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Setting up a Computer Laboratory for a National High School in Nueva Ecija: An Updated Perspective on Technological Integration

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ABSTRACT

Integrating technology in education is vital for preparing students for a rapidly evolving digital landscape. This study focuses on establishing a computer laboratory in one of the national high schools in Nueva Ecija, aiming to enhance students' digital literacy and critical thinking skills. By evaluating existing infrastructure and proposing a refined network layout, this research identifies essential hardware and software requirements and security protocols necessary for effective implementation. Recent literature highlights the importance of strategic planning, teacher training, and continuous evaluation in fostering an engaging learning environment. The findings suggest that a well-equipped computer laboratory can significantly impact educational outcomes by promoting personalized learning, collaboration, and information literacy. Ultimately, this initiative seeks to transform students' educational experience and contributes to the broader discourse on technology's role in education.

Keywords: computer laboratory, digital literacy, educational technology, network infrastructure, student engagement.

INTRODUCTION

In today's digital age, computer literacy and technological competence have become indispensable skills crucial for success in both academic and professional realms. Educational institutions are increasingly challenged to integrate advanced technology into their curricula to meet the evolving demands of society and the job market (Abulibdeh et al., 2024). A vital component in this effort is the establishment of well-equipped computer laboratories, which play a significant role in bridging the digital divide and enhancing student learning outcomes (Andrade et al., 2024). This research focuses on the redesigning of the Computer Laboratory in one of the national high schools in Nueva Ecija, the Julia Ortiz Luis National High School (JOLNHS), aiming to transform it into a vibrant hub for fostering critical thinking, creativity, and problem-solving skills among students.

Established in 1945 under the leadership of ex-Governor Juan O. Chioco, the school boasts a storied history characterized by academic excellence and meaningful community contributions (Andres, 2009).

Despite several attempts to rename the institution over the years, Andres further mentioned that the name "Julia Ortiz Luis High School" has been preserved, largely due to the dedicated efforts of local stakeholders and supportive legislators. Over its 63-year history, the school has continued to serve as a beacon of educational and social progress, spearheading initiatives such as agricultural pilot programs in collaboration with the National Irrigation Administration, which have significantly benefited the local community.

As the school stands at the crossroads of tradition and modernity, the integration of a state-of-the-art computer laboratory represents a strategic initiative to equip students with the necessary skills for thriving in a technology-driven future (Singha & Singha, 2024). This study meticulously examines the technical hardware requirements, networking infrastructure, and the broader educational impact of the proposed redesign. By aligning the school's infrastructure with modern educational standards, the project aims to empower students with essential digital skills that are crucial for navigating an increasingly interconnected world (Omodan, 2024). Through this transformation, the school seeks not only to enhance the learning experience but also to ensure that its students are well-prepared to meet the challenges of a rapidly evolving digital landscape.

Literature Review

Recent literature emphasizes the multidimensional impact of computer laboratories on education. Technology integration fosters active engagement and personalized learning, enabling students to explore concepts at their own pace (Parveen et al., 2024). The ability to access information digitally cultivates information literacy, a skill vital in navigating the information-rich landscape of today (Canaria et al., 2024). Furthermore, computer-assisted learning promotes collaborative and communication skills that mirror real-world scenarios (Ramadevi et al., 2023).

A successful computer laboratory setup necessitates strategic planning. Infrastructure, including hardware and software, must align with pedagogical goals (Rukajat et al., 2024). A well-designed curriculum that seamlessly integrates technology can enhance subject matter comprehension and application (Wonu & Amannah, 2024). Teacher professional development is also pivotal; educators need training to harness technology effectively for instruction (Sprague et al., 2023).

Moreover, recent studies highlight the role of computer laboratories in fostering creativity and critical thinking among students. According to Kwangmuang et al. (2021), when students have access to technology, they are more likely to engage in higher-order thinking tasks, which are essential for problem-solving and innovation. This sentiment is echoed by Bereczki & Kárpáti (2021), who found that integrating technology into classroom practices encourages students to take ownership of their learning, resulting in increased motivation and deeper understanding of subject matter.

The physical environment of computer laboratories also plays a crucial role in their effectiveness. Research by Seffah et al. (2021) indicates that flexible seating arrangements and collaborative workspaces can enhance interaction among students, promoting teamwork and communication skills. Similarly, the incorporation of user-friendly software tools is essential for maximizing learning outcomes, as they allow students to engage with content in diverse and meaningful ways (Criollo et al., 2023).

Furthermore, studies have shown that a supportive school culture that embraces technology integration is key to successful implementation. In a comprehensive review, Runge et al. (2023) emphasize the importance of creating an environment where teachers feel empowered to experiment with technology, as this leads to more innovative and effective instructional practices.

Finally, the impact of computer laboratories extends beyond academic performance; they also equip students with essential 21st-century skills. As noted by Thornhill-Miller et al. (2023), skills such as critical thinking, creativity, collaboration, and communication are increasingly recognized as fundamental competencies for success in the modern workforce, further underscoring the necessity of effective technology integration in educational settings.

Research Objectives

This research aims to achieve the following objectives:

1. Conduct a comprehensive assessment of the computer laboratory's physical environment, including the adequacy of technological resources and accessibility features. This evaluation helps identify strengths and weaknesses in the current setup, focusing on the usability and effectiveness of existing equipment and facilities for student learning.
2. Analyze the existing network infrastructure to identify areas for improvement. This involves physically reconfiguring devices, implementing robust security protocols, and optimizing network performance. The restructuring process includes systematic testing at various stages to detect and rectify any issues, ensuring a secure and reliable network environment for users.
3. Establish a framework for providing ongoing technical support to the school. This includes developing protocols for troubleshooting, suggesting preventative maintenance procedures, and addressing technical queries from staff and students. By offering continuous assistance, the project aims to enhance the overall functionality and reliability of the computer laboratory, empowering users to maximize their learning experiences.

METHODOLOGY

This study utilized an exploratory research design where the researchers thoroughly investigated the current network infrastructure and gathered insights into user requirements and expectations.

In particular, the researchers performed the following:

Network Audit. Conducted a comprehensive audit of the existing network infrastructure. Document hardware, software, configurations, topology, and performance metrics.

Security Assessment. Evaluated the current security measures and identified vulnerabilities, potential threats, and security gaps.

Surveys/Interviews. Conducted interviews with the Computer Laboratory in charge and ICT teachers to understand their needs, expectations, and pain points regarding network performance, accessibility, and security.

They also performed the following data and technical assessment analysis activities:

Resource Identification. Created a list of hardware and software requirements needed for the computer laboratory reconfiguration activity.

Network Mapping. Designed visual representations of the current network topology, including devices, connections, and traffic flow.

Network Layout Development. Utilized the insights gathered from the technical assessment and user requirements analysis to design an improved network layout. Consider scalability, redundancy, security measures, and efficient traffic flow in the new design.

Ethical Considerations

This research adhered to ethical standards throughout the data collection process during the technical assessment and user requirements gathering. All data collected were handled with strict confidentiality,

with participants' identities and responses anonymized to protect their privacy. The data were securely stored and made accessible only to authorized personnel involved in the research. Prior to conducting network assessments and gathering user feedback, necessary permissions were obtained from the school principal.

Participants were informed about the purpose of the assessment, the type of data collected, and how the information would be used. The research incorporated feedback from stakeholders at each stage of the assessment process, which was instrumental in making informed adjustments to the network layout design, ensuring that the final implementation met the actual needs of users.

After conducting pilot and prototype testing, the research team analyzed the results and made necessary modifications to the network design based on empirical evidence and user input. This iterative process enhanced the overall effectiveness and user experience of the computer laboratory. By following these ethical principles, the research fostered trust and collaboration among all participants, ensuring that the project was conducted responsibly and with integrity.

RESULTS AND DISCUSSION

Resource Identification

In Table 1, the physical devices required to establish a robust network infrastructure at the research locale, are outlined. These devices will facilitate the connection of two or more access points in a single direction across a considerable distance, thereby providing reliable internet access. The designated locations for the installation include the principal's office and the senior high school building.

Table 1. Devices Needed in Setting Up the Computer Laboratory

Device	Quantity	Uses/Functions
Acer Desktop Computer	50	Used for various computing tasks, including programming, data analysis, and accessing educational resources.
D-Link Switch	4	Facilitates network connectivity by connecting multiple devices within a local area network (LAN).
UTP Cable	1	Used for transmitting data signals in Ethernet networks, connecting devices to switches and routers.
RJ45 Connectors	100	Connects UTP cables to devices, enabling network connections and data transmission.
TP-Link Router	2	Provides internet access and network connectivity, allowing multiple devices to connect wirelessly or via Ethernet.
FCC Wireless Bridge	2	Extends wireless network coverage and connects wired devices to a wireless network.
Power Over Ethernet Injector	2	Supplies power and data to devices like IP cameras and access points over Ethernet cables, reducing the need for separate power sources.

These devices are currently available within the school's inventory, and the researchers have made adjustments to the layout of the existing network to optimize functionality. Such modifications are crucial, as effective network design is essential for ensuring high-quality internet access and enhancing overall user experience (Familoni & Babatunde, 2024). The new layout will take into consideration the optimal placement of devices to improve coverage and connectivity, aligning with best practices in network design. The following section details the specific changes made to the existing network design to achieve these objectives.

Network Mapping

The figure below illustrates the physical layout of the network in one of the computer laboratories located in the research locale, depicting the connection between the Principal's Office and the School's Laboratory Room. This network mapping is essential for understanding the infrastructure that supports internet access across key areas of the school, facilitating both administrative and educational activities.

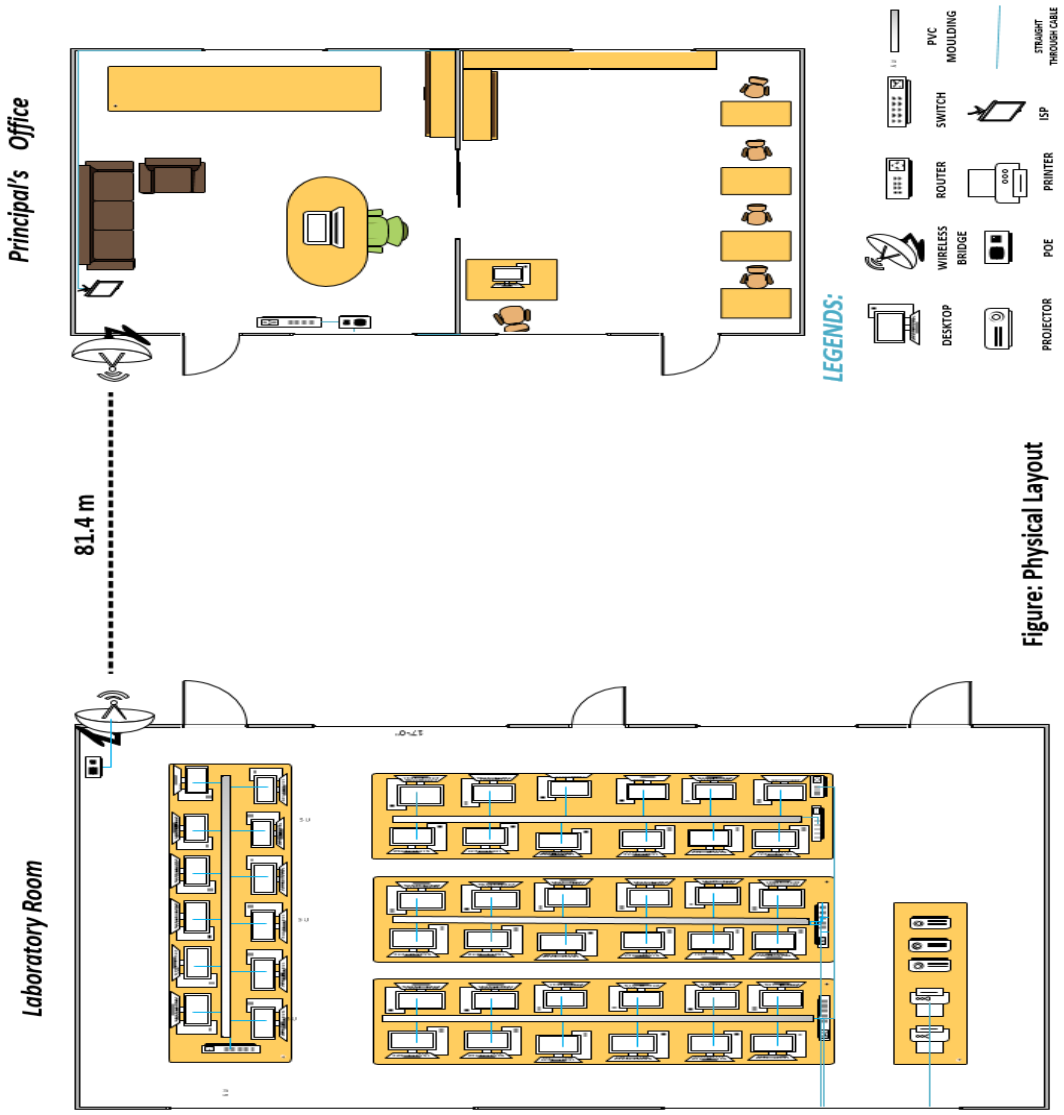

Figure: Physical Layout

Fig. 1. Physical Network Layout

The physical network layout serves as a blueprint for the overall connectivity strategy within the school. At the core of this setup is the Principal's Office, which acts as a central hub for network management.

From this point, the network extends to various locations, including the School's Laboratory Room, ensuring that students and staff have reliable access to the internet and digital resources.

In this layout, multiple access points are strategically placed to optimize wireless coverage throughout the school. The use of high-quality devices such as the TP-Link routers and FCC Wireless Bridges enhances connectivity and reduces potential dead zones, thereby improving the overall user experience (Jang et al., 2019). The network also utilizes UTP cables for wired connections, ensuring stable and fast data transmission where needed.

Furthermore, the D-Link switches included in the layout facilitate efficient data traffic management, allowing for seamless communication between devices connected to the network. This setup aligns with best practices in network design, which emphasize the importance of a well-planned topology that supports both current needs and future expansion (Qureshi et al., 2020).

By mapping the network in this way, the researchers aim to provide a comprehensive view of how the components interconnect, ultimately enhancing the educational environment by ensuring that technology is integrated effectively into daily operations. This mapping will also serve as a reference for future maintenance and upgrades, reinforcing the school's commitment to providing a modern learning environment that meets the demands of today's digital landscape.

Network Layout Development

The network layout presented in Figure 1 below illustrates the logical arrangement of computers within the school's local area network. This layout is essential for understanding how the various components of the network interact and communicate with each other, thereby enhancing overall operational efficiency.

In this logical layout, each computer and device is represented in relation to its function within the network. This arrangement not only indicates how data flows between devices but also highlights the relationships and dependencies among them. By organizing the network in this manner, the researchers can ensure that resources are allocated efficiently, and that all users have access to necessary tools and information.

The logical arrangement allows for easy identification of network segments and helps in troubleshooting potential issues that may arise. For instance, by grouping computers used for similar purposes—such as those in the School's Laboratory Room versus administrative offices—staff can optimize performance and manage resources effectively. This segregation aids in reducing network congestion, ensuring that high-demand areas have the necessary bandwidth to function smoothly (Ojugo & Eboka, 2020).

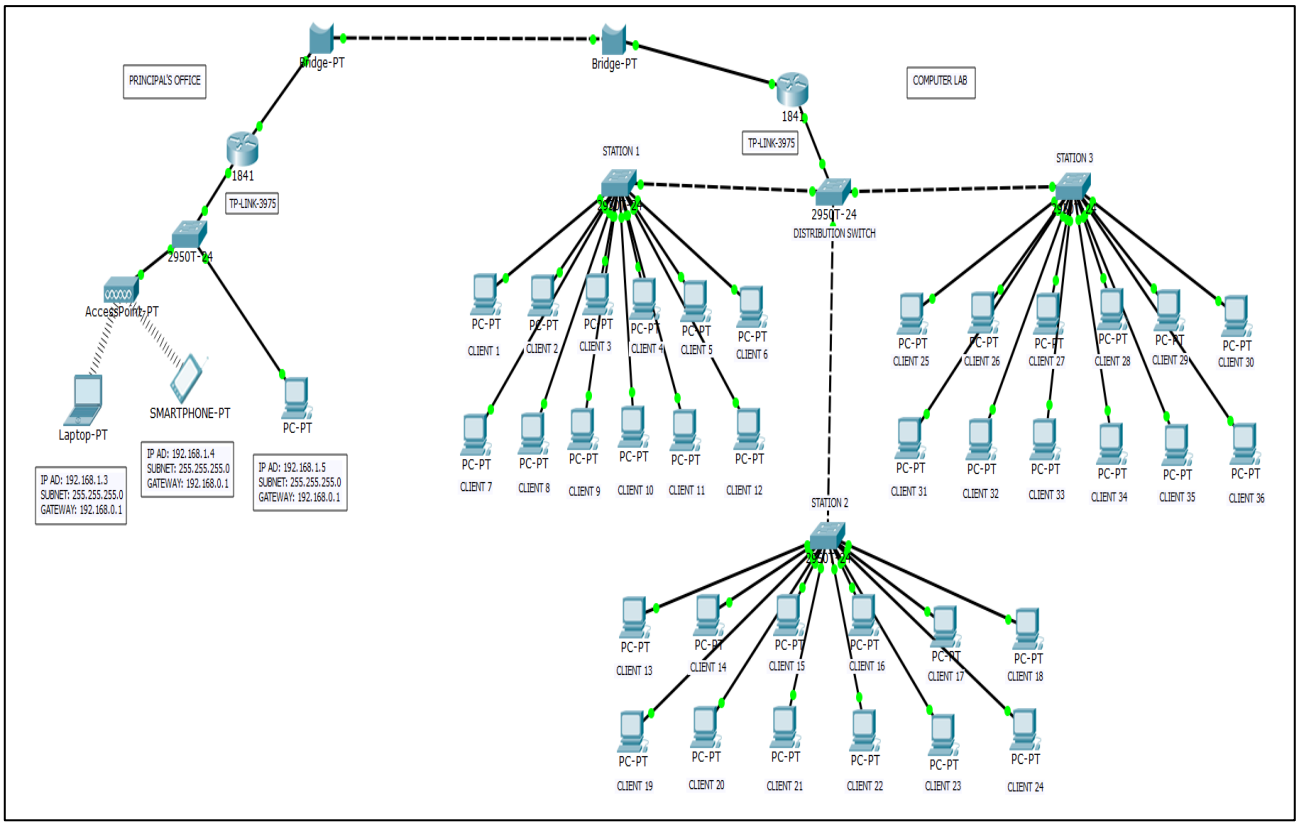

Fig 2. Logical Layout of the Network

Moreover, the layout reflects a hierarchical structure that enhances security and management. Critical devices, such as servers or switches, can be placed at strategic points within the network, enabling easier monitoring and maintenance. This structured approach aligns with best practices in network design, which advocate for clear delineation between different network functions and user groups (Kizza, 2024). In developing this logical network layout, the research team aimed to create an infrastructure that not only meets current technological demands but is also adaptable to future needs. As educational technology continues to evolve, this layout provides a flexible framework that can accommodate new devices, applications, and learning tools. Ultimately, this logical arrangement will contribute to a more effective and engaging educational experience for both students and faculty.

Implementation

The refined network layout was be deployed at the research locale, ensuring that all configurations are accurately implemented and robust security measures are established. This process involved a systematic rollout, beginning with a detailed checklist to verify that all components, such as routers, switches, and access points, are correctly installed and configured. It is crucial to enforce security protocols at this stage, including firewall settings, access controls, and encryption standards, to safeguard sensitive data and protect the network from potential threats (Arogundade, 2023). Proper implementation will lay the foundation for a reliable and secure network infrastructure, essential for supporting the school's educational initiatives (Aldosemani, 2023).

Documentation

Comprehensive documentation was prepared for the new network layout, serving as a valuable resource for both current and future stakeholders. This documentation includes detailed diagrams of the network

architecture, configurations of all devices, and outlined security protocols. Additionally, troubleshooting guides were provided to assist ICT in-charge in resolving potential issues swiftly and efficiently.

Training

To maximize the benefits of the new network layout, informal training sessions was provided for the ICT in-charge. These sessions covered the features of the new network, best practices for usage, and strategies for maintaining security. Engaging and informative training sessions will empower users to effectively utilize the new system (Luckin et al., 2022). It also helps in fostering a culture of technology integration that enhances the educational experience of the students.

CONCLUSION AND RECOMMENDATION

The establishment of a computer laboratory at JOLNHS signifies a progressive initiative aimed at equipping students with the essential skills needed in the digital age. By integrating insights from recent literature, this research endeavors to facilitate the effective implementation of the laboratory and illuminate its potential impact on student learning outcomes. This initiative promises to not only transform the educational experience for students but also enrich the broader discourse on the role of technology in education and its capacity to shape the future of learners.

In light of the findings from this study, the researchers recommend several key actions. First, it is essential to establish a regular schedule for routine maintenance, updates, and security patches to ensure that the network infrastructure remains current and secure. This proactive approach will help mitigate vulnerabilities and enhance the overall reliability of the network.

Second, continuous monitoring of network performance is crucial. By promptly addressing any emerging issues, the school can maintain a high level of service and minimize disruptions to educational activities. Implementing these recommendations will help create a sustainable and effective technological environment that supports both teaching and learning at the said school.

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