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METHODOLOGY TO REDUCE THE DIGITAL DIVIDE IN EDUCATION: A CASE STUDY OF ECUADOR

METODOLOGÍA PARA REDUCIR LA BRECHA DIGITAL EN EDUCACIÓN: CASO DE ESTUDIO ECUADOR

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ABSTRACT

Ecuador faces a significant digital divide that affects students and teachers, limiting their access to educational and technological resources, especially in geographically dispersed areas with socioeconomic inequalities. This study focuses on implementing sustainable strategies at the Dayuma Kento Educational Unit, located in the La Joya de los Sachas canton, Orellana province. The main objective is to improve equitable access to technology and strengthen the quality of education. Through surveys, key challenges were identified, leading to the development of four intervention areas. The first, Equipment, consisted of providing the institution with essential technological infrastructure, including network devices and video surveillance systems, ensuring efficient internet access. The second, Connectivity, improved internet access and coverage through secure wired and wireless networks, facilitating user access to online resources. The third area, Infrastructure, involved adapting school spaces with computers and connectivity to optimize the use of technology in educational environments. Finally, the Pedagogy component focused on training students and teachers in the effective use of ICT, integrating it into teaching and learning processes. Subsequent surveys revealed positive results, highlighting a 65% increase in teachers' interest in technology training and a significant improvement in the educational experience and student engagement thanks to the effective incorporation of technological tools in the classroom.

Palabras clave:
Metodología, brecha digital, conectividad, pedagogía, TIC.

RESUMEN

Ecuador enfrenta una notable brecha digital que afecta a estudiantes y docentes, limitando su acceso a recursos educativos y tecnológicos, especialmente en áreas con dispersión geográfica y desigualdades socioeconómicas. El presente estudio se centra en implementar estrategias sostenibles en la Unidad Educativa Dayuma Kento, ubicada en el cantón La Joya de los Sachas, provincia

	de Orellana. El objetivo principal es mejorar el acceso equitativo a la tecnología y fortalecer la calidad educativa. A través de encuestas se identificaron desafíos clave que condujeron al desarrollo de cuatro ejes de intervención. El primero, Equipamiento, consistió en dotar a la institución de infraestructura tecnológica esencial, incluyendo dispositivos de red y sistemas de video vigilancia, asegurando una distribución eficiente de internet. El segundo, Conectividad, mejoró el acceso y la cobertura de internet mediante redes seguras tanto cableadas como inalámbricas, facilitando a los usuarios el acceso a recursos en línea. El tercer eje, Infraestructura, implicó la adecuación de espacios escolares con dotación de computadoras y conectividad para optimizar el uso de la tecnología en entornos educativos. Finalmente, el eje de Pedagogía se centró en capacitar a estudiantes y docentes en el uso efectivo de las TIC, integrándolas en los procesos de enseñanza y aprendizaje. Posteriormente, encuestas evidenciaron resultados positivos destacando un incremento del 65% en el interés de los docentes por formarse en tecnología y una mejora significativa en la experiencia educativa, interés de los estudiantes gracias a la incorporación efectiva de herramientas tecnológicas en el aula.

Introduction

Access to technology and connectivity have become essential elements of the education system, a reality that was further highlighted by the pandemic, which exacerbated preexisting shortcomings, such as inadequate educational infrastructure, a shortage of teachers, and low academic performance (De Jesús & Ayala Ramírez, 2021). According to data from Ecuador's Ministry of Education (MINEDUC), of the 16,096 educational institutions in the country, 7,759 lack internet connectivity, which is equivalent to 28.41% of the total. Of these, 4,618 are in urban areas and 3,141 in rural areas (Pérez O, González M, Otero I, 2005). The digital divide affects both urban and rural areas. In the same classroom, there are students who are proficient in using digital devices alongside others who are not, and in some cases, classrooms equipped with technology but staffed by teachers who lack digital skills. This digital divide has a negative impact on learning, leading to a decline in educational standards. During the pandemic, although the government increased the supply of digital devices, teaching and learning dynamics broke down, which paradoxically led to a decline in educational quality (Andocilla et al., 2023).

Experiments in Norway and Sweden have shown that banning the use of electronic devices in classrooms can improve reading skills and critical thinking, suggesting that these devices may act as distractions (Villalta Jadan et al., 2023). In light of this situation, this case study at the Dayuma Kento Educational Unit in the La Joya de los Sachas canton, Orellana province, seeks to identify the digital divide affecting the student population through a survey. Based on the results, a plan will be proposed for the provision of electronic devices and Internet access in accordance with the number of students, infrastructure, and the socioeconomic conditions of the families (UNESCO, 2024).

The pandemic has highlighted the extent of the digital divide in education, significantly affecting students and teachers, especially in areas with limited internet access, as observed in the province of Guayas (Tutivén, F., & Muñoz, 2021). Studies show that a lack of internet access and adequate devices has hindered online learning and increased student dropout rates, with the greatest impact on public and rural institutions. Despite government efforts to bridge this gap, inequalities persisted and became more visible during the health crisis (Prince Torres, 2021).

On the other hand, research on connectivity and equipment in Ecuador’s public schools shows that fluctuations in government investment have affected the availability of technological resources, limiting the effective use of ICT in education (Pita Salazar et al., 2021). These limitations have been particularly evident in the university setting, where a direct impact on the teaching-and-learning process has been observed. Furthermore, the digital divide has been identified as an obstacle to the universal right to education, exacerbating social inequalities and limiting equitable access to education, especially during the pandemic (Moreira et al., 2017).

Taken together, these studies show that the digital divide is a complex phenomenon that affects all levels of Ecuador’s education system, from elementary and secondary school through college. While some studies highlight the lack of infrastructure and connectivity as the main obstacles, others focus on social inequalities and their impact on access to education (Baca-Pumarejo et al., 2018). The pandemic has served as a catalyst that has amplified these inequalities, underscoring the urgent need for more effective and sustainable policies to bridge the digital divide and ensure quality education for all (Moreira et al., 2017).

In this context, this project focuses on implementing key strategies to bridge the digital divide, including an appropriate pedagogical approach that provides for the urgent training of teachers and students, infrastructure equipped with wireless technology, augmented reality, and virtual reality, computer labs with internet access, and lesson plans designed to develop skills, competencies, and methodological strategies in a digital environment. This enabled students to compare, identify, critique, and search for information on their own. This article is divided into 4 sections. A review of related topics and the focus on the digital divide presented in the Introduction. Section 2 explains the methodology to be used to bridge the digital divide. The results are presented in Section 3, and the discussion and conclusions are highlighted in Section 4.

Methodology

This section describes the methodology to be used in the article, which consists of assessing the digital divide by identifying and quantifying its underlying causes using indicators that facilitate the analysis and formulation of strategies to reduce it (Díaz Lazo et al., 2005). This methodology is applied in an educational institution, where the evaluation criteria take into account the resources the institution must provide to students so that they can incorporate new technologies into their personal and educational development. The analysis focuses on the relationship between schools and students, highlighting the importance of ICTs in this relationship and considering three key aspects for reducing the digital divide: economic, social, and educational (Valenzuela Urra et al., 2022).

Infrastructure must keep pace with technological advances; there is no point in equipping a classroom with an interactive whiteboard if it does not have Internet access. Content and applications must be tailored to the educational level and the skills to be acquired, while teachers must be trained in the use of ICT (Anaya Figueroa et al., 2021). All of this requires appropriate conditions for carrying out curricular activities. At the Dayuma Kento Educational Unit, the Ishikawa method was used to identify the causes that have widened the digital divide by analyzing the factors that affect the technology available to students.

To assess the digital divide at the Dayuma Kento Educational Unit, key variables related to Internet access infrastructure, the quality of educational content and applications, and teachers' skills—as identified using the Ishikawa method—were considered (Gómez et al., 2008). The research focused on quantifying these variables and analyzing their impact on the digital divide. The study population included 187 students at various grade levels and 43 teachers. Surveys were conducted before and after the training sessions to gather data on access to technology, digital skills, and the use of ICT in the classroom, in both the morning and afternoon sessions. The information was anonymized to protect the participants' identities using the Office 365 Forms platform, as shown in Figure 1; this platform was provided by the Ministry of Education. This approach made it possible to identify the causes, characteristics, and possible actions to reduce the digital divide within the institution.

Figure 1
Survey of Faculty and Students at UEDK

Note. Figure 1 shows the surveys used to measure the digital divide, which are administered to teachers and students.

Internet access infrastructure and the digital divide are intrinsically linked. However, the digital divide also has deeper causes, such as the lack of educational programs that adequately integrate ICT into the educational process (Sánchez et al., 2018). In this regard, the variables to be analyzed for this study are those that directly influence the existence of the digital divide, whether due to a lack of or deficiencies in Internet access infrastructure, as revealed by Ishikawa's analysis. Therefore, to assess the digital divide at the Dayuma Kento School from the perspective of what the school offers its students, the following variables were considered:

- ICT-supported access infrastructure.
- Educational content and applications.
- Teachers' skills and competencies.

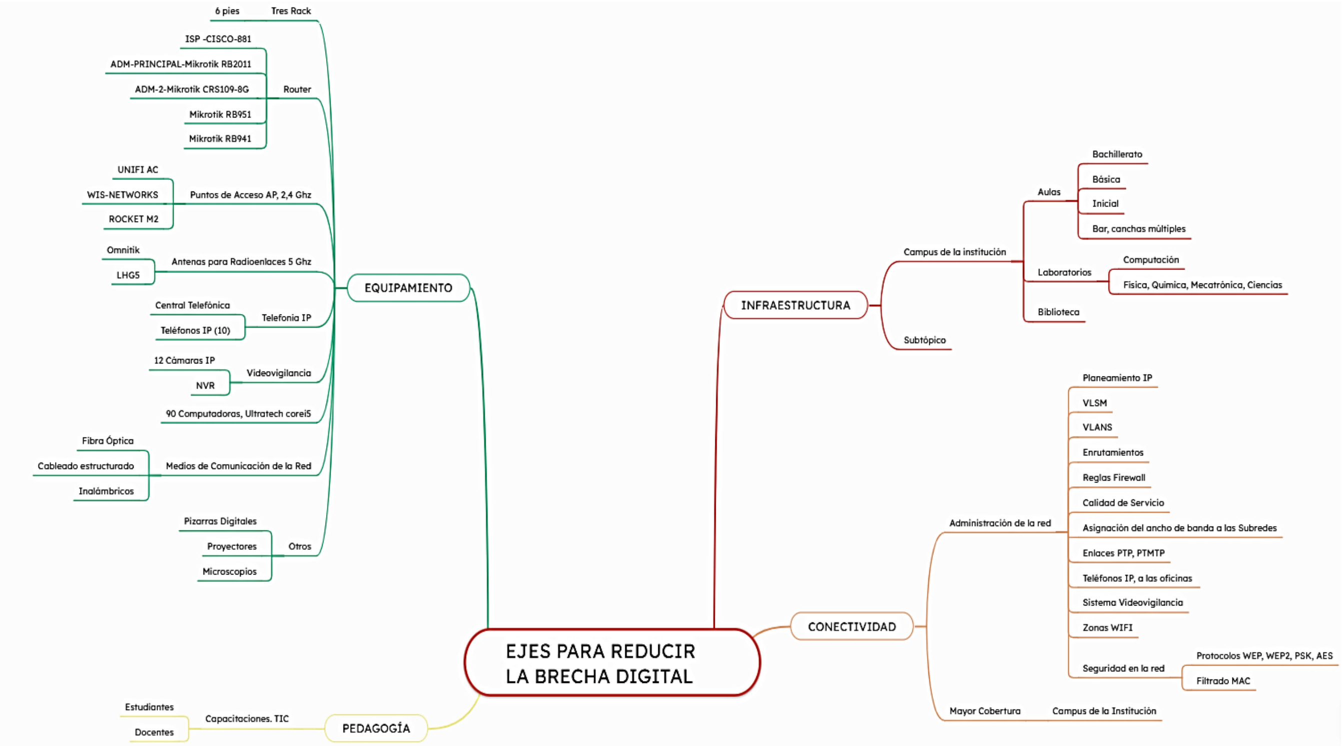
Answering the central question of this study ("What is the extent of the digital divide at the Dayuma Kento Educational Unit in the city of Joya de los Sachas? What are its causes and characteristics, and what actions should be implemented to reduce it?") requires quantifying the variables mentioned and analyzing how each of them contributes to the existence of the digital divide.

The digital divide and ICT use are inversely related: a wider digital divide implies lower ICT use, and vice versa. This requires integrating ICT into traditional teaching methods (Gómez-Prada et al., 2019). The integration of these technologies—especially the Internet—into education is transforming school practices in a way similar to the computerization of the past. Nowadays, it is inconceivable to manage information in a school without digital technology. The implementation of ICT requires organizational and educational process adjustments to ensure its planned integration, optimal use, and quality, in accordance with the guidelines of the Ministry of Education.

The methodology and implementation processes for reducing the digital divide—the result of this research—consist of four main parts or pillars, as shown in Figure 2:

- Equipment
- Infrastructure
- Connectivity
- Pedagogy

Figure 2
Mind Map: Strategies for Bridging the Digital Divide



Note. Mind map of the key areas and all their components for bridging the digital divide.

Equipment

To ensure that both students and teachers have the devices they need for digital learning, it is essential to start by taking inventory of the current devices and assessing their condition and functionality. Next, we need to purchase new devices, such as laptops and tablets, for those who do not have them. This is essential, as a survey showed that the number of teachers without training in digital skills decreased by 45% after they received new equipment. In addition, implementing a schedule for regular maintenance and device updates will ensure their continuous operation. Offering workshops and courses on the use of these devices will allow students and teachers to become familiar with and make the most of the available tools, which has resulted in an 82% increase in teachers' digital competence, according to the survey results.

Infrastructure

It is crucial to create a physical environment that facilitates the effective use of digital technologies in teaching and learning. For this reason, classrooms must be adapted and equipped with modern technologies, such as projectors, interactive whiteboards, and charging stations for devices. The importance of these improvements was evident in the survey, in which teachers reported significant improvements in their students' learning experience as a result of having adequate infrastructure. It is also essential to create spaces within the school dedicated to collaborative work and the use of technology, such as computer labs and multimedia rooms. An ongoing maintenance plan will ensure that all equipment and spaces are in optimal condition, while also ensuring that they are safe and accessible to all members of the educational community. The quality and functionality of these spaces and facilities, along with their use by students and faculty, will be the main indicators of success, based on the positive results observed in surveys conducted after these improvements were implemented.

Connectivity

It is essential to ensure that all members of the educational community have a stable, high-quality internet connection. This begins with an assessment of the existing network infrastructure and its coverage, followed by the implementation of the necessary improvements to ensure a fast and stable connection. The importance of these actions was reflected in a descriptive statistical analysis, in which the most significant variable was the implementation of technology in the classroom. This demonstrated a significant improvement in the effective use of technology in teaching once connectivity was improved. In addition, it is crucial to establish agreements with internet service providers to offer subsidies or discounted rates to students and teachers. It is also necessary to set up free internet hotspots in strategic locations throughout the school and the community to make access easier for those who need it. Indicators of success will include the speed and stability of the internet connection, as well as the percentage of students and teachers with regular access, which, according to surveys, has been key to improving the quality of learning.

Pedagogy

It is vital to effectively integrate digital technologies into teaching and learning methods. Offering continuing education programs for teachers on the pedagogical use of digital technologies has proven to be highly effective, as reflected in the survey results, in which a growing number of teachers expressed a desire to receive more technology training after participating in the initial programs. This was the profile of the teachers surveyed, who, as can be seen in Table 1, are mostly experienced educators who have witnessed firsthand the transition from traditional to digital pedagogy.

Table 1

Population / Sample of Teachers

Number of respondents	Faculty Profile	Antiquity	Academic Year
25	Teacher of elementary and high school education	old	2023–2024
2	Upper Secondary General Education Teacher	new	2023–2024
7	Math Teacher	old	2023–2024
4	Language Teacher	old	2023–2024
5	Technical Instructor	old	2023–2024

It is essential to create and adapt digital educational materials that are relevant and accessible. Implementing teaching methodologies that encourage the active use of technology—such as project-based learning and the *flipped classroom*, among others—can have a significant impact. According to the analysis of the survey data, the application of these methodologies resulted in an increase in the perception of technology's positive impact on learning. Using digital tools for ongoing assessment and personalized feedback for students is essential to maintaining and improving these results.

Results

This section analyzes the experimental results and provides a detailed examination of the strategies used to bridge the digital divide. It also presents the findings of surveys conducted among teachers and students before and after the implementation of this project. The analysis of the results includes the variables used to assess the digital divide.

Working on infrastructure helps meet the needs of the educational community; thus, the main technological systems that were implemented are as follows: Main rack, Cisco 881 router from the Internet service provider, patch panel for structured data and voice cabling, IP PBX, secondary rack, omnidirectional antenna, 5 GHz, point-to-multipoint links, CPE antennas. (Customer Premises Equipment), 5 GHz, point-to-multipoint links, 2.4 GHz access points (AP 1, 2), 2.4 GHz access point (AP 3), three 2.4 GHz access points (AP 4, 5, 6) in classrooms and computer labs, 2.4 GHz AP 7, 2.4 GHz AP 8, monitoring center with 9 IP cameras and 6 IP phones.

Figure 3
Telecommunications Technology Equipment

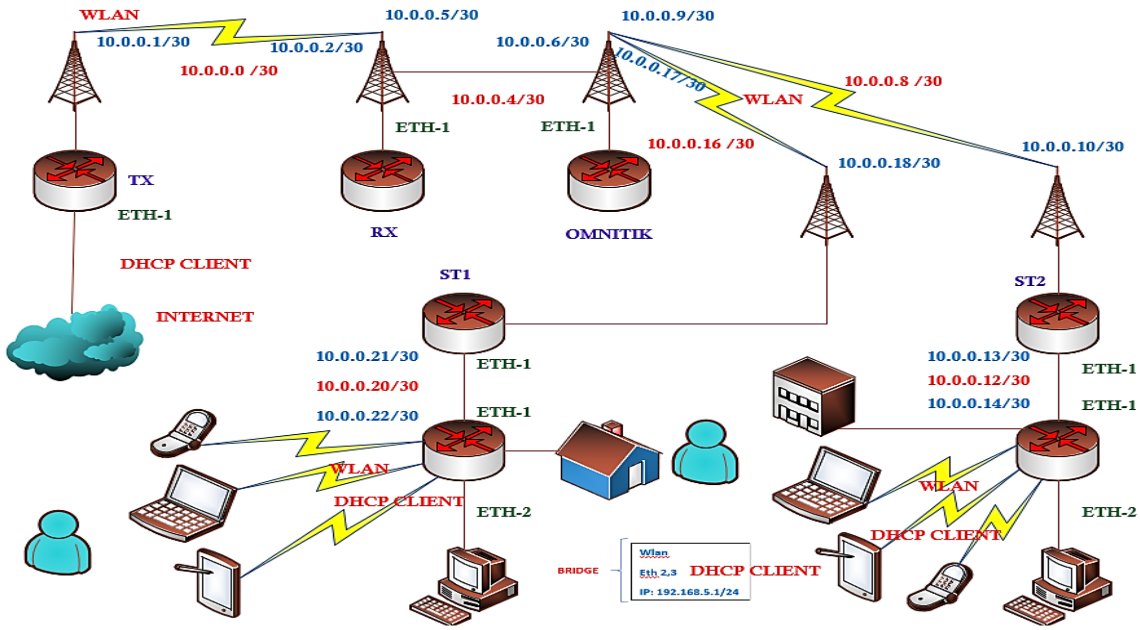
Note. Figure 3 shows the various pieces of equipment needed for internet connectivity, communication, and image display at the UEDK.

The subscribed-to Internet service offers a bandwidth of 20 Mbps for uploads and 10 Mbps for downloads, and its topology is shown in Figure 4. The service provider uses fiber-optic technology with a 1:2 sharing ratio. For this corporate contract, a Cisco 881 edge router was assigned.

The intranet on the educational campus is managed through four routers and eight access points, providing wireless coverage to 90% of the institution's campus area. The configurations applied to these devices include: IP address planning using the IPv4 protocol with private IP addresses; variable-length subnet masks (VLSM), which optimize the use of IPv4 addresses and device resources; static routes to allow access to network resources from any subnet; and Quality of Service (QoS), which enforces restrictions on internet access through the main device's firewall, in accordance with internal policies. In addition, bandwidth is allocated among networks and subnets using simple queues, and point-to-multipoint links are established at the 5 GHz frequency to extend the wireless signal to areas without Ethernet network access points. The security of the 2.4 GHz Wi-Fi network is ensured through the WPA and WPA2 protocols and MAC filtering.

Figure 4

The institution's network topology.

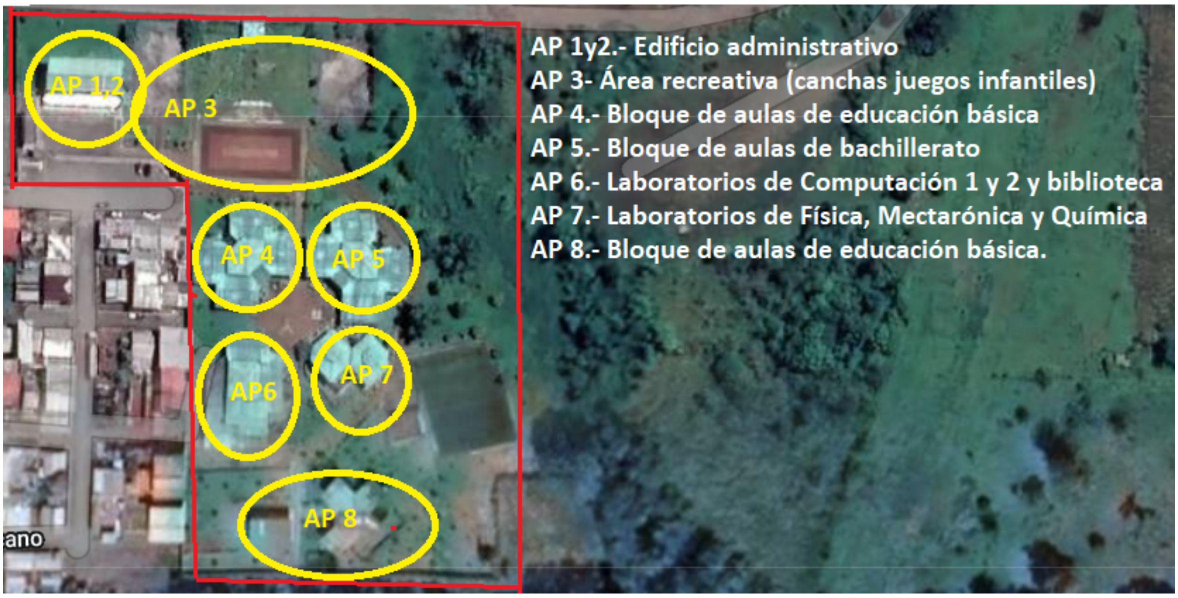


Note. Figure 4 shows the network topology used throughout the institution.

The intranet infrastructure includes three *racks* interconnected via fiber optics, from which structured cabling is distributed to the network points in the educational facility's buildings. The intranet is managed using Mikrotik routers, with the Winbox program used to manage the "Administrator," "Admin-dos," "Chemistry Lab Router," and "Mechatronics Router" devices deployed on the network. The settings configured on the main router, called "Administrator," include assigning IP addresses to all subnets, configuring the DNS (Domain Name System) protocol, implementing NAT (Network Address Translation), and managing routing. On the "Admin-Dos" router, IP addresses are configured using VLSM (variable-length subnet mask), and an omnidirectional antenna is connected, which allows for point-to-multipoint connections. In addition, rules are created in the device's firewall to block certain websites, static routing is implemented, and bandwidth is allocated to subnets using the simple queues option.

The routers in the Mechatronics and Chemistry Lab areas are configured with specific IP addresses and Wi-Fi networks for each location, using MAC filtering to ensure that only authorized users can access the wireless network, thereby enhancing security. Access points (APs) 3, 4, 5, 7, and 8 operate at a frequency of 2.4 GHz and are strategically located to provide Wi-Fi coverage across 90% of the campus, as shown in Figure 5. Once inside the APs' operating system, you can view details such as the frequency channel, channel width, region code, and the throughput of the wireless signals. The Wi-Fi network is configured in the "Wireless" settings with key parameters such as the SSID "RED-DOCENTES," and in addition to passwords, MAC filtering with whitelists is applied for teachers' devices, ensuring greater security and coverage across almost the entire campus.

Figure 5
Level of Wi-Fi signal coverage on the institution's campus



Note. The figure shows the educational institution's campus and the Wi-Fi coverage in the various areas.

APs 3, 4, 5, 7, and 8 are access points that operate at a frequency of 2.4 GHz and are located at strategic points throughout the institution to provide Wi-Fi coverage to 90% of the campus. Once you have logged into the access points' operating system, you can view the network status, including the frequency channel, channel width, region code, and maximum speed; you can also view the throughput of the wireless signals.

Figure 6
Main menu for APs 3, 4, 5, 6, and 8.

Note. WisNetworks Operating System Home Screen

In the "Wireless" option, you can configure the Wi-Fi network and its main settings, such as the SSID: RED-DOCENTES, the channel, channel bandwidth: To enhance network security in addition to passwords, MAC filtering with whitelists is implemented, which includes the MAC addresses of teachers' laptops and cell phones. It is worth noting that this network signal covers almost the entire campus.

Using the same equipment, virtual APs are configured to broadcast a new wireless signal with a different password. This creates a Wi-Fi signal named "RED ESTUDIANTES," with a different password and whitelist. The whitelist consists of the MAC addresses of students' devices (laptops and cell phones). When a student requests network access for their device, the device's MAC address is added to the whitelist for a limited time, since the bandwidth is not sufficient for all users.

The fourth proposed strategy for reducing the digital divide in education is pedagogy; for which a sample was drawn from sixth-year students in lower secondary school, ninth-year students in upper secondary school, and first-year high school students in both the morning and afternoon sessions, totaling 187 respondents and 43 teachers. They were administered a test assessing their knowledge of demographic information, access to technology, digital skills, and the use of technology in the classroom. After the test, training sessions were held according to a set schedule that lasted two weeks, with one hour per day for each grade level in elementary and high school. The topics covered in the training were as follows:

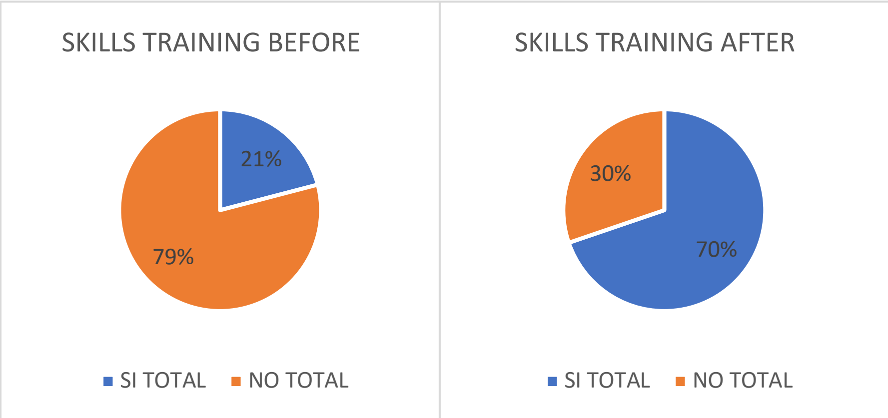
- The Evolution of Technology
- Proficiency in Microsoft Office (Word, Excel, PowerPoint)
- Proper Use of the Internet
- Study of digital platforms (Office 365, Google)
- Email, OneDrive, Google Drive.
- Office tools used in education (Canva, Genially, Mindomo, Classroom, Kahoot, Mentimeter).
- Introduction to Artificial Intelligence (AI)
- Augmented Reality, Virtual Reality
- The Metaverse.
- Introduction to Educational Robotics (programs: (Tinkercad, mBlock, Ottoblocky, Proteus, Fritzing, Arduino).

Analysis of Teacher Surveys

A total of 43 teachers were surveyed. The sampling method used was simple random sampling.

Before the training, only 9 teachers had received formal training in digital skills or in integrating them into their teaching. However, following the training, the number of trained teachers rose to 30, representing a significant increase from 21% to 70%—that is, a 49% increase. Similarly, the percentage of teachers who had not received training in digital skills decreased from 34 to 13, a 49% reduction, reflecting a drop from 79% to 30%, as shown in Figure 7.

Figure 7
Technology Skills Training



Note. Results of the technology training sessions before and after the training.

The Student's t-test, developed and promoted by William Sealy Gosset and commonly known as the "t-test," is a statistical tool used to determine whether there is a significant difference between the means of two groups. This test is particularly useful when working with small samples and the population standard deviation is unknown. When applying Student's t-test to paired samples, we observe that the p-value is less than 0.05; that is, the null hypothesis is rejected, meaning the two groups are not equal and, therefore, there are differences between receiving more technology training before and after. However, since this is a dichotomous qualitative variable, it is not normally distributed; therefore, the nonparametric Wilcoxon test is performed.

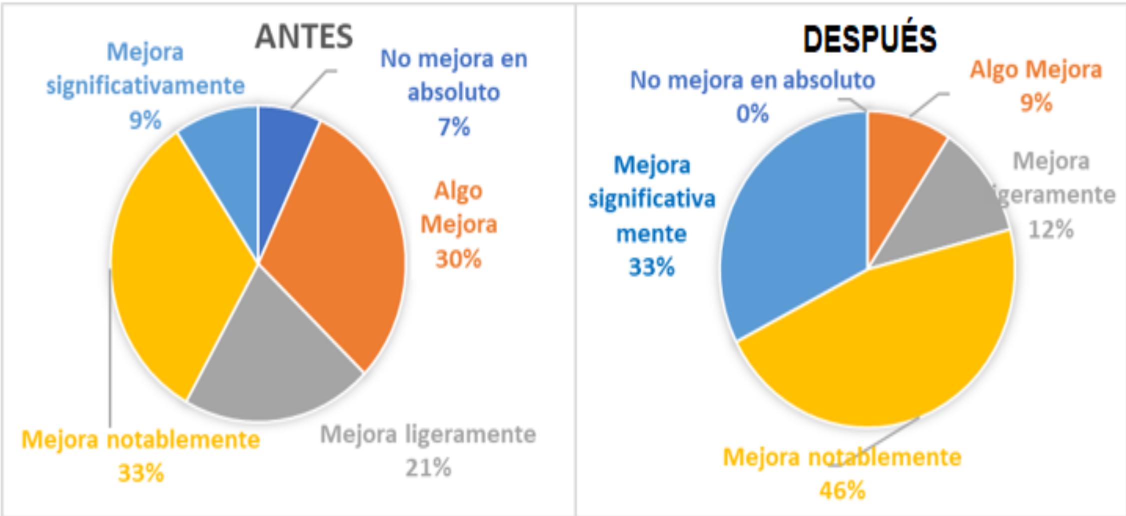
When analyzing the impact of educational content and applications, the "no improvement" option decreased from 3 teachers who did not believe in the impact of technology on learning to 0 teachers; all 43 teachers believe that the use of technology in the classroom has an impact on improving students' learning experience, representing a 7% improvement.

For this option, the impact of the improvement is very insignificant; the number also drops from 13 to 4 teachers—that is, from 30% to 9%, a decrease of 21%. Similarly, for the "slight improvement" option, the percentage drops slightly from just under 9 teachers to 5, or 12%. In total these three options together result in a 39% improvement. On the other hand, the options "noticeably improved" and "significantly improved" increased from 14 to 20 for the former (13%). And the second, the most significant, was from 4 to 14 (24%). In other words, between them, they increased their rating of the impact of using technology in their classrooms to improve their students' learning experience by 37% (16 teachers).

What can we conclude in light of these results? Well, the application of statistical tests, such as Student's t-test and the nonparametric Wilcoxon test, shows that technology training has a significant impact on teachers' perceptions of the use of technology in learning. The results show a notable shift in teachers' opinions: those who initially did not believe in the positive impact of technology (3 teachers) are no longer present, while the proportion of teachers who considered the improvement to be "very insignificant" and "slightly significant" has decreased considerably, with declines of 21% and 12%, respectively. In contrast, the categories with the greatest impact—"noticeable improvement" and "significant improvement"—saw increases of 13% and 24%, respectively, representing a total increase of 37% in positive assessments of technology use. This reflects a profound shift in teachers' perceptions of technology integration as a key tool for improving students' learning experience, highlighting the effectiveness of training programs.

Figure 8

The Impact of Technology on Classrooms: Then and Now



Note. Figure 8 illustrates the significant impact that the use of technology has on the institution.

Analysis of the Student Survey

Table 2

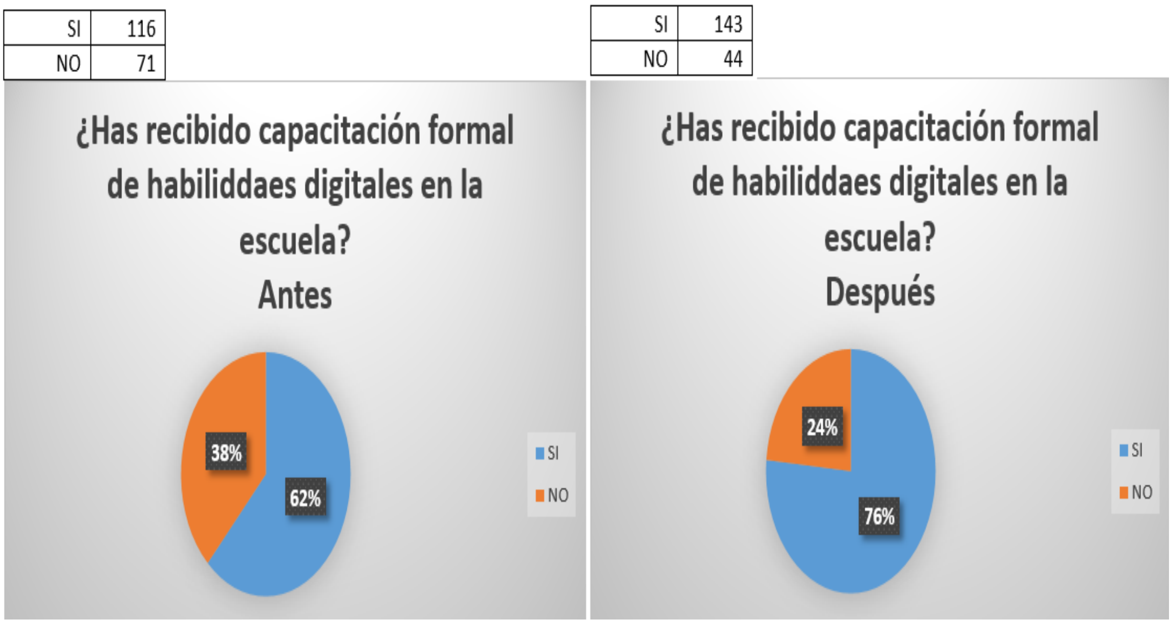
Student population / sample

Number of respondents	***Genre***	***Age***	***Course/Level***
187	Men's (109)	Under 12 years old (28)	Sixth Grade (Middle School)
	Women (78)	Ages 12–14 (62)	9th grade (upper elementary)
		Ages 15–17 (97)	First Year of High School (Science, Mechatronics, Electromechanics)

Note. Number of students surveyed.

When applying the nonparametric Wilcoxon test, a p-value less than 0.05 is obtained, leading to the rejection of the null hypothesis and indicating that there are significant differences between the two samples—that is, they are not equal. This leads to the conclusion that formal training in digital skills at school has had a significant impact. As shown in Figure 8, before the training, 62% of respondents answered "YES," while after the training, that percentage rose to 76%. This 14% increase reflects a rise of 27 cases and a corresponding decrease in the lack of training.

Figure 8
Survey administered to students before and after.



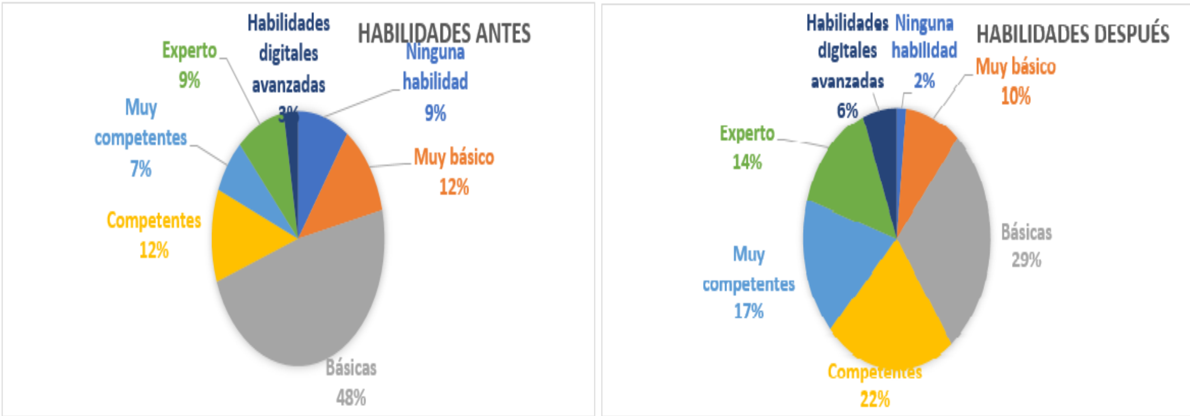
Note. Survey results from before and after the student training.

When applying Student's t-test to paired samples, we observe that the p-value is less than 0.05; therefore, the null hypothesis is rejected. They are not the same, and therefore there are differences between the pre- and post-training measures; however, since these are dichotomous qualitative variables, they are not normally distributed, so the Wilcoxon test is used. The number of respondents with no digital skills decreased from 9% to 2%, meaning it dropped from 18 to 3 people, with 15 respondents showing an improvement in their skills. With regard to skills rated on the Likert scale (competent, very competent, expert, and advanced), a 30% increase was observed among all respondents, bringing the total number of people in these categories to 56. The "highly competent" and "expert" options each increased by 10%. In addition, the skills gap was reduced by 28%, with a 19% decrease in basic skills—from 90 to 54 respondents—meaning that 46 students progressed beyond basic skills.

What do these variations mean? And what are the tasks that the Dayuma Kento Educational Unit should focus on? The results obtained using the nonparametric Wilcoxon test and Student's t-test confirm significant differences in the respondents' digital skills before and after formal training, reflecting a positive and measurable impact. The 14% increase in the number of people with digital skills (from 62% to 76%) highlights the program's success, resulting in 27 additional cases of individuals with basic skills. In addition, the percentage of respondents without digital skills dropped sharply from 9% to 2%, representing an improvement for fifteen people. This progress is complemented by a notable 30% increase in the higher skill levels (competent, very competent, expert, and advanced), with the "very competent" and "expert" levels each rising by 10%. The 19% decline in basic skills (46 students advanced) indicates progress toward more advanced competencies, confirming the effectiveness of training as a transformative tool in the development of digital skills.

Figure 9

Survey administered to students before and after

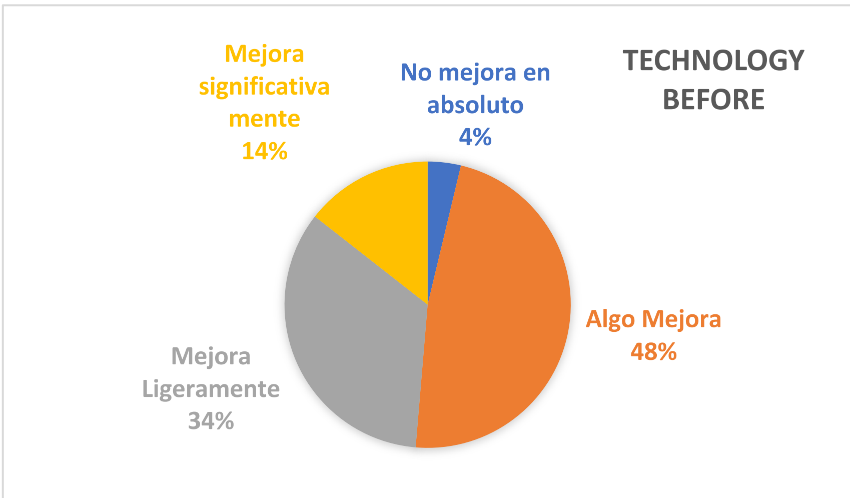


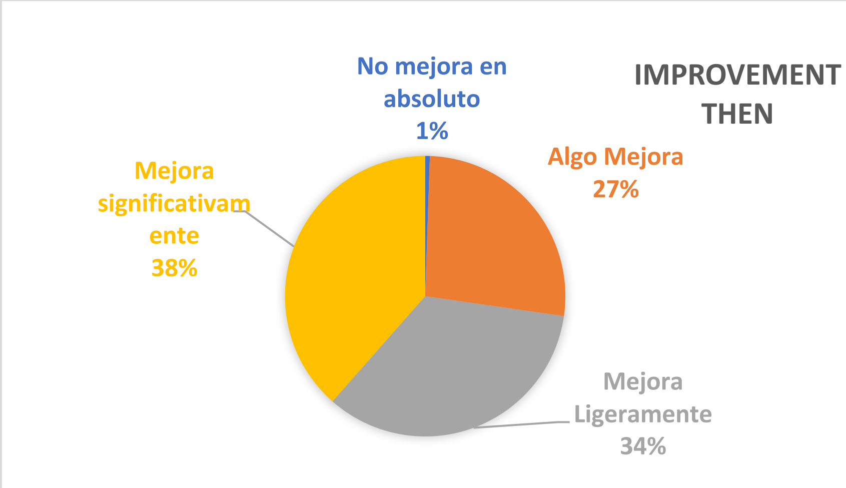
Note. Figure 9 shows how students' skills improve during the learning process following the training.

In terms of technology use, the "no improvement at all" option decreased from 7 to 1 respondent, representing a 3% decline. Although the percentage of respondents who chose the "some improvement" option remains high, it fell from 48% to 27%. There were no significant changes in the "slightly improved" option, but the most significant option, "significantly improved," saw a notable increase, rising from 27 to 72 respondents, representing a 24% improvement in classroom learning, up from 14% to 38%.

Figure 10

Technology enhances the learning experience both before and after training





Note. Figure 10 shows how technology enhances the learning experience after training.

Finally, a summary of the variables analyzed for both the teacher and student surveys is presented, as shown in Table 1. The results of the surveys conducted among teachers. The results show that, following the survey, teachers' perceptions and attitudes toward the importance of technology in the classroom have changed for the better.

A summary of the results from the student surveys is also presented, showing a notable improvement in perceptions after the survey. However, there remains some doubt or mistrust among students regarding technology, as they often associate it with greater control and an increased academic workload, among other factors.

Table 3

Summary of Descriptive Statistics from the Faculty and Student Surveys

	Teachers		Students	
Variables Analyzed	**Before**	**Afterward**	**Before**	**Afterward**
Percentage of teachers who have received training in the effective use of technology.	21%	70%	62%	76%
Percentage of teachers who believe that technology significantly improves learning	30%	95%	48%	27%
Percentage of teachers who have received formal training in digital skills	30%	67%		

Note. Table 3 presents a summary of the descriptive statistics from the faculty and student surveys.

With regard to digital skills training, the percentage of teachers who received formal training rose from 30% to 67%, reflecting an improvement in teachers' technological proficiency. These results highlight the positive impact of training on both skill development and changing attitudes toward the use of technology in education, establishing it as a key tool for improving the learning experience.

Finally, all the technology and equipment installed and used at the Dayuma Kento Educational Unit led to the school's participation in the 18th Binational Science and

Technology Fair held in Peru, where it delivered a brilliant presentation with a project titled: Augmented reality robotic arm, which won second place, as shown in the following link: https://educacion.gob.ec/estudiantes-de-orellana-triunfan-en-concurso-estudiantil-de-indole-internacional/.

Discussions and Conclusions

The integration of digital technologies into education is a crucial issue in today's world, where the digital transformation is redefining teaching and learning methods. In this discussion, four key aspects were analyzed: equipment, infrastructure, connectivity, and pedagogy, all of which are essential to ensuring an educational environment that maximizes the use of ICT and minimizes the digital divide.

Formal training in digital skills has been highly effective, as evidenced by a 49% increase in the number of teachers trained and a significant improvement in their skills. In addition, continuing education has sparked growing interest, with 65% more teachers interested in receiving additional training. In addition, the modernization of the technological infrastructure—including improved connectivity and the retrofitting of classrooms with advanced technologies—has significantly enhanced the educational experience. This is reflected in teachers' positive perception of the impact of technology on student learning.

The implementation of the methodology to bridge the digital divide at the Dayuma Kento Educational Unit has shown that adequate provision of technological equipment, improved connectivity, and training for both students and teachers are essential to promoting more equitable access to educational resources. This has not only made technology more accessible, but has also significantly improved the quality of the teaching and learning process, as evidenced by the increased participation and interest of the educational community in continuing to strengthen its technological skills.

The results underscore the importance of a comprehensive approach that addresses both technical and pedagogical aspects in order to bridge the digital divide. The combination of adequate infrastructure, improved connectivity, and teaching strategies focused on the integration of ICT has enabled technology to become an effective tool for learning, thereby reducing educational inequalities and opening up new opportunities for academic development in communities with limited access to technology.

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