Recibido: Dic. 20, 2024 | Aceptado: May. 14, 2025 | Publicado: May. 22, 2025

Information and communication technologies to strengthen school coexistence in institutions of the Atlántico department, Colombia

Tecnologías de la información y la comunicación para el fortalecimiento de la convivencia escolar en instituciones del departamento del Atlántico, Colombia

DOI: https://doi.org/10.21803/ingecana.4.4.898

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Abstract

This research formulated a theoretical and empirical approach regarding the use of Information and Communication Technologies (ICT) in pedagogical practices to strengthen school coexistence in educational institutions of the Atlántico Department in Colombia. The study was based on theories such as constructivism, behav- iorism, cognitivism, and sociocultural theory. Conducted under an interpretative paradigm and phenomenological method, it employed observation and semi-structured interviews with three key informants, followed by coding, categorization, and triangulation. Four categories emerged: ICT usage, technological tools, teaching experiences, and emerging theoretical foundations. Findings showed that a strategic and ethical use of ICT fostered inclusive and harmonious school environments by reducing bullying, exclusion, and conflict through the development of social skills, empathy, and mutual respect. A complementary experimental design was conducted to corroborate the hypothesis, with ANOVA showing statistically significant differences in key coexistence variables.

Keywords: ICT, pedagogical practices, school coexistence, digital citizenship, experimental design

Resumen

Esta investigación formuló un planteamiento teórico y empírico sobre el uso de las Tecnologías de la Información y la Comunicación (TIC) en las prácticas pedagógicas para el fortalecimiento de la convivencia escolar en instituciones educativas del departamento del Atlántico en Colombia. El estudio se fundamentó en teorías como el constructivismo, el conductismo, el cognitivismo y la teoría sociocultural. Realizado bajo un paradigma interpretativo y método fenomenológico, empleó la observación y entrevistas semiestructuradas a tres informantes clave, seguidas de codificación, categorización y triangulación. Surgieron cuatro categorías: Uso de las TIC, herramientas tecnológicas, experiencias docentes y fundamentos teóricos emergentes. Los resultados mostraron que un uso estratégico y ético de las TIC fomentaba entornos escolares inclusivos y armoniosos al reducir el acoso, la exclusión y los conflictos mediante el desarrollo de habilidades sociales, la empatía y el respeto mutuo. Se realizó un diseño experimental complementario para corroborar la hipótesis, con ANOVA que mostró diferencias estadísticamente significativas en variables clave de convivencia.

Palabras Clave: *TIC, prácticas pedagógicas, convivencia escolar, ciudadanía digital, diseño experimental.*

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Cómo citar este artículo:
C. G. Sarmiento Domínguez, «Information and communication technologies to strengthen school coexistence in institutions of the Atlántico department, Colombia». Ingente Americana, vol. 4, n°4, e-898, 2024. DOI: https://doi.org/10.21803/ingecana.4.4.898

Introduction

The progressive incorporation of Information and Communication Technologies (ICT) into the educational landscape has significantly transformed the dynamics of teaching and learning [1]–[5]. This shift is not merely technological but also deeply pedagogical and social, as it influences the way knowledge is constructed, communicated, and shared. In the specific context of the Atlántico Department in Colombia—a region characterized by a rich tapestry of cultural, social, and ethnic diversity—the strategic use of ICT emerges as a critical tool to mediate and adapt educational practices to the diverse realities of students [3][4]. The intersection between digital technologies and inclusive education practices has the potential to redefine the boundaries of traditional schooling, promoting access, equity, and meaningful participation [6][7].

ICT, when applied within well-defined pedagogical frameworks, can foster collaborative environments that go beyond the conventional academic objectives [1][8]. These technologies support the creation of inclusive learning spaces where students can develop not only cognitive skills but also social competencies such as empathy, cooperation, and respect for differences. By facilitating multimedia expression, real-time communication, and personalized learning experiences, ICT allows for differentiated instruction that accommodates various learning styles and sociocultural backgrounds. This is especially pertinent in educational systems that face challenges related to social inequality, intercultural tensions, and gaps in school engagement.

School coexistence refers to the set of relationships and interactions that take place among the members of an educational community in a climate of mutual respect, peaceful resolution of conflicts, and recognition of diversity. However, issues such as bullying, discrimination, social exclusion, and various forms of school violence continue to undermine this ideal [9]. These problems, often rooted in broader social and familial contexts, require innovative and context-sensitive interventions that go beyond disciplinary measures. In this regard, ICT can serve as a catalyst for promoting positive coexistence by enabling tools and platforms that support peer mediation, emotional literacy, and democratic participation in school life [2][3].

The present study explores the potential of ICT to enhance school coexistence through an analysis of pedagogical strategies, teacher narratives, and student interactions. It adopts a mixed-methods approach that integrates qualitative insights from phenomenological research—focused on capturing the lived experiences of educational actors—with quantitative validation through statistical techniques such as Analysis of Variance (ANOVA). The objective is to identify patterns, correlations, and effective practices that can inform

decision-making processes among educators, school administrators, and educational policymakers. Ultimately, this research seeks to contribute to theoretical and practical understanding of how digital technologies can be harnessed to cultivate more respectful, inclusive, and democratic educational environments [10][11].

II. THEORETICAL FRAMEWORK

This study is supported by a diverse set of educational theories that explain how learning occurs and how technological tools can enhance educational processes. These theories provide the conceptual basis for understanding how Information and Communication Technologies (ICT) contribute to the development of competencies, the promotion of values, and the strengthening of school coexistence. The theoretical framework includes constructivism, cognitivism, behaviorism, and sociocultural theory, each offering a particular lens through which to analyze the integration of ICT in educational settings.

- **Constructivism:** This theory posits that learners actively build knowledge through experiences, reflection, and interaction with others. Learning is seen as a dynamic process where individuals construct meaning based on prior knowledge and social en- gagement. ICT aligns with constructivist principles by offering collaborative tools such as forums, shared documents, and virtual learning environments where students can co-construct knowledge [12]. Through platforms that encourage dialogue, feedback, and cooperative problem-solving, learners are em- powered to become active participants in their educational process. In the context of school coexistence, this approach promotes the development of communication skills, empathy, and collaborative conflict resolution.

- **Cognitivism:** Cognitivism focuses on internal mental processes such as perception, memory, and reasoning. It emphasizes the importance of helping learners organize and process information in ways that enhance comprehension and retention. ICT supports cognitive development through adaptive learning environments, simulations, and interactive content that respond to learners' needs. These tools offer immediate feedback, help visualize complex concepts, and allow for repeated practice in a personalized manner [13][14]. Such features are particularly useful in addressing diverse learning styles and promoting cognitive engagement, which are essential for fostering a constructive and respectful school environment.

- **Behaviorism:** Based on stimulus-response models, behaviorism asserts that learning results from conditioning through reinforcement. ICT applications, particularly those incorporating gamifi- cation, use this model to encourage desired behaviors [15][16]. By integrating elements such as rewards, points, badges, and progress tracking, educational platforms can motivate students to participate, collaborate, and respect community norms. This type of reinforcement can support the establishment of positive behavior patterns, such as mutual respect, punctuality, responsibility, and teamwork, all of which are fundamental to peaceful and cooperative coexistence within the school setting.

- **Sociocultural Theory:** Rooted in the work of Vygotsky, so- ciocultural theory emphasizes the role of social interaction, cultural tools, and language in the learning process [17]. Learning is mediated by interactions with others and shaped by the cultural context in which it occurs. ICT

expands these interactions beyond the classroom, allowing students to engage in synchronous and asynchronous communication with peers, educators, and external communities [18]. Online collaborative projects, discussion platforms, and multicultural exchanges enable students to learn from diverse perspectives and practice democratic values. This approach reinforces the notion of school as a space for inclusion, dialogue, and intercultural understanding.

In addition to these theoretical foundations, this study also con- siders the guidance provided by international organizations such as UNESCO, the Inter-American Development Bank (IDB), and the Organization of Ibero-American States for Education, Science and Culture (OEI). These institutions emphasize that ICT, when appropriately integrated into educational systems, can serve as powerful tools for reducing inequalities, facilitating meaningful communication, and supporting inclusive, democratic practices. They advocate for educational policies that ensure equitable access to technology, strengthen digital competencies among educators and students, and promote the use of ICT as a means for civic engagement and participation. However, the effective integration of ICT in schools is not automatic; it depends on several interrelated factors, including institutional support, technological infrastructure, and continuous teacher training [19]. Professional development initiatives must equip educators not only with technical skills but also with pedagogical strategies to use ICT meaningfully in the classroom. Without such support, there is a risk that ICT tools may reproduce existing educational gaps rather than bridge them. Therefore, the theoretical framework adopted in this study underlines the importance of context- aware, theory-informed, and equity-driven approaches to the use of ICT in fostering school coexistence.

III. METHODOLOGY

This study adopted a mixed-methods approach, structured in two sequential phases—qualitative and quantitative—to provide a comprehensive understanding of the role of Information and Communication Technologies (ICT) in promoting school coexistence. The integration of qualitative and experimental methodologies responds to the dual purpose of exploring subjective educational experiences and validating the impact of ICT-based strategies through measurable outcomes. The methodological design was grounded in interpretative paradigms for the qualitative component and positivist logic for the experimental phase. This allowed for both the exploration of meanings and verification of causal relationships, resulting in a robust and triangulated research process.

A. Qualitative Phase

Participants: For the interpretative phase, three educators with a high level of ICT integration in their teaching practices were selected through purposive sampling. The participants were drawn from three different schools located in urban and semi-urban areas of the Atlántico Department in northern Colombia. Criteria for inclusion required that participants had a minimum of five years of experience, had received formal training in digital pedagogy, and had demonstrated leadership in implementing ICT to improve school climate or resolve conflicts. This intentional selection aimed to ensure rich, experience-based contributions to the analysis of coexistence strategies mediated by technology.

Data Collection: Information was gathered through in-depth semi- structured interviews and systematic non-participant classroom observations. The interviews focused on the teachers' perceptions of ICT's role in fostering collaboration, promoting respect, managing peer conflicts, and cultivating empathy among stu-

dents. Classroom observations were conducted over four consecutive weeks and documented naturally occurring behaviors during ICT-enhanced lessons, including student interactions, teacher mediation practices, and group dynamics. Ethical approval was secured, and informed consent was obtained from all participants, ensuring adherence to confidentiality and anonymity standards.

Data Analysis: A thematic analysis was carried out using a phenomenological orientation, which enabled the identification of recurrent themes rooted in the lived experiences of participants. The analysis process involved multiple coding cycles, beginning with open coding to detect emergent patterns, followed by axial coding to establish interrelations among categories. Analytical rigor was ensured through triangulation across interviews, observation logs, and literature review. Data were also peer-reviewed by two external researchers with expertise in ICT in education. This ensured consistency in interpretation and minimized researcher bias. The resulting categories included: "ICT as a mediator of dialogue," "technology-enabled inclusion," and "digital tools for conflict prevention." These themes formed the foundation for the design of the subsequent experimental intervention.

B. Experimental Phase

The second phase of the study employed a quasi-experimental design with pre-test and post-test measures and non-equivalent groups. Two classrooms from different institutions were selected: one assigned as the experimental group (EG), and the other as the control group (CG). The schools were chosen for their similar demographic and infrastructural characteristics, ensuring that observed effects could be attributed to the intervention rather than contextual disparities. The study was conducted over a period of six consecutive weeks, during which the experimental group was exposed to structured ICT-based strategies designed to strengthen school coexistence, while the control group followed the standard curriculum without the use of these tools.

Intervention Design: The intervention included the application of ICT activities aligned with the theoretical dimensions of school coexistence—cooperation, peaceful conflict resolution, and classroom climate. Activities included digital storytelling on respect, simulation games focused on emotional regulation, collaborative online boards for conflict mediation, and video forums with guided reflections on tolerance and diversity. Teachers in the experimental group were trained in advance on the use of these resources and followed a standardized pedagogical script to ensure consistency across sessions. Sessions were held three times per week, each lasting approximately 45 minutes.

Variables and Instruments:

- **Collaboration Level (COL):** Measured using a rubric designed to assess the frequency, quality, and reciprocity of student interactions during group tasks mediated by ICT.
- **Peaceful Conflict Resolution (PCR):** Evaluated through a structured observation protocol that recorded behavioral indicators such as the use of dialogue, negotiation, and mediation strategies during peer interactions.
- **Classroom Climate (CLA):** Assessed through a validated self-report questionnaire administered to students, measuring perceptions of emotional safety, belonging, mutual respect, and teacher support.
- **Data Analysis:** Pre-test and post-test data for all three variables were analyzed using one-way Analysis of Variance (ANOVA) to determine statistically significant differences between the experimental and control groups. Assumptions of normality and homogeneity of variances were verified using the Shapiro–Wilk and Levene's tests, res-

pectively. The ANOVA results indicated statistically significant improvements in the experimental group across all variables, with p-values below 0.05. In particular, the experimental group exhibited a notable increase in collaborative behaviors and the ability to resolve interpersonal conflicts through dialogue [16]. Effect sizes were calculated using Cohen's d, revealing moderate to strong effects in the variables of collaboration and classroom climate. These findings con- firm the hypothesis that the intentional use of ICT tools contributes meaningfully to the improvement of interpersonal relationships and the promotion of peaceful, respectful learning environments [18]. Additionally, qualitative observations during the experimental phase corroborated the emergence of more cooperative group dynamics and higher student engagement, supporting the mixed-methods design's integrative strength [19].

IV. RESULTS

The results of this study reveal that the structured integration of Information and Communication Technologies (ICT) into classroom practices had a positive and statistically significant effect on key indicators of school coexistence. The analysis focused on three main areas: the pedagogical use of ICT, the adaptation of technological tools to promote coexistence, the role of teacher training, and the theoretical grounding that emerged during implementation. These dimensions were triangulated through both qualitative insights and quantitative metrics to provide a comprehensive understanding of the observed transformations.

- **ICT Usage:** In the experimental group, the structured and purposeful use of ICT contributed to a noticeable reduction in incidents related to cyberbullying and verbal aggression. Teachers implemented activities that encouraged positive online interactions and fostered accountability in digital spaces. Stu- dents demonstrated increased awareness of appropriate digital behavior, reflecting improved digital citizenship competencies. Moreover, the use of collaborative platforms promoted respect and equity in participation, as all voices were given a space in virtual tasks, leading to more inclusive group dynamics.

- **Technological Tools:** The tools selected for the intervention such as interactive games, digital storytelling platforms, and collaborative whiteboard were intentionally designed or adapted to promote empathy, communication, and cooperative learning. Students showed greater engagement when responding to peer contributions and discussing emotional or conflictive situations presented in multimedia formats. These tools enabled the simulation of real-life social dilemmas, helping students to reflect on their actions and make more prosocial decisions. The immersive nature of these tools appeared to facilitate emotional identification and perspective-taking, both essential for peaceful coexistence.

- **Teaching Experience:** Teachers who received prior training in the pedagogical use of ICT reported greater confidence and control in managing student behavior and fostering respectful classroom environments. The training sessions, which focused on conflict-sensitive pedagogy and the ethical use of digital tools, were critical in aligning technological usage with coexistence goals. As a result, teachers were able to mediate conflicts more constructively, using digital platforms not only as instructional supports but also as mediating agents for social- emotional regulation. The integration of ICT shifted

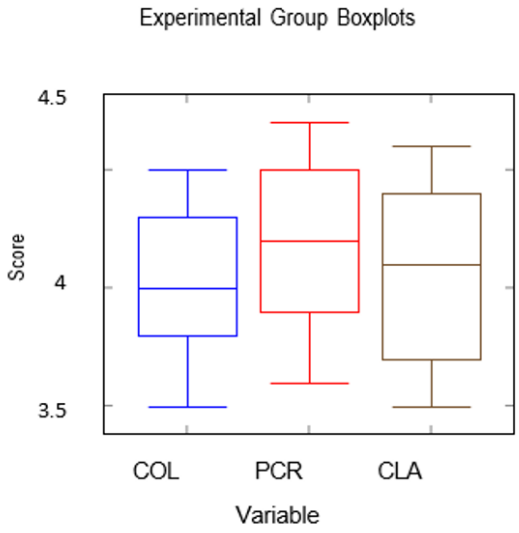
the focus from punitive discipline to restorative practices facilitated by technological means.

- **Theoretical Integration:** During the analysis of teacher interviews and student outputs, digital citizenship emerged as a central cross-cutting theme. Concepts such as responsible participation, respect for diversity, and constructive online communication were frequently referenced, suggesting a theoretical internalization of coexistence values through ICT- mediated instruction. This integration was not merely declarative but embedded in classroom routines and student discourse, reinforcing the theoretical constructs proposed in the study's framework.

Quantitative results complemented the qualitative findings, offering empirical support for the observed improvements. Figure 1 presents the distribution of scores for the experimental group across the three assessed variables: Collaboration Level (COL), Peaceful Conflict Resolution (PCR), and Classroom Climate (CLA). The boxplots illustrate a consistent pattern of higher medians and narrower interquartile ranges in the experimental group, indicating both improved central tendencies and reduced variability among student responses.

Specifically, the PCR variable showed the highest gain in the experimental group, with a median score of 4.2 and an interquartile range concentrated between 3.9 and 4.5, suggesting strong consensus among participants regarding improvements in conflict resolution practices. The CLA variable also reflected a significant shift, with students reporting greater emotional security and mutual respect in their classroom environments. The COL variable, while slightly more dispersed, demonstrated positive trends in peer collaboration and collective task engagement (Figure 1).

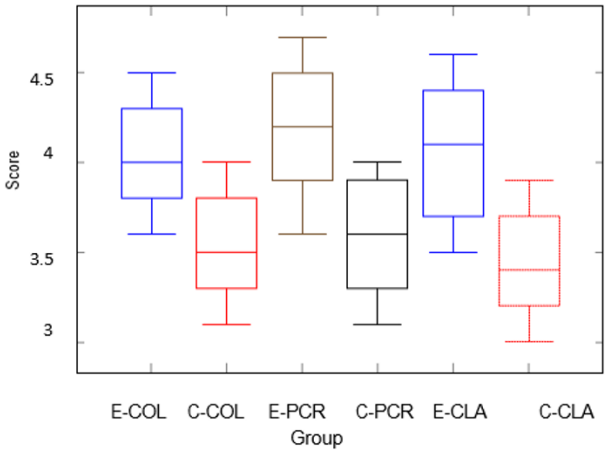
Fig. 1
Boxplots of Experimental Group Scores for COL, PCR, and CLA



Score Dispersion by Variable and Group

The consistent performance across these variables supports the study's central hypothesis: that ICT, when applied with intentionality and supported by pedagogical planning, can serve as a powerful facilitator of school coexistence. These results form the basis for the subsequent discussion on implications, limitations, and scalability (Figure 2).

Fig. 2
Score Dispersion Comparison: Experimental (E) vs. Control (C) Groups



V. DISCUSSION

The findings of this study reinforce the notion that Information and Communication Technologies (ICT), when integrated with peda- gogical intentionality and sociocultural sensitivity, can function as effective mediators in the construction of respectful, empathetic, and cooperative school environments. The role of ICT extended beyond its instrumental value as a set of tools; it served as a catalyst for transforming interpersonal dynamics, promoting digital citizenship, and encouraging student participation in conflict resolution processes.

From the qualitative perspective, teachers and students reported a notable shift in classroom interactions, particularly in terms of empathy, mutual respect, and the capacity to resolve disputes through dialogue rather than confrontation. These findings align with existing literature, which posits that ICT can foster socio-emotional learning when used in emotionally safe environments supported by adult the experimental group benefited from relatively stable connectivity and device availability, which facilitated the implementation of the proposed strategies. Nonetheless, interviews revealed that other institutions in the region still face significant barriers that could limit the scalability of such interventions.

Teacher training also emerged as a determinant of success. Educators who had previously engaged in professional development in ICT integration and conflict-sensitive pedagogy demonstrated greater confidence and adaptability when facilitating the intervention. Their ability to combine technical skills with emotional intelligence and classroom management was key to ensuring that digital tools were not only used effectively, but also ethically and empathetically. Conversely, teachers lacking this preparation reported anxiety, con- fusion, and a tendency to revert to traditional methods, limiting the transformative potential of ICT.

Contextualization of ICT use was the third pillar identified. The interventions succeeded not merely because of the tools used, but because those tools were embedded in pedagogical frameworks relevant to the local context. Activities that reflected the sociocultural realities of the students—such as community-based digital narratives, or collaborative projects addressing local coexistence challenges—generated more meaningful engagement. This confirms that ICT implementation must go beyond replication of foreign models and instead incorporate culturally responsive content and practices.

Despite these positive outcomes, several challenges persist. Structural inequalities in infrastructure remain a major obstacle, particularly in rural and peri-urban areas. Schools with insufficient bandwidth, outdated equipment, or no access to reliable electricity cannot implement ICT-based strategies consistently. Moreover, while teacher training is essential, it requires sustained investment and institutional support to ensure continuity and avoid burnout. In many cases, training opportunities are short-term or disconnected from classroom realities, reducing their practical value.

Additionally, the integration of ICT into the curriculum often occurs in isolated or fragmented ways, disconnected from broader educational goals. For ICT to genuinely contribute to school co- existence, it must be woven into the curriculum through crosscutting themes such as ethics, emotional intelligence, and democratic participation. One-time workshops or isolated digital activities are insufficient; what is needed is a long-term pedagogical commitment to integrating digital citizenship as a foundational element of the school culture.

Recommendations emerging from this study include, first, the prioritization of equitable access to technology across all schools, particular-

ly those serving vulnerable or marginalized populations. This involves not only infrastructure investment but also policy frameworks that guarantee sustainability and adaptability to changing technological environments.

Second, teacher training programs must move beyond technical instruction and incorporate pedagogical, ethical, and socio-emotional dimensions of ICT use [10]. Training should be participatory, context-driven, and supported by mentorship models that foster communities of practice among educators. Teachers should be em- powered not just as users of technology, but as designers of learning experiences that promote coexistence.

Third, educational policy should advocate for the systematic inclusion of digital citizenship content across subjects and grade levels. This includes fostering critical thinking about online behavior, under- standing digital rights and responsibilities, and cultivating empathy in virtual interactions. Students must be equipped not only to use digital tools, but to navigate the complex moral and relational challenges of the digital age.

Lastly, further research is recommended to explore the long-term impacts of ICT on school coexistence, including follow-up studies that track behavioral and attitudinal changes over time. Comparative studies across regions and populations may also reveal patterns of effectiveness and cultural nuances that can inform the design of more adaptable and inclusive strategies.

In conclusion, ICT should not be seen as a panacea, but rather as a powerful complement to pedagogical innovation, emotional literacy, and inclusive educational policies. When implemented with vision and responsibility, it has the potential to reshape school communities into more equitable, empathetic, and dialogic spaces.

VI. CONCLUSIONS

The results of this study confirm that the strategic and pedagogically guided use of Information and Communication Technologies (ICT) can significantly contribute to the strengthening of school co- existence. The integration of ICT not only facilitated the development of digital competencies but also proved to be a valuable ally in the promotion of social values such as empathy, mutual respect, and collaborative problem-solving. Through the implementation of targeted interventions, it became evident that technology can be more than a mere instructional tool—it can become a bridge for building inclusive, participatory, and emotionally safe learning environments. One of the most relevant conclusions derived from both qualitative and quantitative data is that ICT-enhanced practices foster a culture of cooperation and collective responsibility among students. Digital platforms and collaborative tools promoted equitable participation, reduced hierarchical classroom dynamics, and encouraged respectful dialogue. These elements are essential for creating spaces in which students feel heard and valued, which in turn supports the development of healthy peer relationships and shared decision-making.

Furthermore, the study found that the structured integration of ICT contributes to the reduction of disruptive and aggressive behaviors. By providing meaningful and emotionally engaging activities—such as digital storytelling, conflict-resolution simulations, and collaborative digital projects—students were more likely to internalize constructive behavioral patterns and demonstrate prosocial conduct. The use of digital tools helped transform potential conflict scenarios into opportunities for dialogue and reflection, thus reinforcing the role of the classroom as a space for restorative practices rather than punitive discipline.

Another important conclusion is that ICT

interventions, when grounded in inclusive pedagogical frameworks, support the creation of emotionally responsive learning cultures. These cultures are char- acterized by empathy, diversity appreciation, and active engagement with others. Teachers reported that ICT enabled the design of dif- ferentiated activities that accommodated diverse learning styles and emotional needs, while students expressed feeling more comfortable expressing their ideas and resolving tensions when supported by digital mediators.

In summary, the findings demonstrate that ICT, when deployed with intentionality and contextual sensitivity, can be a transformative element in the promotion of school coexistence. It enhances collaboration and mutual respect, minimizes behaviors that disrupt harmony, and supports the construction of inclusive and empathetic educational communities. These outcomes reaffirm the need to view digital technologies not only as tools for academic instruction, but also as vital components in the cultivation of democratic, peaceful, and emotionally intelligent school cultures. The hypothesis was confirmed by both qualitative insights and statistcal evidence.

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