting context-appropriate responses. James (2019) emphasized the need for policy packages that go beyond increasing digital device availability. These should include context-specific strategies such as selecting appropriate technologies and indirect methods for providing internet access in poor regions. Urquizo et al. (2020) supported this view, advocating for community-based initiatives such as intranets and digital literacy workshops to address gaps in teacher competencies and ICT infrastructure.

Although some studies, such as that of Forde and O'Brien (2022), explore the use of digital technologies for practical skill teaching in health education, much of them fail to adequately account for the realities in low-resource environments, leaving a critical gap in understanding how digital pedagogies function under constrained conditions.

Collectively, these studies underscore that teaching digital skills in low-resource environments requires more than just access to devices—it demands systemic change that addresses infrastructure, teacher readiness, curriculum alignment, stakeholder cooperation, and supportive policies. These insights are particularly relevant to the present study, which investigates the digital literacy levels and access challenges of rural students in Nueva Ecija, Philippines. Understanding these barriers is essential in designing sustainable interventions that empower both educators and learners in marginalized educational contexts.

3. Materials and Methods

This study employed a descriptive-quantitative research design to systematically assess and describe the demographic profile, level of digital literacy, and access to technological resources among rural junior and senior high school students in Nueva Ecija, Philippines. This design was chosen to enable the collection of quantifiable data that reflect existing conditions without manipulating variables, allowing for a statistical analysis of patterns and gaps in digital access and skills (Alegado et al., 2025; Olipas & Cochanco, 2025; Olipas, 2025).

The research was conducted in selected public junior and senior high schools located in rural municipalities of Nueva Ecija, Philippines. This province was selected because of its mix of agricultural and developing communities, where students often experience limited access to digital infrastructure. The rural setting is particularly relevant to the study's aim of exploring digital disparities in less resourced educational contexts.

A total of 109 students participated in the study. These respondents were composed of junior and senior high school students, specifically from grades 9 to 12. Students were selected on the basis of their enrollment in rural public schools and their ability and willingness to participate in the survey.

The study used a purposive sampling technique to identify and select respondents. This nonprobability sampling method was appropriate given the specific focus on rural students who are likely to encounter digital access and literacy challenges. Only those students who had regular attendance and provided consent were included in the sample.

Data were collected via a custom-made, validated survey questionnaire developed in alignment with the study's research questions. The instrument consisted of four main sections. The first section addressed Research Question 1 by gathering the demographic profile of the respondents, specifically their sex, access to digital devices, and internet connectivity. These data were intended to characterize the students' backgrounds and provide context for their engagement with digital technologies.

The second section of the instrument corresponded to Research Question 2 and focused on assessing the students' current level of digital literacy. It included items that measured basic digital literacy skills, internet navigation and information retrieval, communication and collaboration, problem-solving and troubleshooting, and access to technology and digital learning resources that support the development of these skills.

The third section addressed Research Question 3, which explored the students' access to resources and infrastructure. The items in this section examined access to digital devices at home or in school, the quality and reliability of internet connectivity, the availability of learning resources, and the presence and quality of school technology infrastructure.

Finally, the fourth section included open-ended items aligned with Research Question 4, which was designed to gather the students' suggestions and insights into possible interventions that could improve their digital literacy and access. This section aims to identify practical, context-sensitive strategies that schools and communities could adopt to help bridge the digital divide in rural education settings.

The instrument was developed on the basis of relevant literature and digital literacy frameworks and was reviewed by three experts in educational technology and ICT integration to ensure content validity. A pilot test was conducted with 10 students from a similar rural school to evaluate the clarity, reliability, and appropriateness of the items before final deployment.

Data collection was conducted between March and April 2025. Prior to participation, informed consent was secured from all respondents, and for those under 18 years of age, assent forms were duly obtained. Once collected, the data were encoded and analysed via descriptive statistics—namely, frequency, percentage, and mean—to describe and interpret the students' demographic characteristics, digital literacy levels, and access to technology and resources. The analysis was carried out via SPSS software to ensure accuracy and clarity in presenting the findings. Ethical guidelines were strictly followed throughout the study. Participation was voluntary, and all information provided by the respondents was treated with strict

confidentiality and anonymity. The respondents were informed of their right to withdraw at any stage of the study without any consequences.

4. Results

4.1. Demographic profile and digital access of rural students

Understanding the demographic characteristics and digital access of rural students provides a critical foundation for evaluating their digital literacy and educational experience. The following results present the data on the sex distribution of the respondents, their access to digital devices, and their internet connectivity at home and in school. These elements help contextualize students' readiness and capacity to engage with technology in academic settings.

Sex. Figure 1 shows the percentage distribution of the respondents by sex.

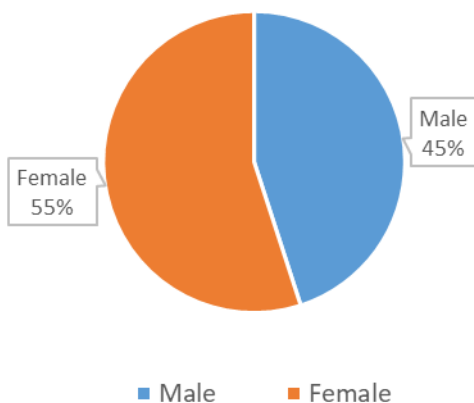


Figure 1 Distribution of percentage of respondents by sex.

The results shown in Figure 1 reveal a slightly greater proportion of female students (55%) than male students (45%). This suggests a fairly balanced gender representation among the respondents, with a modest female majority. The distribution may reflect the general enrollment trend in the participating rural schools and provide context for interpreting digital literacy and access patterns across demographic groups.

Access to Digital Devices. Figure 2 illustrates the percentage distribution of respondents based on the type of digital devices they own or regularly use.

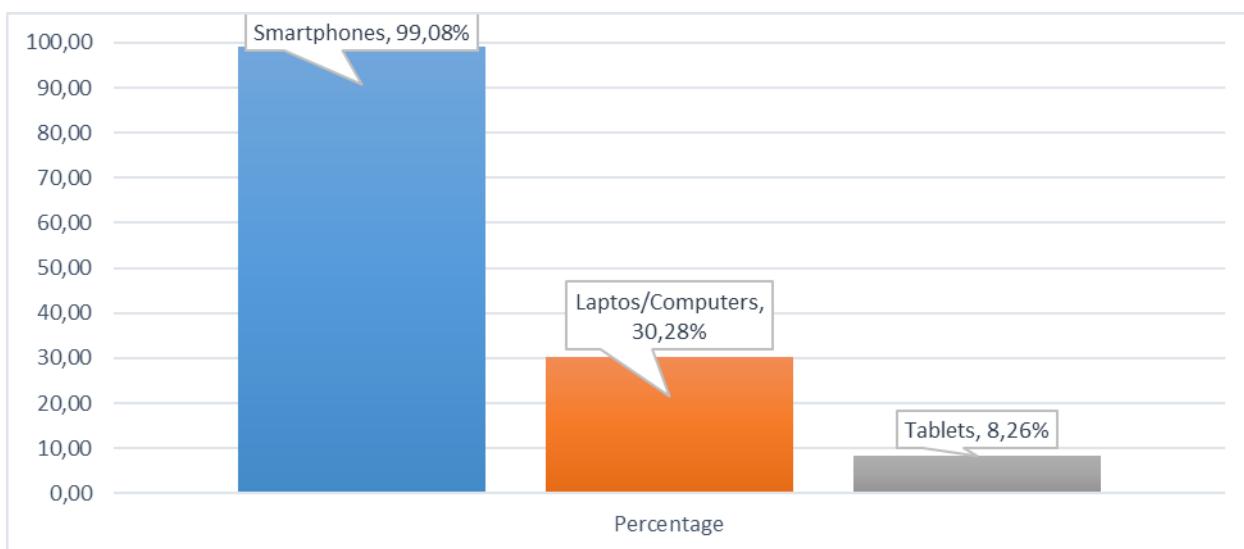


Figure 2 Distribution of respondents by access to digital devices.

As shown in Figure 2, the vast majority of students (99.08%) reported having access to smartphones, making them the most commonly used digital tool among rural learners. In contrast, only 30.28% of the respondents had access to laptops or desktop computers, and an even smaller percentage (8.26%) reported owning tablets. These results indicate a heavy reliance on smartphones for both academic and personal use, which, while providing portability and connectivity, may also limit engagement with tasks that require more advanced features typically available on computers.



Internet Access at Home. Table 1 presents the frequency and percentage distribution of respondents based on their means of accessing the internet at home.

Table 1 Frequency and percentage distributions of respondents by internet access at home.

Means of Accessing the internet at Home	Frequency	Percentage
I have reliable internet access through an internet Service Provider (ISP) and mobile data.	50	45.9%
I have reliable internet access through an internet Service Provider (ISP) only.	38	34.9%
I have reliable internet access through mobile data only.	15	13.8%
I do not have regular internet access at home.	6	5.5%
Total	109	100.0%

The results in Table 1 show that nearly half of the students (45.9%) reported having reliable internet access through both an internet Service Provider (ISP) and mobile data. This was followed by 34.9% of the respondents who accessed the internet exclusively through an ISP. A smaller portion (13.8%) relied solely on mobile data for connectivity, whereas only 5.5% indicated that they did not have regular internet access at home. These findings suggest that while a majority of rural students have some form of reliable internet access, a notable portion still depend solely on mobile data or lack consistent connectivity, which may impact their ability to fully participate in technology-enhanced learning activities.

Internet Access at School. Table 2 shows the frequency and percentage distribution of respondents according to their means of accessing the internet at school.

Table 2 Frequency and percentage distributions of respondents by internet access at school.

Means of Accessing the internet at Home	Frequency	Percentage
I have reliable internet access through an internet Service Provider (ISP) and mobile data.	16	14.7%
I have reliable internet access through an internet Service Provider (ISP) only.	52	47.7%
I have reliable internet access through mobile data only.	14	12.8%
I do not have regular internet access at school.	27	24.8%
Total	109	100.0%

As presented in Table 2, the majority of the students (47.7%) reported having reliable internet access through an internet Service Provider (ISP) only. A smaller group (14.7%) indicated having access to both ISP and mobile data, whereas 12.8% relied solely on mobile data for school internet access. Notably, 24.8% of the respondents reported that they did not have regular internet access at school. These results highlight that although most students have some form of internet connectivity within school premises, nearly one-fourth still face limited or inconsistent access, which may hinder their participation in digital learning activities and affect the overall integration of educational technology in rural school settings.

4.2. Digital literacy skills and resource access among rural students

Assessing the digital literacy skills of rural students and their access to technological resources is vital for understanding their capacity to engage in 21st-century learning environments. The following findings are relevant to understanding the digital literacy skills and resource access of rural students.

Basic digital literacy skills. Table 3 presents the self-assessed basic digital literacy skills of the respondents, measured through their ability to operate and use common digital devices and applications.

Table 3 Basic digital literacy skills.

Item Statements	Mean	Verbal Description
I can operate basic digital devices (e.g., smartphone, computer) without assistance.	3.45	Strongly Agree
I can use a keyboard or touchscreen to navigate digital devices effectively.	3.47	Strongly Agree
I know how to connect to the internet using different devices (e.g., mobile phone, computer).	3.41	Strongly Agree
I am able to use basic software applications (e.g., word processors, calculators) with ease.	3.39	Strongly Agree
Overall Mean	3.43	Strongly Agree

As shown in Table 3, the overall mean score of 3.43 indicates that students strongly agree with the statements, suggesting a high level of confidence in their basic digital competencies. The highest mean score was observed for the item "I can use a keyboard or touchscreen to navigate digital devices effectively" ($\mu = 3.47$), followed closely by "I can operate basic digital devices without assistance" ($\mu = 3.45$). The students also reported strong agreement with their ability to connect to the internet via various devices ($\mu = 3.41$) and to use basic software applications such as word processors and calculators ($\mu = 3.39$). These results imply that rural students possess solid foundational digital skills, particularly in device operation and basic software use, which are essential for navigating technology-based educational environments.



Internet Navigation and Information Retrieval Skills Table 4 summarizes the respondents' self-reported skills in navigating the internet and retrieving information.

Table 4 Internet navigation and information retrieval skills.

Item Statements	Mean	Verbal Description
I can search for information online using a search engine (e.g., Google, Bing).	3.49	Strongly Agree
I can evaluate whether information found online is accurate and reliable.	3.27	Strongly Agree
I can find and use online learning resources effectively.	3.27	Strongly Agree
I am familiar with using social media platforms to stay informed and connected.	3.47	Strongly Agree
Overall Mean	3.36	Strongly Agree

As presented in Table 4, the overall mean score of 3.36 indicates that students strongly agree with the item statements, suggesting a high level of confidence in their ability to search for and evaluate online information. The highest mean score was for the item "I can search for information online via a search engine (e.g., Google, Bing)", with a mean of 3.49, indicating that this is a commonly used and well-understood skill among rural students. The respondents also strongly agreed that they were familiar with social media platforms to stay informed and connected ($\mu = 3.47$). Moreover, both "I can evaluate whether information found online is accurate and reliable" and "I can find and use online learning resources effectively" scored equally at 3.27, still within the "strongly agree" range but reflecting slightly lower confidence than basic search engine use does. These findings suggest that while rural students are proficient in navigating the internet, there is room for further development in critical evaluation and the effective use of academic resources.

Communication and Collaboration Skills. Table 5 presents the students' self-assessment of their communication and collaboration skills in digital environments.

Table 5 Communication and collaboration skills.

Item Statements	Mean	Verbal Description
I can communicate with others via email, text messages, or online platforms.	3.43	Strongly Agree
I can participate in online discussions or group activities for academic purposes.	3.40	Strongly Agree
I can share documents, images, or files online with classmates or teachers.	3.39	Strongly Agree
I am able to attend and engage in online classes or webinars without difficulty.	3.22	Agree
Overall Mean	3.36	Strongly Agree

As shown in Table 5, the overall mean score of 3.36 falls within the "Strongly Agree" range, indicating that most students feel confident in using digital tools for academic interaction. The highest-rated item was "I can communicate with others via email, text messages, or online platforms" ($\mu = 3.43$), followed closely by "I can participate in online discussions or group activities for academic purposes" ($\mu = 3.40$) and "I can share documents, images, or files online with classmates or teachers" ($\mu = 3.39$). Although slightly lower, the item "I am able to attend and engage in online classes or webinars without difficulty" still received a high mean of 3.22, interpreted as "Agree." These results suggest that while rural students generally demonstrate strong communication and collaboration skills in digital settings, there may be minor barriers—such as connectivity or platform familiarity—that affect full engagement in live online learning environments.

Problem-solving and troubleshooting skills. Table 6 outlines the respondents' perceived abilities in problem-solving and troubleshooting via digital tools.

Table 6 Problem-solving and troubleshooting skills.

Item Statements	Mean	Verbal Description
I can troubleshoot simple digital device issues (e.g., restarting a computer, adjusting settings).	3.16	Agree
I can solve common internet connectivity problems (e.g., reconnecting to Wi-Fi).	3.27	Strongly Agree
I can use basic digital tools to organize and manage my academic work (e.g., calendars, reminders).	3.31	Strongly Agree
I can use digital tools to create presentations or academic reports.	3.30	Strongly Agree
Overall Mean	3.26	Strongly Agree

As outlined in Table 6, the overall mean score of 3.26 falls within the "Strongly Agree" range, suggesting that students generally feel capable of handling common digital challenges and applying digital tools in academic contexts. The highest mean score was observed for the item "I can use basic digital tools to organize and manage my academic work (e.g., calendars, reminders)" ($\mu = 3.31$), closely followed by "I can use digital tools to create presentations or academic reports" ($\mu = 3.30$). The students also strongly agreed with their ability to resolve internet connectivity issues ($\mu = 3.27$). The lowest-rated item, "I can troubleshoot simple digital device issues (e.g., restarting a computer, adjusting settings)," had a mean of 3.16, interpreted as "Agree." This suggests that while students are generally confident in using digital tools for academic productivity, there may be a slight gap in technical troubleshooting skills that could benefit from targeted support or training.

Access to Technology and Resources. Table 7 presents the respondents’ perceived access to technology and related support systems.

Table 7 Access to technology and resources.

Item Statements	Mean	Verbal Description
I have access to a digital device (e.g., phone, tablet, computer) when I need it for educational purposes.	3.40	Strongly Agree
I have reliable internet access to support my academic and personal online activities.	3.32	Strongly Agree
I have received guidance or support in improving my digital skills (e.g., from school, family, or community programs).	3.29	Strongly Agree
I feel confident using technology for my studies and daily tasks.	3.36	Strongly Agree
Overall Mean	3.34	Strongly Agree

As shown in Table 7, the overall mean score of 3.34 indicates that students strongly agree with the statements, reflecting generally positive access to digital tools and confidence in using them for academic purposes. The highest mean score was recorded for the item “I have access to a digital device (e.g., phone, tablet, computer) when I need it for educational purposes” ($\mu = 3.40$), suggesting that most students can access a device when necessary. Students also strongly agreed with having reliable internet access to support their online academic and personal activities ($\mu = 3.32$) and feeling confident in using technology for studies and daily tasks ($\mu = 3.36$). The lowest, yet still strong, mean ($\mu = 3.29$) was associated with receiving guidance or support in developing digital skills. These findings imply that the rural students in the study generally have adequate access to both technology and support systems, although there remains a potential need for expanded structured guidance or formal digital literacy programs.

4.3. Access to digital resources and school infrastructure

Access to digital resources and school infrastructure contributes to enhancing the learning experience of students. The following section presents the assessment made by the respondents to gain a deeper understanding of their access to the digital resources and school infrastructure that contribute to their digital literacy.

Access to Digital Devices. Table 8 displays the students’ self-reported access to digital devices for academic and personal use.

Table 8 Access to digital devices.

Item Statements	Mean	Verbal Description
I have regular access to a smartphone, tablet, or computer for academic or personal use.	3.48	Strongly Agree
The digital devices I have access to are sufficient for completing my schoolwork or educational activities.	3.38	Strongly Agree
I can easily access a digital device when needed for my studies.	3.30	Strongly Agree
I am able to use my device for various academic tasks without any difficulty.	3.32	Strongly Agree
Overall Mean	3.37	Strongly Agree

As shown in Table 8, the overall mean score of 3.37 falls within the “Strongly Agree” range, indicating that students generally have adequate and consistent access to the digital tools necessary for learning. The highest mean score was recorded for the item “I have regular access to a smartphone, tablet, or computer for academic or personal use” ($\mu = 3.48$), suggesting that device availability is not a major barrier for most students. The respondents also strongly agreed that the devices they use are sufficient for completing schoolwork ($\mu = 3.38$) and that they can easily access a device when needed ($\mu = 3.30$). Similarly, the students expressed confidence in their ability to use their devices for various academic tasks ($\mu = 3.32$). These findings reflect a generally positive level of digital device accessibility among rural students, which is a crucial foundation for digital literacy development and technology-enhanced education.

Internet Connectivity. Table 9 presents the students’ perceptions of their internet connectivity for academic purposes.

Table 9 Internet connectivity.

Item Statements	Mean	Verbal Description
I have reliable internet access at home for educational purposes.	3.30	Strongly Agree
I can access the internet regularly at school or public places (e.g., library, internet cafe).	2.95	Agree
I can use the internet to research academic topics and complete school assignments.	3.32	Strongly Agree
I face difficulties with internet connectivity.	2.91	Agree
Overall Mean	3.12	Agree



As outlined in Table 9, the overall mean score of 3.12 falls within the “agree” range, indicating that while students generally have access to the internet, some limitations persist. The highest mean score was for the item “I can use the internet to research academic topics and complete school assignments” ($\mu = 3.32$), followed by “I have reliable internet access at home for educational purposes” ($\mu = 3.30$), both of which fall within the “Strongly Agree” range. In contrast, lower scores were observed for “I can access the internet regularly at school or public places” ($\mu = 2.95$) and “I face difficulties with internet connectivity” ($\mu = 2.91$), both interpreted as “Agree.” These findings suggest that while most students are able to access and use the internet effectively at home, connectivity issues—particularly outside the home—remain a concern and may affect the consistency and quality of their engagement with digital learning.

Availability of Learning Resources. Table 10 presents the respondents’ perceptions regarding the availability of digital learning resources to support their academic needs.

Table 10 Availability of learning resources.

Item Statements	Mean	Verbal Description
I have access to online educational materials such as videos, digital textbooks, or research papers.	3.32	Strongly Agree
I can easily access educational websites or platforms for my academic studies.	3.28	Strongly Agree
My school provides resources or subscriptions to online educational platforms.	3.10	Agree
I am able to find reliable and accurate information online to support my learning.	3.21	Agree
Overall Mean	3.23	Agree

In Table 10, the overall mean score of 3.23 falls within the “agree” range, suggesting that students generally have access to relevant learning materials, although there may be inconsistencies in institutional support. The highest-rated item was “I have access to online educational materials such as videos, digital textbooks, or research papers” ($\mu = 3.32$), followed closely by “I can easily access educational websites or platforms for my academic studies” ($\mu = 3.28$), both of which received “Strongly Agree” ratings. In contrast, lower mean scores were observed for items such as “My school provides resources or subscriptions to online educational platforms” ($\mu = 3.10$) and “I am able to find reliable and accurate information online to support my learning” ($\mu = 3.21$), both rated as “Agree.” These findings indicate that while students are proactive in finding and using online materials, there is room for improvement in terms of school-provided digital resources and training in information literacy.

School Teaching Infrastructure. Table 11 illustrates students’ perceptions of their school’s technological infrastructure in support of digital learning.

Table 11 School teaching and infrastructure.

Item Statements	Mean	Verbal Description
I have access to online educational materials such as videos, digital textbooks, or research papers.	3.32	Strongly Agree
I can easily access educational websites or platforms for my academic studies.	3.28	Strongly Agree
My school provides resources or subscriptions to online educational platforms.	3.10	Agree
I am able to find reliable and accurate information online to support my learning.	3.21	Agree
Overall Mean	3.23	Agree

As outlined in Table 11, the overall mean score of 3.02, interpreted as “agree,” suggests that students moderately recognize the presence of infrastructure to support technology use in their learning environment. The item “My school provides sufficient devices (e.g., computers, tablets) for students to use” received the highest mean score of 3.16, followed closely by “The technology infrastructure at my school supports the use of digital tools in my learning” ($\mu = 3.15$), both falling within the “Agree” category. Meanwhile, “I have access to charging stations or power sources to keep my devices powered during school hours” had a mean of 2.92, and the lowest was “The school has a stable internet connection that is available to students for academic use” ($\mu = 2.83$). These findings indicate that while students generally acknowledge the availability of basic technological support in schools, gaps remain—particularly in internet reliability and access to essential infrastructure such as charging facilities—highlighting areas for improvement in school-based digital support.

4.4. Proposed intervention activities to enhance digital literacy and bridge the digital divide

In light of these findings, the following intervention activities, as presented in Table 12, are proposed to enhance digital literacy and bridge the digital divide among rural students. These initiatives aim to address identified gaps in access, skills, and support systems, thereby promoting equitable and meaningful participation in technology-enhanced education.

4. Discussion

The demographic profile of the respondents revealed a relatively balanced gender distribution, with a slight majority of female students, as shown in Figure 1. This balance allows for a more inclusive interpretation of the results across genders. Having a relatively balanced gender distribution reflects inclusive gender roles and ensures that diverse perspectives are



adequately represented (Jane, 2024; Walters et al., 2020). In terms of access to digital devices, smartphones emerged as the predominant tool among rural students, with 99.08% reporting ownership or regular use, as shown in Figure 2. However, far fewer students had access to laptops or desktop computers (30.28%), and even fewer owned tablets (8.26%). This indicates a high dependence on mobile devices, which, although useful for connectivity, may limit students' engagement in tasks that require advanced digital functions, such as document editing, programming, or multimedia production. According to Tamarasi (2023), smartphones offer convenient communication access to information and educational resources. However, they can also lead to learning distractions, reduced direct social interactions, potential isolation, risk to mental health, and online security (Devina et al., 2024).

Table 12 Proposed intervention activities.

Intervention Activity	Key Features/Descriptions	Potential Partners
Digital Literacy Skills Training Program	Workshops on device operation, internet use, info evaluation, online communication, and troubleshooting	ICT teachers, TESDA, DepEd, HEIs
Peer-to-Peer Tech Mentorship Program	Tech-savvy students mentor peers during ICT activities and digital tasks	Schools, student councils, student organizations/clubs
Community Digital Access Hubs	Digital hubs in barangay centers or libraries with internet, devices, and charging stations	LGUs, DOST, DepEd, private donors, HEIs
Teacher Capacity-Building on ICT Integration	Training on blended learning, educational platforms, and classroom tech integration	DepEd, ICT experts, HEIs
School-Based Tech Planning & Resource Audit	Annual audits of device and internet access, informing upgrades and planning	School ICT coordinators, DepEd
Parent and Community Digital Awareness Sessions	Orientations for parents on online safety, digital parenting, and supporting students' tech-based learning	School heads, barangay officials, ICT experts, HEIs

Internet access data further highlight disparities between home and school environments. At home, a majority of the students had internet access through a combination of mobile data and ISP services, but 5.5% lacked regular access, as presented in Table 1. More concerning is the situation in schools, where nearly a quarter (24.8%) of the respondents reported no reliable internet access, as shown in Table 3. These findings point to institutional limitations in digital infrastructure that may hinder consistent and equitable access to technology-enhanced learning. The results suggest that while students are digitally connected at the household level, gaps in school-based infrastructure could undermine broader efforts to develop digital literacy and bridge the digital divide in rural areas. These findings align with those of the study of Ceballos (2024), which reported that over 35% of public schools still lack internet connectivity.

In terms of digital literacy skills and resource access among rural students, the findings of this study reveal that rural students in Nueva Ecija exhibit strong foundational digital literacy skills, as reflected by their ability to operate digital devices, navigate basic software, and use the internet for academic tasks, as shown in Table 3. Students also reported confidence in searching for information online and utilizing social media for educational purposes, although slightly less so in evaluating the accuracy and reliability of the information they encounter, as reflected in Table 4. Similarly, communication and collaboration skills were well developed, with students showing ease in digital messaging, file sharing, and online group participation; however, a slightly lower mean score for engaging in live online classes suggests limited exposure to synchronous learning environments, as presented in Table 5. Moreover, students were generally competent in managing academic work via digital tools, although their ability to troubleshoot technical issues was relatively less developed, as illustrated in Table 6. Encouragingly, most students reported consistent access to digital devices, reliable internet, and support from schools or communities in improving their digital skills, as presented in Table 7. These findings imply that while access and confidence in digital engagement are high, future interventions should focus on enhancing higher-order digital skills such as critical evaluation of online content, real-time engagement in virtual learning, and basic troubleshooting abilities to ensure comprehensive digital readiness.

The development of these skills is crucial in preparing students to navigate the complexities of the digital world. As Pérez-Escoda et al. (2017) emphasized, fostering the ability to assess the credibility of online information plays a vital role in promoting media literacy and combating misinformation. Similarly, meaningful participation in virtual classrooms promotes collaboration and deeper learning, a need that has become even more apparent in today's hybrid and online learning contexts (Kusmawan, 2024). Equipping students with basic troubleshooting abilities also ensures that they can independently resolve common digital problems, leading to more seamless and uninterrupted learning experiences (Tymchuk et al., 2024). However, addressing these needs requires confronting persistent challenges. Digital skills gaps remain prevalent, particularly among students from marginalized communities (Suarez Enciso et al., 2024; Jackman et al., 2021), and infrastructure limitations such as poor internet connectivity and inadequate digital tools continue to obstruct equitable access to learning (Kusmawan, 2024). Moreover, as digital engagement increases, so do the risks of cyberbullying and digital overuse, underscoring the importance of promoting not only skill development but also digital well-being (Jackman et al., 2021). These considerations point to the



need for holistic, context-sensitive educational interventions that support both digital competence and safe, inclusive learning environments.

With respect to access to digital resources and school infrastructure, rural students in Nueva Ecija generally have strong access to digital devices, with most respondents indicating that they regularly use smartphones, tablets, or computers for academic purposes, as shown in Table 8. This high level of device availability supports students' ability to participate in digital learning. However, consistent and reliable internet connectivity—particularly in public or school settings—remains a challenge. While the students agreed that they had reliable home internet access, they reported lower confidence in accessing the internet at school or public places and still experienced occasional connectivity issues, as reflected in Table 9. Access to digital learning resources such as online videos and educational platforms was also favourable, yet the limited availability of school-provided subscriptions and guidance suggests a gap in institutional support for structured learning, as shown in Table 10. Furthermore, while students acknowledged the presence of basic technological infrastructure in schools, the low ratings for internet stability and access to charging stations, as illustrated in Table 11, underscore the need for investment in practical infrastructure to fully enable digital learning environments. These findings imply that while student-level access and digital readiness are promising, systemic improvements in school-based digital infrastructure and support mechanisms are necessary to ensure equitable and sustained access to digital education in rural settings.

The broader literature reinforces this need, highlighting both the opportunities and persistent challenges associated with implementing digital education in low-resource environments. While digital education has the potential to transform rural learning, its success is heavily dependent on addressing infrastructure limitations, digital skill gaps, and socioeconomic barriers. A key obstacle remains the lack of adequate digital infrastructure in many rural areas. In the context of the Philippines, as cited by Ragaza (2025), over 35% of public schools still lack internet connectivity, 20% do not have functional computers, and most students have minimal exposure to artificial intelligence, automation, and digital tools. Beyond infrastructure, the issue of digital literacy poses an equally significant challenge. According to Hu et al. (2023), both students and teachers often lack the necessary competencies to fully utilize digital tools. Without strategic training and curriculum integration, these tools remain underutilized—a concern echoed by both local and international studies.

Socioeconomic inequalities also shape the digital landscape in rural areas. Disparities in income and access to digital resources disproportionately affect rural learners, as noted by Shamsudin et al. (2023), whereas cultural attitudes and cognitive barriers influence how communities adopt and engage with technology (Hu et al., 2023). To address these multifaceted issues, researchers call for coordinated policy action and community-based strategies. Zhang (2023) emphasized the importance of fostering urban–rural educational synergy and developing context-sensitive solutions that align with the lived realities of rural populations.

In sum, while progress has been made in equipping rural students with digital tools and basic literacy, much remains to be done. A holistic and inclusive approach—one that encompasses infrastructure upgrades, targeted teacher training, community engagement, and responsive policy—is essential to ensure that digital education in rural settings is not only accessible but also equitable, sustainable, and transformative.

The proposed interventions presented in Table 12 are rooted in the key findings of the study, which revealed that while rural students exhibit strong foundational digital literacy—particularly in device operation, online navigation, and communication—gaps remain in infrastructure access, higher-order digital skills, and sustained support mechanisms. For example, although most students have smartphones, access to more advanced devices such as computers is limited, and internet connectivity remains inconsistent, especially within school environments. These challenges not only hinder students' ability to participate fully in digital learning but also limit opportunities for developing essential 21st-century skills.

To address these issues holistically, the proposed activities emphasize both capacity building (e.g., student training and teacher development) and structural support (e.g., digital hubs and resource audits). Moreover, involving parents and community stakeholders ensures shared responsibility and long-term sustainability. By aligning with national education goals and Sustainable Development Goal 4 (Quality Education), these interventions are designed not only to respond to the current needs of rural learners but also to future-proof their digital competencies in an increasingly technology-driven world.

5. Conclusion and Recommendations

This study aimed to assess and understand the level of digital literacy and access to digital resources among rural students in Nueva Ecija. Specifically, it sought to (1) characterize the demographic profile of students in terms of sex, access to digital devices, and internet connectivity; (2) assess their current level of digital literacy across basic skills, internet use, communication, and problem-solving; (3) evaluate their access to technology and infrastructure, including learning resources and school facilities; and (4) propose targeted intervention activities to enhance digital literacy and bridge the digital divide. A descriptive-quantitative research method was employed, involving 109 junior and senior high school students selected through purposive sampling. Data were collected via a validated, custom-made questionnaire and analysed via descriptive statistics such as frequency, percentage, mean, and standard deviation.

The findings revealed that while most rural students demonstrate strong foundational digital literacy skills—particularly in device use, online navigation, and communication—challenges persist in areas such as reliable internet access, school-based

infrastructure, and access to advanced learning tools. Notably, internet connectivity at school was inconsistent, and school-provided digital resources remained limited. On the basis of these findings, the study recommends implementing intervention programs such as student and teacher digital training, community access hubs, infrastructure audits, and policy advocacy. These efforts should aim not only to provide equitable access to technology but also to build higher-order digital skills essential for academic success and future readiness in a technology-driven society.

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Ethical Considerations

The authors declare that the conduct of the study adheres to the ethical guidelines and procedures involving human participants. Permission was obtained from the research locale, authorized by the proper authorities of a rural education institution in Nueva Ecija, Philippines. All the respondents consented to participate in this study and were fully aware of its purpose. Additionally, the authors declare that no personal information about the participants was collected in compliance with the Data Privacy Act of the Philippines.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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