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Apoyos pedagógicos e implementación de tecnología en el aula: percepciones de docentes y directores costarricenses

Pedagogical support and technology implementation in the classroom: perceptions of Costa Rican teachers and principals

José Antonio García-Martínez [1], Esther Vanessa Soto-Delgado [1]

RESUMEN

Introducción: Este estudio analiza la incorporación de las tecnologías digitales para el aprendizaje en centros educativos públicos de Costa Rica, a partir de las percepciones de docentes y personas directoras, considerando tanto los apoyos pedagógicos disponibles como su implementación en el aula.
Metodología: Se llevó a cabo desde un enfoque cuantitativo con diseño ex post facto y transversal. Se aplicó un instrumento en línea a 951 participantes, a través de un muestreo no probabilístico, mediante un cuestionario estructurado en torno a las variables de apoyo y recursos pedagógicos e implementación en el aula.
Resultados: Los resultados muestran una valoración positiva del uso de tecnologías digitales, destacando la búsqueda y creación de recursos como prácticas frecuentes. Sin embargo, se identifican debilidades en el uso de recursos educativos abiertos y en la detección de plagio digital. Además, las personas docentes presentan una percepción más favorable que las personas directoras, con diferencias estadísticamente significativas en ambas escalas.
Conclusiones: Se concluye que, aunque existe una apropiación creciente de las TIC en contextos educativos, persisten desafíos relacionados con su integración crítica, la colaboración interdisciplinaria y el uso ético.

Palabras clave: Integración de las TIC, prácticas pedagógicas, liderazgo educativo, innovación educativa, desarrollo profesional del profesorado.

Clasificación JEL: H51; I2; I210

ABSTRACT

Introduction: This study examines the integration of digital technologies for learning in public schools in Costa Rica, based on the perceptions of teachers and school leaders, considering both the pedagogical support available and its implementation in the classroom.
Methodology: Conducted with a quantitative, ex post facto, cross-sectional design, an online instrument was administered to 951 participants through a non-probabilistic sampling method. The structured questionnaire focused on two key dimensions: pedagogical support and resources, and classroom implementation.
Results: Findings reveal a generally positive appraisal of digital technology use, with resource searching and creation highlighted as frequent practices. However, weaknesses were identified in the use of open educational resources and in digital plagiarism detection. Furthermore, teachers held more favorable perceptions than school leaders, with statistically significant differences observed in both dimensions.
Conclusions: In conclusion, although there is a growing appropriation of ICT in educational settings, challenges remain regarding critical integration, interdisciplinary collaboration, and ethical use.

Keywords: ICT integration, pedagogical practices, educational leadership, educational innovation, teacher professional development.

JEL Classification: H51; I2; I210

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[1]Universidad Nacional. Heredia, Costa Rica.

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INTRODUCTION

The incorporation of technology permeates virtually every aspect of daily life, influencing the ways in which people learn, communicate, stay informed, seek entertainment, and build connections, among other activities (Gay Querol Leiva, 2025). Consequently, within the current educational landscape, the integration of technology should not be viewed merely

as an innovation confined to specific areas, but rather as a cross-cutting theme spanning the entire educational process. It facilitates access to up-to-date content, fosters critical thinking, promotes collaboration, and enables the personalization of instruction, while also serving to democratize education (García-Martínez et al., 2023; Blanco-López et al., 2021).

According to UNESCO (2021), the rapid changes resulting from technological integration do not always translate into greater equity, inclusion, or democratic participation for societies. Costa Rica is not exempt from this reality; indeed, according to the *Ninth Report on the State of Education* (Programa Estado de la Nación, 2023), significant challenges persist in this domain, hindering the establishment of a foundation for an interconnected society. Prominent among the objectives yet to be achieved are ensuring efficient technological infrastructure within educational institutions, equipping teaching staff with the requisite competencies, and effectively leveraging ICTs within pedagogical processes.

Based on the evidence gathered, this study aims to highlight the pivotal role of educational management in ensuring that the processes of ICT integration are executed with clear pedagogical and administrative intentionality. In this regard, prior research (Anderson & Dexter, 2022; Cerdas-Montano et al., 2022; Márquez Coronel, 2024; Soto-Delgado & García-Martínez, 2024) indicates that the pedagogical leadership practices of school administrators not only facilitate the incorporation of ICTs into schools but also exert a profound influence on processes of technological and organizational transformation.

At the international level, Wohlfart & Wagner (2022) conducted a study analyzing the implementation of the SELFIE self-assessment tool (Self-reflection on effective learning by fostering the use of innovative educational technologies) within the German educational context. The participants found the SELFIE tool to be useful, demonstrating the openness and acceptance necessary for honest and critical feedback. The anonymity of the instrument was a significant factor in eliciting sincere opinions. Nevertheless, the study concluded that those involved would not adopt SELFIE as a permanent tool, as it focuses on digital competencies while overlooking other relevant areas of institutional development.

In 2023, Schmitz et al. administered a survey to 2 247 secondary education teachers in Switzerland with the aim of determining the impact of transformational leadership practices—specifically those of principals who support teachers in their use of ICTs. This study concluded that transformational leadership had a positive and significant impact on digital infrastructure and on teachers' positive beliefs regarding technology use, as well as on their technical skills and their competence in teaching their students with the aid of ICTs. These authors emphasize that school leadership is a crucial element for the integration of technology in the classroom.

Rafya et al. (2024) conducted a meta-analysis to determine the impact of technology integration on teacher preparation; furthermore, they sought to analyze teachers' perceptions regarding existing barriers to the effective use of ICTs in the classroom. The study incorporated a literature review of 13 studies from six countries that met the inclusion criteria established by the authors. The study determined that teacher training programs must address both personal and contextual barriers, as a lack of initial and ongoing training emerged as a recurring theme across the reviewed research. Finally, the authors highlighted the importance of utilizing assessments that accurately measure teachers' technological skills in order to provide training strategies tailored to their specific needs.

For their part, Zhang & Chen (2025) conducted a study in China to identify the leadership strategies required to enhance ICT-mediated pedagogical practices in higher education institutions. The findings pointed to the influence of personal factors—such as a willingness to innovate and intrinsic motivation—as well as external factors, most notably access to technological resources, professional development opportunities, the presence of a collaborative culture, and funding to support these processes. These authors underscored the efficacy of "technologically intentional" leadership, emphasizing the importance of personalized approaches that address both personal and institutional barriers.

Within the Costa Rican context, Valverde Hernández & Paniagua-Esquivel (2021) highlight significant disparities regarding the access to and availability of digital technologies within public educational institutions. Broadly speaking, observations indicate that only a subset of these institutions possesses computer labs or specialized libraries, while approximately three-quarters have some form of internet connection. However, a substantial proportion of these centers operate with severely limited network speeds; specifically, about one-third fall within low bandwidth ranges, whereas smaller percentages achieve medium or higher speeds. These inequalities are evident not only in technological infrastructure but also across educational regions, where certain zones exhibit considerably lower levels of access and equipment—a stark contrast to the regional directorates in the country's central areas, which

tend to demonstrate more favorable conditions. Taken together, this landscape reveals structural gaps that directly impact opportunities for the pedagogical integration of ICTs and continue to pose a significant challenge for the national educational system.

The Programa Estado de la Nación (2023) concluded that, while the country has made strides in terms of technological coverage and connectivity, significant gaps persist between rural and urban contexts, as well as substantial inequalities among the country's economic regions and household income quintiles. Furthermore, the report highlights that the social and cultural capital of Costa Rican families significantly influences the manner in which students interact with and utilize technology.

Separately, since 2018, the Paniamor Foundation—in coordination with the Instituto de Investigaciones Psicológicas de la Universidad de Costa Rica—has been conducting systematic assessments to understand how minors interact with technology. To gather data, researchers visited over 1,000 households selected by the Instituto Nacional de Estadística y Censos (INEC). Among the most salient findings from the latest study (2023) is the increasingly early use of electronic devices by children and adolescents within educational institutions, notwithstanding the restrictions maintained by many schools and colleges. Moreover, the primary uses of these devices are oriented toward entertainment, learning, and communication. Finally, the study notes limited usage for pedagogical purposes, as well as limited guidance from teachers regarding Internet usage (Pérez Sánchez, 2024).

Despite this context, empirical studies in Costa Rica addressing the pedagogical integration of ICTs from the perspective of teachers and school principals remain scarce. The available evidence tends to focus on variables such as access, infrastructure, or connectivity, thereby relegating to the background the analysis of pedagogical practices and the institutional support that conditions their implementation in the classroom. In this regard, a significant research gap has been identified, stemming from a lack of comparative data that effectively links school leadership, pedagogical resources, and the effective use of technology within public educational institutions.

Integration of ICT in education

According to Wang (2022), the incorporation of ICTs into education has transformed over the last decade, bringing about changes in various aspects. In terms of content, there has been a shift from an approach centered on the transmission of information toward a curriculum oriented toward competence development—one in which critical thinking, problem-solving, and information literacy play a central role. Regarding methods, the focus has shifted from the teacher to the student, fostering autonomous learning through digital resources that replace traditional practices. With respect to time, ICTs enable asynchronous access to classes and materials, thereby introducing flexibility into study paces. Finally, in terms of space, learning is no longer exclusively dependent on the physical classroom; instead, it can take place from anywhere, thanks to connectivity and virtual environments.

According to Zou (2025), digital learning entails not merely replacing traditional methods but rather enriching instruction by making it more engaging, accessible, and personalized. In this regard, technological integration supports innovative practices such as the flipped classroom, blended learning, and learning environments enhanced by digital platforms, artificial intelligence, and augmented reality—practices that have demonstrated improvements in student engagement and academic outcomes. Furthermore, technological integration holds the potential to foster more collaborative and inclusive teaching practices (Batista Pérez & Gallur Santorum, 2025).

For their part, Bharti et al. (2024) examined the role of ICTs within educational systems, focusing specifically on their impact on teachers and students. Their findings describe the incorporation of ICTs across three primary dimensions. First, the use of technologies—such as interactive whiteboards, educational software, and multimedia presentations—renders the learning process more dynamic and participatory, moving away from passive rote memorization; this shift, in turn, has led to improved student participation and engagement. Second, the routine use of ICTs within the educational dynamic was associated with improved academic performance in science, mathematics, and languages, as these tools facilitate the comprehension of complex concepts. Thirdly, tools such as forums, videoconferencing, and instant messaging enhance interaction among students. Furthermore, platforms like Google Docs enable real-time collaborative work.

Nevertheless, these authors underscore the importance of ensuring that the integration of ICT is carried out in a planned and intentional manner, aligned with the objectives established by the educational institution. Moreover, they highlight challenges such as distractions caused by the use of electronic devices during the school day, unequal access to technology, and the need for teacher training (Bharti et al., 2024).

Evaluation of technological integration and school leadership

This study utilizes SELFIE, a free tool developed by the Comisión Europea (2018), as a foundation for exploring the perceptions of teachers and school leaders regarding how primary, secondary, and vocational education institutions integrate technology into their educational practices. This customizable self-reflection tool anonymously gathers the perceptions of teaching staff and school leadership concerning the incorporation of ICTs within their educational institutions.

Among the areas evaluated is the "pedagogical support and resources" dimension, which explores the creation of digital content, the search for online educational resources, the use of virtual learning environments, the use of ICTs for school-related communication, and the utility of technological tools for teaching (Comisión Europea, 2018). According to Anderson & Dexter (2000), successful technological integration in educational institutions is typically characterized by intentional leadership that prioritizes continuous learning—a context in which the leader's role is not limited solely to setting goals and coordinating activities, but also actively promotes the acquisition of competencies and skills among the staff themselves. Furthermore, leaders who successfully implement ICT usage in their institutions often foster distributed leadership, wherein the entire educational community applies its competencies toward the goal of student improvement (Márquez Coronel, 2024). In this regard, a taxonomy has been developed that summarizes the key leadership roles within the realm of educational technology (Anderson & Dexter, 2000). This framework highlights the leader's role in managing the acquisition of technological infrastructure; planning and executing budgets for the purchase and maintenance of ICTs; utilizing digital communication channels to engage with the educational community; adapting technological tools to meet the needs of diverse groups; and providing opportunities for media literacy, among other responsibilities.

In light of the foregoing, the following research question arises: How do school principals and teachers perceive the pedagogical support, available resources, and implementation of digital technologies in the classroom within their educational institutions? In this regard, the general objective is to analyze the incorporation of digital technologies for learning in educational institutions from the perspective of principals and teachers, taking into account the available support and pedagogical resources, as well as the implementation of these technologies in the classroom. Specifically, the aim is to:

1. Identify the preparation, support, and availability of pedagogical resources offered to teachers and principals regarding the use of digital technologies in learning.
2. Examine the implementation of digital technologies in the classroom to foster innovation in pedagogical practices.
3. Detect significant differences between the perceptions of teachers and principals regarding the scales for support and resources, as well as the classroom implementation of digital technologies.

METHODOLOGY

The research was framed within a quantitative approach, employing a non-experimental design, as no control or manipulation was exercised over the observed variables. Data collection was conducted at a single point in time; thus, it is characterized as a cross-sectional study (Hernández & Mendoza, 2018). Furthermore, a descriptive scope was utilized.

Population and Sample

The study population consisted of teachers and principals from public educational institutions in Costa Rica. The non-probabilistic convenience sample comprised a total of 951 participants: 237 (24,9 %) principals and 714 (75,1 %) teachers.

The inclusion criteria applied were: a) currently serving as a teacher or in a leadership position at a public educational institution in Costa Rica at the time of data collection; b) possessing at least one year of work experience at their current educational institution; c) being a registered member of the Colegio de Licenciados y Profesores en Letras, Filosofía, Ciencias y Artes (Colypro); d) having completed at least 75 % of the data collection instrument; and e) having voluntarily provided informed consent. Conversely, individuals working in private institutions were excluded, as were incomplete questionnaires that failed to meet the defined minimum response rate or that lacked explicit acceptance of the informed consent.

Regarding gender distribution, 78,9 % of the participants were women and 21,1 % were men. The average age

was 45,3 years (SD = 8,77), with a range of 21 to 65 years. With respect to work experience, the overall average was 16,2 years (SD = 8,31), while the average tenure at the current educational institution was 8,65 years (SD = 7,14).

Information collection instrument

For data collection, the survey technique was employed (Bisquerra Alzina, 2014). Specifically, an online questionnaire consisting of several thematic blocks and closed-ended questions was used as the instrument. The first of these blocks included sociodemographic questions. Next, a series of items related to professional training in the use of technology was incorporated. Finally, various scales from the SELFIE instrument, developed by the Comisión Europea (2018), were integrated. This instrument was validated within the framework of the DigCompOrg model and initially applied in educational institutions across 14 European countries (Kampylis et al., 2019). Various studies—such as that by Fernández Miravete & Prendes Espinosa (2022)—attest to its utility for reflecting on the integration of digital technologies in school environments.

Although the questionnaire contained several scales, this article focuses on the results from the scales (Table 1) titled "Pedagogy: Support and Resources" (5 items) and "Pedagogy: Classroom Implementation" (7 items). Both utilized a five-point Likert-type format, with options ranging from 1 (strongly disagree) to 5 (strongly agree). Regarding the validation of the instrument, it underwent review by six specialists in pedagogy, research, and educational management, which allowed for the adaptation of the items to the Costa Rican context. Subsequently, a pilot test was conducted with a group of fifteen participants whose characteristics matched the profile of the target population. The final version of the questionnaire was distributed over a three-month period using the LimeSurvey® platform. For its dissemination, the project benefited from the collaboration of Colypro, which supported the process through email distribution and social media posts.

To ensure the reliability of the instrument, Cronbach's alpha coefficients were calculated for the scales administered. The obtained values (table 1) were 0,823 for the Support and Resources scale and 0,921 for the Classroom Implementation scale, exceeding the threshold of 0,70, which indicates adequate internal consistency.

Table 1.
Variables, conceptualization, number of items, and reliability coefficient

Scales	Conceptual definition	Items	Cronbach's Alpha
Pedagogy: support and resources	"Preparation for the use of digital technologies for learning through the updating and innovation of teaching and learning practices." (Comisión Europea; 2018, p. 11)	5	,823
Pedagogy: classroom implementation	"This area relates to the implementation of digital technologies for learning in the classroom, through the updating and innovation of teaching and learning practices." (Comisión Europea; 2018, p. 12)	7	,921

Procedure and ethical considerations

Data analysis was conducted using the statistical software SPSS®. Descriptive statistical techniques were applied to obtain absolute and relative frequencies, as well as measures of central tendency (mean, median, mode) and dispersion (standard deviation, variance). Reliability coefficients were also calculated, and comparisons of means were performed using Student's t-test.

Throughout the entire research process, fundamental ethical principles were upheld. From the design phase through the drafting of the results, measures aimed at protecting the participants were implemented. Participants were provided with clear information regarding the study's objectives, data confidentiality, and the voluntary nature of their participation—a process that entailed obtaining their informed consent.

RESULTS and DISCUSSION

Support and availability of pedagogical resources

Regarding the support for and availability of pedagogical resources oriented toward the use of digital technologies (table 2), it is observed that the item with the highest mean score was: "Our teaching staff effectively searches for digital educational resources via the internet." Teachers demonstrated a high level of agreement (X = 4,24; SD = 0,93), while principals also rated this aspect positively, albeit with a lower mean score (X = 3,92; SD = 0,95). This

discrepancy may stem from the fact that the teaching staff perceives a higher level of established competence regarding the autonomous search for digital resources—possibly due to their direct contact with classroom needs.

Another item with a high mean score is: "Our teaching staff creates digital resources to enhance their instructional work"; however, this item reveals a more pronounced gap between teachers (X = 3,90; SD = 1,03) and principals (X = 3,51; SD = 0,97). This difference reflects a less favorable perception on the part of the administrative staff regarding the teaching staff's capability—or actual practice—in terms of creating their own digital content.

With respect to the use of virtual learning environments, both groups yielded moderate mean scores; nevertheless, a slight difference is once again evident, with teachers obtaining a mean score of 3,63 (SD = 1,11) and the administrative staff a mean of 3,48 (SD = 1,16). Furthermore, a greater degree of data dispersion is observed, suggesting a more heterogeneous level of implementation across educational institutions.

Regarding the use of digital technologies for institutional communication (e.g., WhatsApp, Telegram, blogs, among others), high scores were observed in both groups, with a mean of 4,10 (SD = 1,00) among teachers and 4,05 (SD = 0,80) among principals. These results indicate widespread use of digital tools for internal and external communication, emerging as a standard practice within the institutions.

Finally, the item with the lowest mean in both populations was: "Teachers use open educational resources (OER)." Although teachers achieved a mean of 3,58 (SD = 1,27), principals reported a considerably lower perception (X = 3,16; SD = 1,19). This discrepancy—coupled with the high standard deviation—suggests both lower usage and significant variability in the adoption of OER; this could be attributed to a lack of awareness, a lack of specific training, or institutional barriers to their implementation.

Table 2.
Statistics for the support and resources scale

Items	Role	1	2	3	4	5	X	DE
Our teaching staff effectively searches for digital educational resources via the internet.	Doc	2,8	1,7	12,3	35,0	47,9	4,24	0,93
	Dir	2,2	1,3	32,9	29,8	33,8	3,92	0,95
Our teaching staff creates digital resources to enhance their teaching practice.	Doc	2,9	6,0	23,5	32,9	34,3	3,90	1,03
	Dir	2,2	12,0	35,1	34,2	16,4	3,51	0,97
The school's teaching staff utilizes virtual learning environments with students.	Doc	5,5	8,1	30,3	29,7	26,2	3,63	1,11
	Dir	11,1	5,3	23,6	44,0	16,0	3,48	1,16
The teaching staff uses digital technologies for communication related to the school (WhatsApp, Telegram, Facebook, blogs, etc.).	Doc	3,5	2,8	16,1	35,6	41,7	4,10	1,00
	Dir	1,3	2,2	14,7	53,1	28,6	4,05	0,80
The teaching staff utilizes Open Educational Resources (public domain, under an open license, or free of charge).	Doc	9,0	11,2	23,5	25,5	30,5	3,58	1,27
	Dir	11,6	15,2	32,6	26,8	13,8	3,16	1,19

Note: Doc = Teachers; Dir = Principals; 1 = Strongly disagree; 2 = Disagree; 3 = Slightly agree; 4 = Agree; 5 = Strongly agree; X = Mean; and SD = Standard deviation.

The results obtained (table 2) are generally positive, although they warrant analysis from the perspectives of educational policy, school leadership, and teacher training. First, the high rating assigned to teachers' competence in seeking out digital resources demonstrates a solid command of these resources—a finding consistent with what Zou (2025) and Wang (2022) describe as a transformation of the teaching role into that of a facilitator capable of curating and adapting content within digital environments. This capacity for resource-seeking can also be interpreted as a form of professional autonomy, developed in direct response to classroom demands—particularly in contexts where institutional infrastructure or administrative leadership fail to provide clear guidance on the matter. The gap observed between different professional groups suggests that, while teachers perceive themselves as competent in this task, school principals may be less aware of these practices—possibly due to a disconnect between school administration and daily pedagogical practice. This reinforces the need for distributed leadership models, as highlighted by Anderson & Dexter (2000).

Regarding the creation of digital resources by teaching staff, a disconnect is evident between the recognition of teachers' efforts and the institutional perception of pedagogical innovation. The fact that this practice is valued more highly by the teaching staff than by the administrative team may be interpreted as a sign that innovation processes are not always made visible or supported by school management. In this regard, the literature serves as

a cautionary note, indicating that transformational leadership has a direct impact on teachers' capacity to innovate using technology (Schmitz et al., 2023). This discrepancy in perception may point to internal communication issues, as well as serving as a barrier to the development of an organizational culture within the educational setting that values and promotes innovative teaching practices involving the integration of technology.

Regarding the use of virtual environments, the results suggest an uneven implementation, reflecting structural differences among educational institutions—differences that have already been evidenced and that highlight gaps in access to infrastructure, connectivity, and training across various regions of the country (Programa Estado de la Nación, 2023; Valverde Hernández & Paniagua-Esquivel, 2021). Although a moderate level of adoption is evident, the dispersion observed in the responses could point to a problem regarding the pedagogical integration of these tools; this aligns with the findings of Rafya et al. (2024), who note that a lack of training and contextualized support constitute persistent barriers to the effective use of ICTs.

Conversely, the evident use of digital tools for institutional communication demonstrates an effective leveraging of easily accessible and low-cost technologies, such as messaging applications. This finding aligns with the observations of Bharti et al. (2024) regarding the potential of ICTs to foster communication and collaboration; however, it also raises questions concerning the pedagogical application of such integration—specifically, while these practices undoubtedly strengthen communication, they do not necessarily entail a transformation of the teaching-learning process itself.

Finally, the use of OERs (Open Educational Resources) exhibits the most pronounced limitations, both in terms of usage levels and the consistency of their implementation. This could be attributed to factors such as a lack of awareness regarding their existence, an absence of institutional policies promoting their integration, or insufficient specific training in technological competencies (Wang, 2022). Furthermore, the low scores and high data dispersion may reflect the absence of an effective institutional digital strategy—a situation that calls into question the leadership's capacity to guide pedagogical processes mediated by ICTs, as underscored by the Comisión Europea (2018).

Implementation of digital technologies in the classroom

Table 3 shows that the results reflect a positive perception regarding the pedagogical use of digital technologies, albeit with significant variations depending on the type of practice, as well as differences between the roles of teachers and principals. The item with the highest mean among teachers was: "Our teaching staff uses digital technologies to adapt their teaching methods to the individual needs of the students" (X = 3,86; SD = 1,04), followed by the statement: "Our teaching staff uses digital technologies to foster student creativity" (X = 3,82; SD = 1,03). These results indicate that teachers acknowledge an active use of digital technologies to personalize instruction and promote creative thinking. In contrast, principals reported lower means for these two items (X = 3,55; SD = 1,07 and X = 3,58; SD = 0,93, respectively), reflecting a perceptual difference between those who execute pedagogical practices and those who supervise them.

Another aspect rated highly by both groups is the use of technologies for assessment purposes. This item presents a mean of 3,62 (SD = 1,21) for teaching staff and 3,54 (SD = 1,05) for principals, suggesting a general acceptance of digital tools in the processes of assessing learning. In contrast, the item with the lowest mean across both populations is: "Our teaching staff uses digital technologies to identify potential cases of student plagiarism," with an identical average of 2,86 for both teachers (SD = 1,39) and principals (SD = 1,18). This low score could be linked to a limited implementation of specific plagiarism detection tools or to insufficient teacher training in this area, despite the growing importance of the topic.

Relatively low scores are also observed for the item "Our teaching staff encourages student participation in interdisciplinary projects using digital technologies," with a mean of 3,33 (SD = 1,25) among teachers and 3,17 (SD = 1,21) among principals. This could reflect institutional or curricular challenges regarding the development of technology-supported interdisciplinary initiatives, as well as limitations in time or resources.

Finally, regarding collaboration among students using digital technologies, although the mean scores fall within the mid-range, teachers rate this slightly higher (X = 3,67; SD = 1,11) compared to principals (X = 3,49; SD = 1,11). This pattern recurs across almost all items, reinforcing the notion of a more positive perception among teachers, who are directly involved in classroom implementation.

Table 3.
Statistics for the classroom implementation scale

Items	Role	1	2	3	4	5	X	DE
Our faculty uses digital technologies to adapt their teaching methods to the individual needs of students.	Doc	3,9	5,0	24,2	34,6	31,8	3,86	1,04
	Dir	2,7	15,6	27,2	33,0	21,4	3,55	1,07
Our faculty uses digital technologies to foster student creativity.	Doc	3,5	5,6	26,2	34,6	29,7	3,82	1,03
	Dir	1,8	8,5	37,1	34,8	17,9	3,58	0,93
Our faculty conducts digital learning activities that motivate students.	Doc	4,8	5,5	27,2	34,5	27,7	3,75	1,06
	Dir	8,5	8,5	22,8	41,1	19,2	3,54	1,14
Our faculty uses digital technologies to facilitate collaboration among students.	Doc	5,2	8,5	26,6	32,9	26,3	3,67	1,11
	Dir	9,4	3,1	34,8	34,8	17,9	3,49	1,11
Our faculty encourages student participation in interdisciplinary projects using digital technologies.	Doc	10,4	14,4	28,2	24,8	21,8	3,33	1,25
	Dir	10,3	22,3	20,1	34,4	12,9	3,17	1,21
Our faculty uses digital technologies to identify potential cases of student plagiarism.	Doc	22,7	20,4	20,9	19,6	16,0	2,86	1,39
	Dir	16,5	20,5	31,3	23,7	8,0	2,86	1,18
Our faculty uses digital technologies for assessment purposes.	Doc	7,4	10,4	23,4	29,4	28,9	3,62	1,21
	Dir	4,6	11,2	26,8	39,7	17,4	3,54	1,05

Note: 1 = Strongly disagree; 2 = Disagree; 3 = Slightly agree; 4 = Agree; 5 = Strongly agree; X = Mean; SD = Standard deviation.

In light of the results obtained regarding the second objective of the study (table 3), a generally positive assessment is observed among the teaching staff, albeit with certain divergences when compared to the administrative staff.

The high scores teachers assigned to the use of technology—specifically for adapting instruction to individual needs and fostering student creativity—demonstrate an adoption of ICTs that aligns with the views of Wang (2022). This alignment stems from the fact that these technologies facilitate a shift from homogeneous instructional models toward personalized approaches focused on the development of complex competencies. This teaching practice also resonates with the arguments put forth by Zou (2025), who notes that ICTs do not merely replace traditional methods; rather, they enrich and diversify the educational experience by rendering it more meaningful and engaging.

The disparity between the perceptions of these two groups regarding these specific items can be interpreted through the lens of Anderson & Dexter (2000). These authors suggest that effective pedagogical leadership—particularly in the context of technology integration—requires an understanding and appreciation of what actually transpires within the classroom; this requires a perspective grounded not solely in planning logistics, but in a close examination of the contextual dynamics inherent to the teaching-learning process. Furthermore, these discrepancies underscore the need to strengthen communication and feedback channels between school administration and the teaching faculty—a point emphasized by Schmitz et al. (2023), who highlight the value of transformational leadership as a bridge connecting institutional strategy with classroom-level teaching practices.

In addition to the foregoing, the use of technology for assessment purposes received a moderately high rating. This suggests that the teaching staff is beginning to incorporate digital resources not only into their instructional delivery but also into their methods for evaluating student learning—a trend consistent with the methodological shifts highlighted by Bharti et al. (2024). However, the low rating assigned to the use of technology for plagiarism detection points to a significant area requiring improvement. This finding may be linked to the observations made by Rafya et al. (2024) regarding the need to address personal and contextual barriers, as well as the lack of specific training in the use of plagiarism detection tools or the absence of clear institutional policies on academic integrity in digital environments.

Along these lines, the low score obtained regarding ICT-mediated interdisciplinary projects is likely due to curricular rigidity or logistical limitations, as previously noted in the Ninth Report on the State of Education (Programa Estado de la Nación, 2023). Although ICTs have the potential to expand the scope of—and time available for—learning, their use remains confined to traditional dynamics (Batista Pérez & Gallur Santorum, 2025). This disconnect may also stem from a school culture that does not yet sufficiently promote teacher collaboration in the design of integrated learning experiences. This endeavor requires leadership capable of fostering pedagogical innovation and the flexible restructuring of organizational frameworks (Anderson & Dexter, 2022).

Finally, the moderate yet favorable perception regarding the promotion of student collaboration through digital

technologies indicates that, while progress has been made in the use of interactive and collaborative tools, there remains ample room to strengthen more active and constructivist practices—a finding consistent with the arguments put forth by Bharti et al. (2024) regarding the development of communication and teamwork skills.

Differences between the perceptions of teachers and principals

To gain deeper insight into the perceptions held by different groups regarding the use of digital technologies in the pedagogical process, a mean comparison analysis was conducted using an independent-samples Student's t-test (table 4), with the aim of identifying significant differences across two scales employed in the study. Additionally, the magnitude of the effect was estimated using Cohen's d statistic, in order to assess the practical relevance of the differences found beyond their statistical significance. In the "Pedagogy: support and resources" scale, the results show a statistically significant difference between both groups (t (934)= 4,274; p<,001).

Specifically, teachers have a higher mean (X=19,44; SD = 4,13) than principals (X=18,11; SD = 3,87), indicating that the former perceive the existence of conditions, support, and digital materials to support their teaching work more favorably. The effect size (0,33) obtained for this scale falls within the small-to-moderate range; consequently, its practical impact should be interpreted as moderate within the context of institutional perceptions.

Regarding the scale "Pedagogy: implementation in the classroom", a significant difference was also identified between the two groups (t (932) = 4,135; p < ,001). Similarly, teachers obtained a higher mean X = 24,92 (SD = 6,64), while principals reported a mean of 23,73 (SD = 6,66). In this instance, the effect size is small (0,18), suggesting that—while the difference is statistically significant—the perceptions of teachers and principals regarding the implementation of digital technologies in the classroom may hold limited practical relevance.

Table 4.
Results of Student's t-test for mean comparison, by role

Scales	Group Statistics			t-test for equality of means			Cohen's d
	Role	X	SD	t	gl	Sig. (bilateral)	
Pedagogy: support and resources	Dir	18,11	3,87	4,274	934	,000	0,33
	Doc	19,44	4,13				
Pedagogy: implementation in the classroom	Dir	23,73	6,66	4,135	932	,000	0,18
	Doc	24,92	6,64				

The difference favoring teachers (X = 19,44) over principals (X = 18,11) suggests that the former perceive—with greater clarity and appreciation—the support, materials, and digital conditions that underpin their educational work. According to Anderson and Dexter (2000), this difference can be interpreted within the framework of the theory of educational microsystems, given that teachers—being immersed in direct practice—tend to value the resources available in their immediate context more explicitly. From an institutional perspective, this may also be attributed to the fact that administrators typically hold a more macro or strategic view, which hinders a detailed perception of the day-to-day use of technological resources in the classroom (Anderson & Dexter, 2022).

This finding also highlights the need to strengthen feedback mechanisms across organizational levels. As Schmitz et al. (2023) point out, fluid communication between those who lead and those who implement technology policies enables the alignment of expectations, the identification of actual needs, and the fostering of a culture of continuous improvement that is both more coherent and—above all—contextualized.

Regarding the "Pedagogy: Classroom Implementation" scale, although a statistically significant difference was also detected, it proves to be minor in practical terms. This suggests a fairly homogeneous perception between the two groups regarding the actual use of technologies in classroom activities. This alignment could be interpreted positively, as it demonstrates institutional coherence and a shared culture surrounding technology integration—a relevant aspect considering that effective implementation requires both strategic leadership and pedagogical execution (Zou, 2025). However, it must be noted that a convergence of perceptions does not always guarantee deep or transformative implementation, consistent with the arguments put forth by Wang (2022). In other words, consensus between these groups could reflect practices that are stable yet lacking in innovation; therefore, it would be necessary to investigate the quality and depth of ICT use in the classroom, moving beyond mere presence or frequency of use.

CONCLUSIONS

In conclusion regarding the first specific objective—aimed at identifying perceptions regarding available supports and resources—the results reflect a predominantly positive assessment on the part of the teaching staff. This group specifically highlights the availability of technological resources, digital materials, and institutional support—elements they consider crucial for facilitating their pedagogical work. Although the group of school principals also acknowledges these supports, their assessments are slightly lower. This finding underscores the importance of addressing differentiated perceptions based on the specific role played within the institution, as well as the need to strengthen communication mechanisms across organizational levels to fully leverage the potential offered by technological resources. These results may suggest deficiencies in the processes of observing pedagogical dynamics and providing classroom support—duties that school administrators are expected to perform as part of their official functions.

With respect to the second objective—focused on the implementation of digital technologies in the classroom—generally favorable perceptions are likewise observed, particularly regarding the personalization of learning and the fostering of student creativity. However, areas for improvement were also identified, such as the use of technology to detect academic plagiarism or to encourage interdisciplinary projects. These results suggest that, while there is an openness toward the pedagogical use of ICTs, barriers still persist that limit their more comprehensive and transformative implementation. Consequently, a strategy for continuous teacher professional development is required—one that addresses not only technical competencies but also the ethical and methodological aspects of using technology within complex educational contexts.

As for the third objective, the data reveal statistically significant differences across both of the scales analyzed. In the case of supports and resources, teachers demonstrate a more positive perception—a finding that may be explained by their direct proximity to day-to-day classroom dynamics. However, regarding the dimension related to classroom implementation, while the difference remains statistically significant, it is minimal; this suggests a fairly aligned perception between the two groups. This could indicate the existence of a shared institutional culture, although greater articulation between pedagogical planning and actual execution is still needed.

Regarding identified limitations, at the methodological level, the study was conducted exclusively using a quantitative approach. While this allows for obtaining a generalizable overview, it restricts an in-depth understanding of the experiences and meanings attributed by the participants. In this regard, future research could be approached using mixed methods to facilitate a deeper understanding of the phenomenon under study. Likewise, incorporating the student body's perspective would serve to triangulate the data.

Based on these findings, it is recommended that institutional dialogue spaces between teachers and administrators be strengthened; that continuous professional development programs focused on the innovative pedagogical use of ICTs be developed; and that educational policies fostering technology-mediated interdisciplinary collaboration be promoted. Furthermore, it is essential to invest in specific tools for addressing critical topics such as academic integrity and digital ethics.

Ultimately, the results of this research confirm that the integration of digital technologies into education is a growing reality, viewed positively by the school stakeholders who participated in this study. However, moving toward a more meaningful and transformative use of technology requires complementing available resources with pedagogical leadership, context-specific professional development, and a shared vision. This path is key to building schools that are more innovative, inclusive, and prepared to face the challenges of the 21st century.

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AUTHORSHIP CONTRIBUTION
Conceptualization: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Data curation: José Antonio García Martínez.
Formal analysis: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Funding acquisition: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Investigation: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Methodology: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Project administration: José Antonio García Martínez.
Supervision: José Antonio García Martínez.
Validation: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Writing – Original Draft: José Antonio García Martínez and Esther Vanessa Soto Delgado.
Writing – proofreading and editing: José Antonio García Martínez and Esther Vanessa Soto Delgado.